MTCC LATIN AMERICA
Maritime Technology Cooperation Centre

MARITIME TECHNOLOGY
COOPERATION CENTRE
FOR LATIN AMERICA

Fuel Oil Consumption Data Collection and Reporting

GMN | The Global MTCC Network
A global network for energy-efficient shipping

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MTCC LATIN AMERICA
Maritime Technology Cooperation Centre

Capacity Building for Climate Mitigation in the Shipping Industry

Pilot Project 2
"Fuel Oil Consumption Data Collection and Reporting"

Maritime Technology Cooperation Center- Latin America

(MTCC-Latin America)

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This technical study on ships fuel consumption data collection and detailed analysis was prepared by MTCC Latin America (under its Pilot Project 2) with the participation of the individuals listed below:

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Contents

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The Centre extends its appreciation to the participating government and private companies and organizations on the maritime, port and energy sector that provided assistance to make available the data and information that is the cornerstone of this report.

Panama

- Panama Maritime Authority (PMA)
- Carnival Cruise Lines
- MSC Shipmanagement Ltd
- Transgas Shipping Lines SAC

Peru

- Dirección General de Capitanías y Guardacostas (DICAPI)
- Transgas Shipping Lines SAC
- Transoceanica Naviera SA

Chile

- Chilean Maritime Authority
- Humboldt Shipmanagement
- Ultranav Naviera Ltda

List of abbreviations

ARCH	Hydrocarbons Regulatory Agency (Ecuador)
ASOTEP	Association of Private Port Operators of Ecuador
ASTINAVE	Ecuador Naval Shipyards
CAMAE	Chamber of Shipping of Ecuador
DICAPI	Dirección General de Capitanías y Guardacostas (Peru)
DIMAR	Dirección General Marítima (Colombia)
DIRNEA	Maritime Authority of Ecuador
EEDI	Energy Efficiency Design Index
EU	European Union
EU MRV	EU Monitoring, Reporting and Verification of CO2 emissions
FLOPEC	National Tanker Fleet Association of Ecuador
GloMEEP	Global Maritime Energy Efficiency Partnerships
GMN	Global Maritime Technology Cooperation Centres Network
IMO	International Maritime Organization
IMO DCS	IMO Data Collection System
MEPC	Marine Environment Protection Committee
MIDENA	Ministry of Defense (Ecuador)
MTCC	Maritime Technology Cooperation Centres
PMA	Panama Maritime Authority

List of Graphs / Figures

List of Tables

APPENDIX 1

EXECUTIVE SUMMARY

PILOT PROJECT 2 – “Fuel Oil Consumption Data Collection and Reporting”

The purpose of this technical study is to make use and perform detailed analysis of the fuel oil consumption data collected by MTCC Latin America during its pilot project 2, with a scope of providing useful insights on:

- The effectiveness of processes followed for collecting, reporting and verifying fuel oil consumption data (in line with IMO DCS requirements).
- The completeness and accuracy of the relevant data collected and reported.
- Conclusions drawn on:
    - the effectiveness of processes followed for data collections, reporting and verification,
    - the reported data accuracy, through their comparison against estimated/calculated data through use of other independent data sources and empirical estimations.
- Issues, problems and anticipated difficulties in the overall data collection, reporting and verification process, for all parties involved in it (ship managers, independent verifiers and flag administration).
- Best practices to collect the necessary data and development of the needed trends and data analysis routines.

The methodology followed for the development of this pilot project, was carefully designed and planned, to cover all stakeholders’ views and considerations, as well as, all aspects of the research subject, and comprises:

(1) Literature review on ships fuel oil consumption data collection and reporting;
(2) Identification of the key stakeholders acting actively in the implementation of the fuel consumption data collection, reporting and verification process, as well as the subsequent data analysis for decision making;
(3) Developments of relevant forms, templates, guidelines or protocols for uniform collection of data;
(4) Selection of participating maritime administrations and shipping companies and agreement on uniform collection of data, focusing only on ships of 5,000GT and above;
(5) Initiation of data collection, for the reporting period 01/01/2018 – 31/12/2018 and subsequent storage of this data by MTCC-Latin America;
(6) Analysis of qualitative and quantitative data collected during this pilot project;

(7) Report on the findings of the project together with description of methodologies used, providing details of the above activities and outcomes;
(8) Preparation of dissemination material and dissemination activities of project results (throughout the project's implementation to engage stakeholders as well as after its completion).

In general, we opted to simulate the overall monitoring, reporting and verification process, as the same will be effected for IMO DCS regulation implementation.

This includes taking into consideration the role and activities to be undertaken by all parties involved in the regulatory process: the ship's crew, ship management companies, independent verifiers/classification societies, flag administrations and up to the regulatory body itself (IMO).

To enhance the simulation effectiveness, the lessons learned and the experience gained from the first reporting period (2018) of the EU MRV regulation implementation have been also taken into account.

The monitoring & reporting process (ship's crew and ship management company) has been simulated by collecting annual aggregated and disaggregated IMO DCS data (fuel consumption, hours underway and distance sailed), by making use of the developed reporting forms.

The verification process has been simulated by checking the reported data for completeness, and by making use of historic port calls and AIS hourly positions data, for verifying the reported data accuracy against independent set of data and corresponding calculations.

To complete the process, the aggregation of the verified data for submission to the flag administration by the independent verifier was simulated, and from the flag administration to the IMO relevant database.

Finally, detailed data analysis was performed, for obtaining some useful insights, in regards of implementation effectiveness, as well as for supporting the decision making process and any future measures.

The technical study further includes:
(1) an Appendix where the aggregated EU MRV 2018 data (as provided in the EMSA Thetis MRV Portal) are analysed, in order to obtain valuable insights on the results of the first reporting period
(2) training material on Pilot Project 2, its implementation and its results
(3) a model training Course for combined EU MRV & IMO DCS Regulatory Compliance

1. INTRODUCTION

The adverse effects of man-made climate change are now more apparent than ever before in our everyday lives. This has caused tackling climate change to become a global priority.

The shipping industry has not been left behind. The relevant policy-making IMO´s Marine Environment Protection Committee (MEPC), started on 2011 with amendments by means of technical performance standards to enhance ship´s energy efficiency (EEDI and SEEMP), leading to the reduction of emissions of substances originated from fuel oil and its combustion process.[1]

Afterwards, in 2013, MEPC 65 adopted resolution MEPC.229 (65) on Promotion of Technical Co-operation and transfer of technology relating to the improvement of energy efficiency of ships leading to the strengthening of partnerships with other interested parties.

Later on January 2016, the European Union (EU) and the International Maritime Organization (IMO) reached an agreement to establish a Global Maritime Technology Cooperation Centres Network (GMN) aiming to help reduce greenhouse gas emissions by, among others, encouraging the uptake of innovative energy efficient technologies and practices.

On October 2016, MEPC 70 adopted mandatory MARPOL Annex VI requirements for ships to record and report their fuel oil consumption, by resolution MEPC.278 (70). MEPC 70 also adopted the 2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP), by resolution MEPC.282 (70). The Ship Energy Efficiency Management Plan (SEEMP) is an operational measure that establishes a mechanism to improve the energy efficiency of a ship in a cost-effective manner whilst also providing an approach for shipping companies to manage ship and fleet efficiency performance over time using, for example, the Energy Efficiency Operational Indicator (EEOI) as a monitoring tool.

In April 2018, IMO's Marine Environment Protection Committee (MEPC) adopted an initial strategy on the reduction of greenhouse gas emissions from ships, setting out a vision to reduce GHG emissions from international shipping and phase them out, as soon as possible in this century. The vision confirms IMO’s commitment to reducing GHG emissions from international shipping and, as a matter of urgency, to phasing them out as soon as possible.

[1] IMO Resolution MEPC.203 (62), Adopted don 15 July 2011

Some of the methods available for energy improvements include fuel-efficient operations (improved voyage planning, just in time or speed optimization), optimized ship handling (shaft power, trim, ballast, and propeller design or propeller inflow), hull maintenance, improved propulsion systems, improved fleet management, improved cargo handling or energy management.

Although, these technologies and practices are available in the Latin American region, their effective adoption would be greatly enhanced by an in-depth understanding of the barriers and constraints faced by relevant stakeholders.

a. Description of the MTCC Latin America Pilot Project 2

With the upcoming entry into force of provisions for collection and reporting of fuel oil consumption data of ships, ship owners and maritime administrations are faced with the challenge of finding mechanisms and protocols to record and transmit the required information effectively, and making the data collection system compatible with other monitoring measures.

This pilot project will draw lessons and experiences in data collection and reporting that would facilitate maritime administrations responsibilities regarding collection and reporting of ships fuel oil consumption.

To this end, this pilot project will build on the experience of Latin American maritime administrations participating in this pilot project to identify required data, collect them from a specified number of ships and develop needed trends and data analysis routines.

In addition, this pilot project plans to collect additional information about ships and their voyages to help with effective use of data for ship performance evaluation to a possible extent. This additional information include (a) historic AIS hourly positioning data for the entire reporting period as well as data that can be calculated based on this additional information (ie distance sailed and speed), (b) historic port calls for the entire reporting period and (c) data on energy efficient measures implemented onboard participating ships.

Ships participating were generally ships managed by companies which are based in the participating countries and that were willingly to voluntary contribute to this project, regardless of the flag they fly, of 5,000GT and above, operating regionally or internationally, including ships transiting the Panama Canal. If successful, this information collection would allow the MTCC-Latin America to make headway in calculating ships´

EEOI and voyage periods and enable the MTCC-Latin America use the techniques for offering subsequent relevant services.

This Pilot project considers five main stages, namely:

1) Determining a suitable mechanism to gather information direct from ships, ship operators or through the participating maritime administrations.
This stage included crystalizing data collection forms, templates, guidelines as well as collection and analysis protocols;

2) Collecting data through channels agreed with participating maritime administrations or ship owners.
These channels included data reported to the maritime administration and data gathered directly by the MTCC-Latin America from ship owners or operators.

This pilot project aimed at collecting data on fuel oil consumption relating to at least 30 vessels flying the flag of not less than three participating maritime administrations, goals which were exceeded by far, as **68** vessels, flying the flags of **3** participating maritime administration formed part of this study.

3) Data analysis.
The data collected in the previous stage were analyzed to determine trends and other key variables, and to determine bunker consumption reporting lessons. The summary of results of the data analysis (including the simulation of the verification process using Historic AIS hourly positioning data and historic port calls), is reflected in Part 5 – Conclusions, of this study.
The MTCC-Latin America envisaged the identification of trends and data analysis routines to guide maritime administrations fulfil their responsibilities, and effectively support all parties engaged in the monitoring, reporting and verification process (ship owners/operators, Recognized Organizations to perform such duties).

4) Sharing lessons learned in training workshops.
Lessons learned during the execution of this pilot project were ongoing, throughout the project, and would be included in the second regional capacity building seminar organized by the MTCC-Latin America, which was cancelled.

5) Dissemination activities.
MTCC Latin America placed great attention to the importance of disseminating the Pilot Project findings and experiences through its regional and national workshops, as well as

through other additional dissemination activities that took place in the Latin American region in particular in relation to maritime administrations.

b. Pilot Project aim

The MTCC Latin America Pilot Project 2 “Fuel Oil Consumption Data Collection and Reporting”, aims at utilizing the existing IMO DCS regulation and its requirements as a starting point for voluntary reporting in 2018 for simulation of a reporting period’s activities from data monitoring and reporting to verification and aggregated data submission to the flag administrations and IMO, for evidence based decision making. From January 1st 2019, IMO DCS reporting becomes mandatory for ships over 5,000GT.

c. General objective

To gain experience and learn lessons in the process of collecting and analyzing data regarding ships fuel oil consumption, the analysis of such data and reporting to relevant stakeholders in the region, thus providing them with useful methodologies and processes when implementing provisions on data collection system for fuel oil consumption of ships included in MARPOL Annex VI.

The lessons learned during this pilot project will form the backbone of the recommendations for effective regulatory implementation by all parties involved in the regulatory compliance process (ship managers, flag administrations and independent verifiers delegated to act on their behalf) as well as to decision-makers and policy-makers on both national level (national authorities) and international level (IMO), and will be disseminated accordingly.

d. Target audience

This Pilot Project 2 has been developed taking into consideration the fundamental role of all the Stakeholders acting actively in the implementation of Fuel Oil Consumption Data Collection and Reporting requirements, as well as on the verification process and data analysis for evidence-based decision making by flag administrations and regulatory bodies.

The target audience for this project are all stakeholders acting actively in the above:

- Maritime Administrations
- Ship Owners
- Classification Societies / Recognized Organizations (ROs)
- National Policymakers
- Other interested groups and maritime professionals

This report brings the information obtained to the attention of almost 300 participants and the responsible authorities of 17 Latin American countries that have been engaged and

trained through direct interaction with MTCC Latin America, as well as through the regional and national workshops organized by MTCC Latin America, across the participant countries.
The Pilot Project 2 has delivered 5 capacity-building workshops across the participant countries, providing training on IMO's DCS regulation and on the fuel data collection methodology in accordance with MARPOL Annex VI regulations.

e. Stakeholders participating in the project

A total of **68** ships of over 5000GT, flying the flags of **3** Latin American countries (Panama, Peru, Chile) form part of this study:

The stakeholders participating in this project (per participating country), are reflected here below:

Panama

- Panama Maritime Authority (PMA)
- Carnival Cruise Lines
- MSC Shipmanagement Ltd
- Transgas Shipping Lines SAC

Peru

- Dirección General de Capitanías y Guardacostas (DICAPI)
- Transgas Shipping Lines SAC
- Transoceanica Naviera SA

Chile

- Chilean Maritime Authority
- Humboldt Shipmanagement
- Ultranav Naviera Ltda

2. Methodology

The methodology followed for the development of this pilot project, was carefully designed and planned, to cover all stakeholders views and considerations as well as all aspects of the research subject, and comprises of:

- Literature review on ships fuel oil consumption data collection and reporting;
- Identification of the key stakeholders acting actively in the implementation of the fuel consumption data collection, reporting and verification process, as well as the subsequent data analysis for decision making;
- Developments of relevant forms, templates, guidelines or protocols for uniform collection of data;
- Selection of participating maritime administrations and shipping companies and agreement on uniform collection of data, focusing only on ships of 5,000GT and above;
- Initiation of data collection, for the reporting period 01/01/2018 – 31/12/2018 and subsequent storage of this data by MTCC-Latin America;
- Analysis of qualitative and quantitative data collected during this pilot project;
- Report on the findings of the project together with description of methodologies used, providing details of the above activities and outcomes;
- Preparation of dissemination material and dissemination activities of project results (throughout the project's implementation to engage stakeholders as well as after its completion).

(a) Detailed breakdown of activities:

(1) The Pilot Project 2 activities were launched with an initial literature review, on ships fuel oil consumption data collection and reporting, covering:

- The IMO DCS (Data collection system for fuel oil consumption of ships) regulation and related guidelines/circulars
- The EU MRV regulation 2015/757 and related guidelines/documentation, as well as the experience gained from parties involved in the monitoring, reporting and verification process for EU MRV compliance, for the reporting period 01/01/2018 – 31/12/2018

Relevant documentation reviewed included:

- 2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP) (resolution MEPC.282(70));

- 2017 Guidelines for Administration verification of ship fuel oil consumption data (resolution MEPC.292(71));
- 2017 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database (resolution MEPC.293(71));
- MEPC circular on submission of data to the IMO data collection system of fuel oil consumption of ships from a State not party to MARPOL Annex VI (MEPC.1/Circ.871); and
- Sample format for the confirmation of compliance pursuant to regulation 5.4.5 of MARPOL Annex VI (MEPC.1/Circ.876).
- IMO Ship Fuel Oil Consumption Database has been launched as a new module and that Member States now have access to the Database (Circular Letter No.3827).
- Mandatory MARPOL Annex VI requirements for ships to record and report their fuel oil consumption, (MEPC.278 (70).

(2) Through the literature review, as well as through the review of used practices and experience gained from the EU MRV regulation implementation for the reporting period of 01/01/2018 – 31/12/2018, the key stakeholders acting actively in the implementation of the fuel consumption data collection, reporting and verification process, as well as the subsequent data analysis for decision making, were identified:

- Maritime Administrations
- Ship Owners / Operators
- Recognized Organizations (ROs) acting on behalf of flag administrations
- National and International Policymakers (including IMO)

(3) For the facilitation of Pilot Project 2, MTCC Latin America developed relevant forms, templates, guidelines or protocols for uniform collection of data. The formats were developed taking into account the requirements and guidelines of IMO DCS regulation.

The following forms (MS Excel format) were developed in order to be used in the context of this study:

(a) General information on participating ships

(b) Standardized fuel oil consumption data report

In addition, in support of the participating flag administrations, organizations and ships, relevant instructions specifying how to complete the above forms, were developed and shared with the involved parties.

(a) General information on participating ships Form

Ship Particulars	*Ship Name*
IMO Number	
Operator	
Ship Type	
Gross Tonnage	
Net Tonnage	
Deadweight Tonnage	
Main Engine Rated Power	
Main Engine Fuel Type	
Auxiliary Engine Rated Power	
Auxiliary Engine Fuel Type	
Boiler (y/n)	
Boiler Fuel Type	
Inert Gas Generator (IGG)	
IGG Fuel Type	
EEDI (enter value)	
Ice Class	
Last Hull Maintenance (enter date dd-mm-yy)	

Note: *The "General information on participating ships Form" is a form developed by the MTCC Latin America, taking into account the main details required also by the Standardized data reporting format for the Data Collection System, as specified in Resolution MEPC.282 (70), Appendix 3.*

(b) Standardized fuel oil consumption data report

Ship	Period:				Methodology (y/n)				Fuel Oil Comsumption (tons)					Energy Savings Technologies Utilized During the Voyage (Yes/No)										Monitoring Tool	
Name of ship	Start Date (dd-mm-yy)	End Date (dd-mm-yy)	Hours Underway	Distance Traveled (nm)	Other (specify):	Bunker Delivery Notes (BDN)	Flowmeters	Tank monitoring	Diesel/Gas Oil	LFO	HFO	LNG	Other (specify):	Hull Air Lubrication	Waste Heat Recovery	Solar Electricity	Wind Power	Weather Routing	Autopilot	Trim/Draft Optimization	Optimum Ballast Condition	Other (specify):	Other (specify):	EEOI	Other (specify):

Note: *The Energy Efficiency Operational Indicator (EEOI) is reflected in this table as a monitoring tool for managing ship and fleet efficiency performance over time. The EEOI enables operators to measure the fuel efficiency of a ship in operation and to assess the effect of any changes in operation or the introduction / implementation of technical energy efficient measures.*

Instructions provided on how to complete the forms:

(1) General information on participating ships

This format, seeks to gather information about the particulars of the vessel relevant to fuel oil consumption data collection. Information collected under this format is considered "constant or static" information, and does not need to be recorded or reported periodically, but only at the beginning of the study.

(2) Standardized fuel oil consumption data report

This reporting format has been developed based on Appendix 3 (Standardized Data Reporting Format for the Data Collection System) to the 2016 Guidelines for the Development of a Ship Energy Efficiency Management Plan, contained in IMO´s Resolution MEPC.282 (70).

Note: All spaces should be completed. If the information is not applicable to the ship, please enter N/A.

The following paragraphs provide clarification on the general fields contained in this format:

***-Period:** The Administration would like to receive this information on a daily basis; however, participating ship owners / ship operators could also report this daily data to the Administration on a weekly basis.*

***-Methodology:** The method(s) used to collect fuel oil consumption data should be identified using Y or N under the corresponding column.*

***-Fuel oil consumption:** Quantities of each type of fuel consumed daily on board should be reported in tons.*

***-Energy savings technologies utilized during the voyage:** This qualitative section is to determine the most common energy efficiency measures applied in a particular period.*

***-Monitoring tool:** Although EEOI is not a mandatory tool, it is recommended by MEPC.282 (70). The inclusion of a field for EEOI will shed light on the level of usage of EEOI or other indicators by participating ships.*

Detailed guidance on how to calculate the EEOI, is provided in MEPC.1/Circ.684 "Guidelines for voluntary use of the Ship Energy Efficiency Operation Indicator (EEOI)"

Confidentiality:
Participating organizations were informed on the applicable confidentiality clauses, regarding the provided information. More specifically, both the participating Administrations and the MTCC-Latin America guaranteed that they will ensure the anonymity of the data provided in this study, in a way that the identification of specific ships by third parties will not be possible.

In line with this condition, the disaggregated collected data were securely stored by MTCC Latin America, and the annual aggregated data (used within the study) were anonymized prior to the analysis by removing the ship name and IMO No. and assigning new identification based on the Ship Type.

(4) Having the necessary forms and guidelines for project implementation formed, the MTCC Latin America selected the participating maritime administrations (Panama, Peru, Chile) and as a first step established cooperation with them.

After that, shipping companies managing ships of 5,000GT and above flying their flag, were approached by the MTCC Latin America and relevant agreements on uniform collection and reporting of data from some of their ships for the reporting period 01/01/2018 – 31/12/2018 were established as well.

(5) The data collection process for the reporting period 01/01/2018 – 31/12/2018 was then initiated, with the shipping companies reporting for each ship to either the flag administration or directly to the MTCC Latin America.

For each participating ship, the following information were received:

(a) The General information on participating ships form, containing details on their main particulars (once)

(b) The Standardized fuel oil consumption data report, containing details on fuel oil consumption, distance sailed, hours underway as well as on energy efficient measures implemented during the voyage duly updated, on a daily basis or weekly basis.

All reports submitted and data collected, were securely stored by MTCC-Latin America.

The Pilot Project 2, follows the IMO DCS (Data collection system for fuel oil consumption of ships) Regulation 22A of MARPOL Annex VI and related guidelines/circulars:
According to the regulation, ships of 5,000 gross tonnage and above are required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data (distance, hours underway, including proxies for transport work).

The description of the methodology that will be used to collect the data and the processes that will be used to report the data to the ship's Flag State, are described in each ship's SEEMP Part II, which has to be approved by the flag administration, via issuance of a Confirmation of Compliance.

The aggregated data are to be reported to the Flag State after the end of each calendar year (or to duly appointed ROs acting on behalf of the flag administration), which must perform data verification for determining that the data has been reported in accordance with the requirements.
Upon completion of verification of reported data, the flag administration must issue a Statement of Compliance to the ship.

Flag States are required to subsequently transfer this data to an IMO Ship Fuel Oil Consumption Database within the Global Integrated Shipping Information System (GISIS) platform.

IMO will be required to produce an annual report to MEPC, summarizing the data collected.

(6) Once the reporting period was completed (01/01/2018 – 31/12/2018) the aggregated data report for each ship was developed, simulating the reporting from shipping companies to the flag administration.

The disaggregated data collected per participating ship were then verified against independently obtained AIS positioning data and Port Calls, to establish their completeness and accuracy. This was actually a simulation of the verification process to be carried out in reality. Although the 2017 Guidelines for Administration verification of ship fuel oil consumption data (resolution MEPC.292(71)) do not require the verifier to check the data collected against the AIS data, in this particular project we used historic AIS hourly positioning and historic port calls data, in order to compensate for the absence of detailed departure and arrival reports and copies of Bunker Delivery Notes. Through the historic AIS hourly positioning data and historic port calls data we generated the actual ships voyages list throughout the reporting period, which enabled us assess the accuracy

of reported port calls, hours underway and distance sailed, as well as have a rough assessment of the accuracy of reported fuel oil consumption based on anticipated fuel consumption for each vessel (taking into account average voyage speed, ship type and size and main propulsion details).

The verified aggregated and disaggregated data, were then used for performing the detailed qualitative and quantitative analysis.

(7) After completing the analysis of the collected data, the findings of the project together with description of methodologies used were incorporated into the project's report, providing details of all of the above project activities and outcomes (including insights on experience gained and lessons learned, as well as recommendations for the most effective implementation of the regulatory requirements of IMO DCS).

The detailed report on the methodology and results of Pilot Project 2 was drafted on an ongoing basis, enabling the communication of all available draft results for increased dissemination effect in the national workshops and direct interactions with stakeholders, to maximize interest and engagement.

(8) Following the same method as with the report, the dissemination material was drafted on an ongoing basis, taking into account the available findings and outcomes (including insights on experience gained and lessons learned, as well as recommendations for the most effective implementation of the regulatory requirements of IMO DCS). This enabled the communication of all available draft results for increased dissemination effect in the national workshops and direct interactions with stakeholders, to maximize interest and engagement.

Dissemination activities will continue to be carried out after the project's completion as well.

It is of importance to mention that on the 14th of January 2020, the developed training course for Combined IMO DCS and EU MRV Regulations was delivered as a webinar to key personnel of the Honduras Flag Administration, in an attempt to support the implementation of the IMO DCS regulation.

3. Sources of data

For Pilot Project 2, the following sources of data were utilized:

a. Primary Data Sources:
Ships primary details and collected data (for the reporting period 01/01-31/12 2018)
Primary data include:

(i) the detailed responses in the duly filled in General Particulars Forms, as obtained by the participating companies, for the 68 participating vessels which form part of this study.

(ii) the detailed responses in the duly filled in Fuel Oil Consumption Reports as obtained by the participating companies, for the 68 participating vessels which form part of this study.

a. Secondary Data Sources:
Historic Port Calls and AIS (hourly) positioning data
(For the reporting period 01/01-31/12 2018)
Secondary data include:

(i) Historic port calls data (for each participating ship, for the entire reporting period)

(ii) AIS (hourly positions) data (for each participating ship, for the entire reporting period) obtained independently for simulating the verification process and assessing the completeness and accuracy of the reported data.

Details on the extend of information available through each data source, are indicated in the below tables:

a. Primary Data Sources: Ships primary details and collected data

Ships primary details & collected data (01/01/2018—31/12/2018) ***Primary data: Provided by ship management companies, using the developed forms***
> Ships primary details
(i) Ship principal particulars
(ii) Details on fuel consumers & fuel types used
(iii) Details on energy efficiency technologies used
> Ships collected data
(i) Annual collected IMO DCS data (methodology, fuel consumption, hours underway, distance sailed) reported as aggregated annual or disaggregated daily, monthly and/or per voyage data

b. Secondary Data Sources:

(i) Historic port calls data

Historic port calls data (01/01/2018—31/12/2018) ***Primary data: independently obtained AIS data, as a .csv file of raw data for the entire fleet*** ***Data analysis: Syndeseas Integrated Solution (Syndeseas mrv_log, Historic data function)***
> Identification data: MMSI No. / IMO No.
> Port of call data: Port name, Country Code
> Operational data: Arrival / Departure / Anchorage
> Timestamp data: UTC date/time of Port Call report

(ii) AIS (hourly positions) data

Historic AIS (hourly positions) data (01/01/2018—31/12/2018) ***Primary data: independently obtained AIS data, as a .csv file of raw data for the entire fleet*** ***Data analysis: Syndeseas Integrated Solution (Syndeseas mrv_log, Historic data function)***
> Identification data: MMSI No. / IMO No.
> Positioning data: Latitude, Longitude, Course, Heading
> Timestamp data: UTC date & time of AIS report
> Speed data: Speed, in knots x10
> Operational data: ie vessel underway/anchored/moored, through AIS Navigational status codes

4. Analysis of data

The primary collected reports, were securely stored by MTCC Latin America.

Based on them, the following were developed:

(i) A list of participating vessels and their principal particulars
(ii) Separate annual aggregated data for each vessel obtained
(iii) Separate annual disaggregated data for each vessel as reported

For the collected data analysis, special algorithms and a specific software were utilized, for aggregating, enriching and returning detailed results, after comparison against the collected independently obtained AIS positioning and Port Calls data, for assessing the completeness and accuracy of the reported data.

The reported data accuracy was assessed through their comparison against estimated/calculated data through use of other independent data sources and empirical estimations.

The actual method followed was:

(1) generating the list of voyages for the reporting period based on historic port calls data (departure and arrival date,time),

(2) cross-checking the accuracy of reported distance sailed and hours underway against the historic AIS hourly positioning data and roughly assessing the reported fuel oil consumption, based on voyage average speed, ship type and size and main propulsion details.

Port calls accuracy was overall found without important deviations and distance / hours underway estimated using AIS data were found within acceptable tolerances (+/- 5% from anticipated values per voyage).

Data Analysis and Enrichment

Syndeseas data enrichment (using Syndeseas methodology and algorithms)
Utilizing historic port calls data
> Voyage specific data
(i) Identification of Departure and Arrival Ports, including anchorages in between
(ii) Duration of voyage, based on departure / arrival date & time of port call
(iii) Estimation of distance sailed, based on most frequently used route
Utilizing historic AIS (hourly positions) data
> Distance covered, between any two AIS reports
> Time spent sailing / anchored / moored, based on the AIS reported navigational status
> Speed, between any two AIS reports, using distance covered and time lapsed
> Estimated fuel consumption, for any time period, based on assumptions deriving from IMO 3rd GHG Study and other reliable models

The data were extracted and analyzed both under a:

(i) Qualitative Analysis for establishing level of engagement and participation, and

(ii) Quantitative Analysis, per participating ship, ship type and combined fleet, with an aim of receiving detailed information on all levels of the monitoring, reporting and verification process, thus ensuring accurate and complete insights.

(a) Quantitative Analysis

Quantitative analysis emphasized on the statistical analysis of data collected, for establishing level of engagement and participation.

The pilot project 2 participation goals were far exceeded, as 68 ships flying the flags of 3 participating countries, formed part of pilot project 2.

The list of participating ships per country is as follows:

-Panama: 43 ships

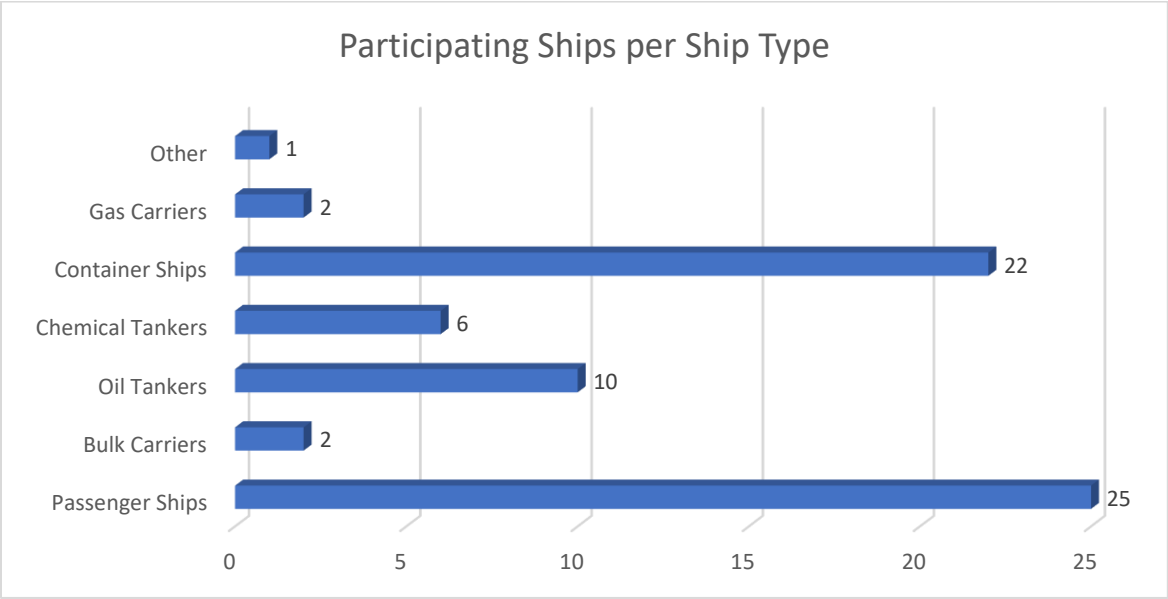
-Peru: 10 ships

-Chile: 8 ships

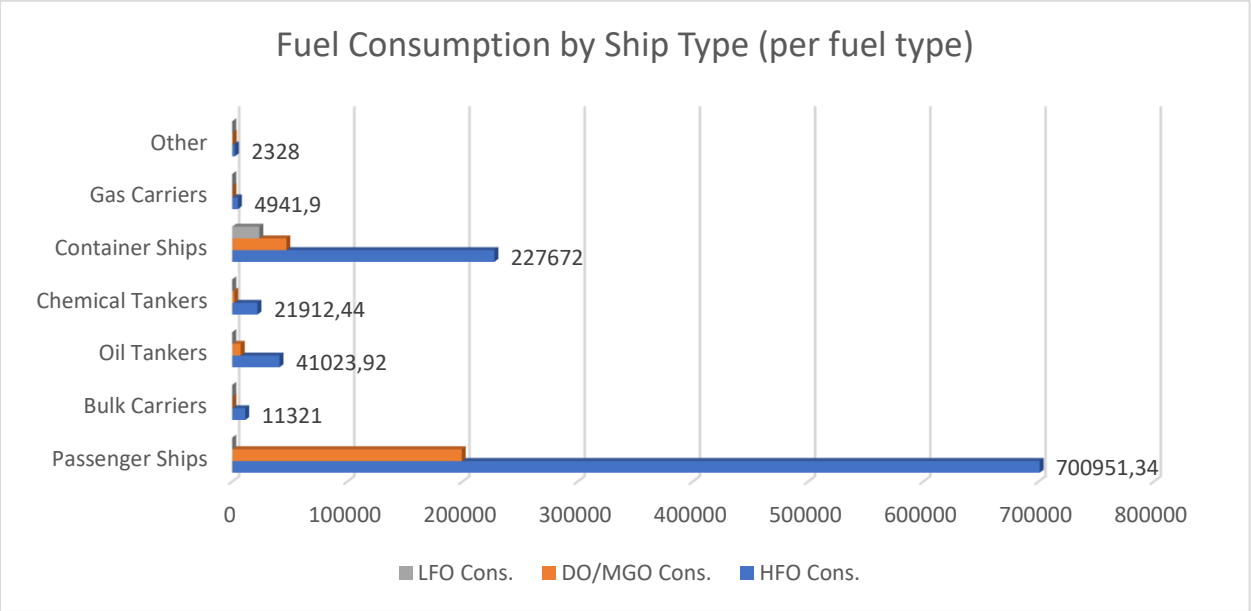
-Other flags: 7 ships

A total of 68 reports with disaggregated data on fuel oil consumption data for ships of various types over 5000GT, covering the period between 01/01/2018 – 31/12/2018 were obtained, for analysis.

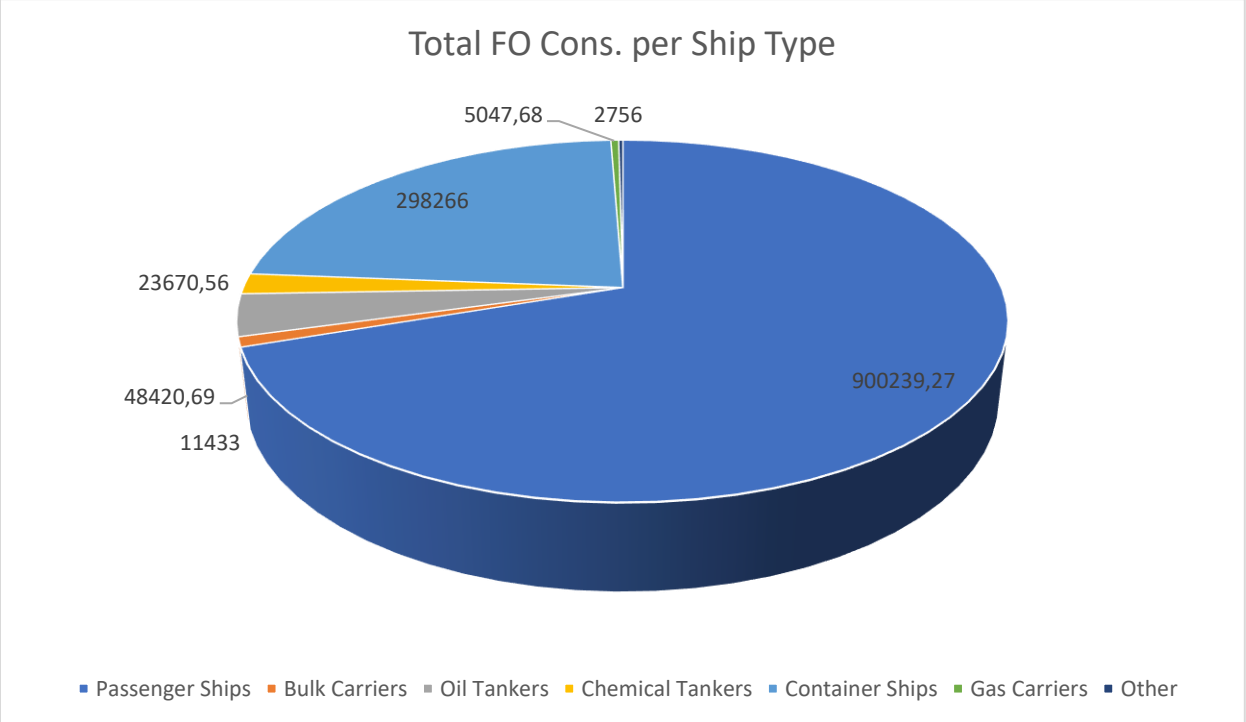
Graph 1-Participating Fleet Analysis per ship type



Graph 2-Total Fuel Consumption by Ship Type (per fuel type used)



Graph 3-Total Fuel Consumption by Ship Type



Further detailed results are reflected at the following tables:

Table 1- Participating Fleet analysis: Primary List of Ships -anonymized-

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Exclusions
1	**Oil Tanker No.1**	24048	38472	2005	excluded: no data provided for the entire reporting period in concern
2	**Oil Tanker No.2**	20121	33755	2010	
3	**Oil Tanker No.3**	56172	105778	2004	
4	**Oil Tanker No.4**	3248	4999	2005	excluded: below 5000GT
5	**Oil Tanker No.5**	3248	4999	2005	excluded: below 5000GT
6	**Oil Tanker No.6**	2865	3543	2006	excluded: below 5000GT
7	**Oil Tanker No.7**	61888	11364	2017	
8	**Oil Tanker No.8**	13666	22062	2008	excluded: no data provided for the entire reporting period in concern
9	**Oil Tanker No.9**	8848	14581	1999	excluded: no data provided for the entire reporting period in concern
10	**Oil Tanker No.10**	38997	68500	2008	excluded: no data provided for the entire reporting period in concern
11	**Oil Tanker No.11**	13425	21081	2003	excluded: no data provided for the entire reporting period in concern
12	**Oil Tanker No.12**	27505	46683	2004	excluded: no data provided for the entire reporting period in concern
13	**Oil Tanker No.13**	38997	63589	2008	excluded: no data provided for the entire reporting period in concern
14	**Oil Tanker No.14**	30109	51215	2009	excluded: no data provided for the entire reporting period in concern
15	**Oil Tanker No.15**	30010	49999	2009	
16	**Oil Tanker No.16**	42096	74543	2006	
17	**Oil Tanker No.17**	42096	74543	2006	
18	**Container No.1**	6406	8715	1998	
19	**Container No.2**	6385	8672	2000	
20	**Other Cargo No.1**	9611	12798	2004	
21	**Bulk Carrier No.1**	9961	17013	2007	excluded: no data provided for the entire reporting period in concern
22	**Bulk Carrier No.2**	7265	12274	2001	excluded: no data provided for the entire reporting period in concern
23	**Bulk Carrier No.3**	40040	76741	2006	
24	**Bulk Carrier No.4**	40040	76737	2004	
25	**Bulk Carrier No.5**	19920	32873	2000	excluded: no data provided for the entire reporting period in concern
26	**Container No.3**	37518	42966	1996	

No.	**Ship (Type/No.)**	Gross Tonnage	DWT	YOB	Exclusions
27	**Container No.4**	54304	68599	2004	
28	**Container No.5**	35954	42183	2004	
29	**Container No.6**	74071	74453	2002	
30	**Container No.7**	40108	52806	2002	
31	**Container No.8**	54304	68307	2004	
32	**Container No.9**	48220	56152	1993	
33	**Container No.10**	21586	21370	1982	
34	**Container No.11**	52181	60350	1990	
35	**Container No.12**	30280	35848	1998	
36	**Container No.13**	53208	67678	1999	
37	**Container No.14**	21586	21370	1982	
38	**Container No.15**	36389	42465	1988	
39	**Container No.16**	53208	67615	1999	
40	**Container No.17**	54881	68121	2004	
41	**Container No.18**	54304	68372	2004	
42	**Container No.19**	37579	45544	1997	
43	**Container No.20**	52181	60350	1990	
44	**Container No.21**	41225	53335	2008	
45	**Container No.22**	52191	67639	1989	
46	**Oil Tanker No.18**	28278	46337	2000	
47	**Chemical Tanker No.1**	27533	45063	1999	
48	**Chemical Tanker No.2**	27530	44577	1999	
49	**Oil Tanker No.19**	23298	37269	2005	
50	**Gas Carrier No.1**	22352	37661	1997	
51	**Chemical Tanker No.3**	30099	51392	2008	
52	**Gas Carrier No.2**	23519	29378	1996	
53	**Chemical Tanker No.4**	8259	14298	2002	
54	**Chemical Tanker No.5**	25507	38847	2004	

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Exclusions
55	**Chemical Tanker No.6**	25431	49358	2005	
56	**LPG Carrier No.1**	10692	13777	1998	excluded: no data provided for the entire reporting period in concern
57	**Passenger No.1**	128052	10250	2012	
58	**Passenger No.2**	110239	10000	2002	
59	**Passenger No.3**	128251	13815	2009	
60	**Passenger No.4**	70526	7200	1991	
61	**Passenger No.5**	70390	7498	1998	
62	**Passenger No.6**	70367	7200	1990	
63	**Passenger No.7**	70538	7180	1994	
64	**Passenger No.8**	110320	12870	2007	
65	**Passenger No.9**	110239	11100	2003	
66	**Passenger No.10**	133500	11000	2018	
67	**Passenger No.11**	70367	7180	1995	
68	**Passenger No.12**	70367	7180	1996	
69	**Passenger No.13**	85942	8983	2002	
70	**Passenger No.14**	110320	13294	2005	
71	**Passenger No.15**	128048	13800	2011	
72	**Passenger No.16**	85942	7089	2004	
73	**Passenger No.17**	70390	6894	1998	
74	**Passenger No.18**	85920	7200	2001	
75	**Passenger No.19**	70538	6870	1993	
76	**Passenger No.20**	85920	7200	2001	
77	**Passenger No.21**	113323	11843	2008	
78	**Passenger No.22**	103881	11142	1996	
79	**Passenger No.23**	101509	10984	1999	excluded: no data provided for the entire reporting period in concern
80	**Passenger No.24**	110000	13294	2004	
81	**Passenger No.25**	101509	11774	2000	
82	**Passenger No.26**	133500	11000	2016	

Table 2- Summary of aggregated reported data for the reporting period 01/01/2018 – 31/12/2018

No.	Ship (Type/No.)	Gross Tonnage	DWT	Distance (nm)	Hrs underway (hrs)	HFO Cons. (metric tonnes)	DO/MGO Cons. (metric tonnes)	LFO Cons. (metric tonnes)	Total Fuel Cons. (metric tonnes)
1	**Oil Tanker No.1**	24048	38472	---	---	---	---	---	---
2	**Oil Tanker No.2**	20121	33755	41808.00	3292.00	4077.00	74.00	0.00	4151.00
3	**Oil Tanker No.3**	56172	105778	10365.00	1222.00	8149.00	17.00	0.00	8166.00
4	**Oil Tanker No.4**	3248	4999	12300.00	1297.00	0.00	922.00	0.00	922.00
5	**Oil Tanker No.5**	3248	4999	29309.00	2744.00	0.00	1164.00	0.00	1164.00
6	**Oil Tanker No.6**	2865	3543	---	---	---	---	---	---
7	**Oil Tanker No.7**	61888	11364	16322.00	1468.00	5918.00	33.00	0.00	5951.00
8	**Oil Tanker No.8**	13666	22062	---	---	---	---	---	---
9	**Oil Tanker No.9**	8848	14581	---	---	---	---	---	---
10	**Oil Tanker No.10**	38997	68500	---	---	---	---	---	---
11	**Oil Tanker No.11**	13425	21081	---	---	---	---	---	---
12	**Oil Tanker No.12**	27505	46683	---	---	---	---	---	---
13	**Oil Tanker No.13**	38997	63589	---	---	---	---	---	---
14	**Oil Tanker No.14**	30109	51215	---	---	---	---	---	---
15	**Oil Tanker No.15**	30010	49999	19344.00	2015.00	5338.00	431.00	0.00	5769.00
16	**Oil Tanker No.16**	42096	74543	54786.00	4725.00	5486.00	1757.00	0.00	7243.00
17	**Oil Tanker No.17**	42096	74543	45957.00	3771.00	4987.00	2244.00	0.00	7231.00
18	**Container No.1**	6406	8715	65785.00	5204.00	3270.00	406.00	0.00	3676.00
19	**Container No.2**	6385	8672	63811.00	5155.00	2954.00	235.00	0.00	3189.00
20	**Other Cargo No.1**	9611	12798	25749.00	3759.00	2328.00	428.00	0.00	2756.00
21	**Bulk Carrier No.1**	9961	17013	---	---	---	---	---	---
22	**Bulk Carrier No.2**	7265	12274	---	---	---	---	---	---
23	**Bulk Carrier No.3**	40040	76741	45736.00	4781.00	5863.00	53.00	0.00	5916.00
24	**Bulk Carrier No.4**	40040	76737	45999.00	4309.00	5458.00	59.00	0.00	5517.00
25	**Bulk Carrier No.5**	19920	32873	---	---	---	---	---	---
26	**Container No.3**	37518	42966	83485.00	6442.00	1121.00	362.00	0.00	1483.00

No.	Ship (Type/No.)	Gross Tonnage	DWT	Distance (nm)	Hrs underway (hrs)	HFO Cons. (metric tonnes)	DO/MGO Cons. (metric tonnes)	LFO Cons. (metric tonnes)	Total Fuel Cons. (metric tonnes)
27	**Container No.4**	54304	68599	98658.00	6577.00	11608.00	5387.00	496.00	17491.00
28	**Container No.5**	35954	42183	102214.00	6768.00	18425.00	168.00	0.00	18593.00
29	**Container No.6**	74071	74453	115374.00	7154.00	26288.00	1137.00	1255.00	28680.00
30	**Container No.7**	40108	52806	83194.00	6731.00	5877.00	1746.00	3946.00	11569.00
31	**Container No.8**	54304	68307	100469.00	6674.00	11170.00	6561.00	0.00	17731.00
32	**Container No.9**	48220	56152	75578.00	6010.00	9770.00	968.00	0.00	10738.00
33	**Container No.10**	21586	21370	56930.00	6032.00	0.00	1899.00	3733.00	5632.00
34	**Container No.11**	52181	60350	78853.00	6258.00	13995.00	3703.00	0.00	17698.00
35	**Container No.12**	30280	35848	62812.00	6268.00	7719.00	311.00	0.00	8030.00
36	**Container No.13**	53208	67678	92575.00	6154.00	13137.00	105.00	5395.00	18637.00
37	**Container No.14**	21586	21370	67988.00	6274.00	0.00	1578.00	4982.00	6560.00
38	**Container No.15**	36389	42465	71839.00	5899.00	10076.00	0.00	0.00	10076.00
39	**Container No.16**	53208	67615	107952.00	6883.00	13188.00	5944.00	0.00	19132.00
40	**Container No.17**	54881	68121	96825.00	6496.00	13468.00	2029.00	3778.00	19275.00
41	**Container No.18**	54304	68372	103608.00	7088.00	15672.00	4392.00	0.00	20064.00
42	**Container No.19**	37579	45544	82688.00	6421.00	10689.00	386.00	0.00	11075.00
43	**Container No.20**	52181	60350	88084.00	6671.00	15543.00	2762.00	0.00	18305.00
44	**Container No.21**	41225	53335	87017.00	6022.00	8658.00	6050.00	0.00	14708.00
45	**Container No.22**	52191	67639	81363.00	6443.00	15044.00	880.00	0.00	15924.00
46	**Oil Tanker No.18**	28278	46337	16076.00	1456.40	2860.74	377.10	0.00	3237.84
47	**Chemical Tanker No.1**	27533	45063	14930.00	1284.00	3062.96	237.48	0.00	3300.44
48	**Chemical Tanker No.2**	27530	44577	20750.00	1694.00	3763.82	337.50	0.00	4101.32
49	**Oil Tanker No.19**	23298	37269	23805.00	1740.00	4208.18	377.67	0.00	4585.85
50	**Gas Carrier No.1**	22352	37661	6894.00	453.00	2285.16	60.28	0.00	2345.44
51	**Chemical Tanker No.3**	30099	51392	19475.00	1491.00	3978.54	299.98	0.00	4278.52
52	**Gas Carrier No.2**	23519	29378	6998.00	503.00	2656.74	45.50	0.00	2702.24
53	**Chemical Tanker No.4**	8259	14298	32456.00	2965.00	2219.50	282.04	0.00	2501.54
54	**Chemical Tanker No.5**	25507	38847	27258.00	2139.00	4335.93	329.50	0.00	4665.43

No.	Ship (Type/No.)	Gross Tonnage	DWT	Distance (nm)	Hrs underway (hrs)	HFO Cons. (metric tonnes)	DO/MGO Cons. (metric tonnes)	LFO Cons. (metric tonnes)	Total Fuel Cons. (metric tonnes)
55	**Chemical Tanker No.6**	25431	49358	23087.00	1767.00	4551.69	271.62	0.00	4823.31
56	**LPG Carrier No.1**	10692	13777	---	---	---	---	---	---
57	**Passenger No.1**	128052	10250	115034.71	8592.70	35730.54	15260.34	0.00	50990.88
58	**Passenger No.2**	110239	10000	100741.04	8582.40	33731.64	3962.48	0.00	37694.12
59	**Passenger No.3**	128251	13815	105129.90	8479.10	32392.32	16403.21	0.00	48795.53
60	**Passenger No.4**	70526	7200	93894.17	8609.60	19423.54	6412.00	0.00	25835.54
61	**Passenger No.5**	70390	7498	81881.53	8522.60	15477.03	4686.28	0.00	20163.31
62	**Passenger No.6**	70367	7200	109079.24	8528.10	22699.01	9577.38	0.00	32276.39
63	**Passenger No.7**	70538	7180	57038.54	8362.90	11236.27	5701.63	0.00	16937.90
64	**Passenger No.8**	110320	12870	114588.19	8483.30	39210.20	11678.19	0.00	50888.39
65	**Passenger No.9**	110239	11100	105239.22	8447.00	32661.55	7603.20	0.00	40264.75
66	**Passenger No.10**	133500	11000	89203.43	6642.10	27179.64	9524.46	0.00	36704.10
67	**Passenger No.11**	70367	7180	46755.85	8552.30	6912.53	6597.08	0.00	13509.61
68	**Passenger No.12**	70367	7180	50389.27	8478.00	6580.29	6957.03	0.00	13537.32
69	**Passenger No.13**	85942	8983	107042.23	8320.60	28991.38	9195.12	0.00	38186.50
70	**Passenger No.14**	110320	13294	69274.29	8593.10	20902.55	5909.27	0.00	26811.82
71	**Passenger No.15**	128048	13800	100154.81	7661.90	45417.42	8412.37	0.00	53829.79
72	**Passenger No.16**	85942	7089	98257.79	8342.50	31844.88	5222.24	0.00	37067.12
73	**Passenger No.17**	70390	6894	91583.31	7889.60	21739.59	3337.91	0.00	25077.50
74	**Passenger No.18**	85920	7200	111031.61	7789.10	29598.65	17201.03	0.00	46799.68
75	**Passenger No.19**	70538	6870	103623.94	8525.20	22887.10	4570.53	0.00	27457.63
76	**Passenger No.20**	85920	7200	102165.48	8245.40	34779.54	1657.03	0.00	36436.57
77	**Passenger No.21**	113323	11843	120744.25	8534.70	45562.09	8155.61	0.00	53717.70
78	**Passenger No.22**	103881	11142	109248.38	8328.00	37167.13	5049.76	0.00	42216.89
79	**Passenger No.23**	101509	10984	---	---	---	---	---	---
80	**Passenger No.24**	110000	13294	116270.48	8510.80	36777.89	10075.80	0.00	46853.69
81	**Passenger No.25**	101509	11774	74303.11	8238.80	20051.76	7823.08	0.00	27874.84
82	**Passenger No.26**	133500	11000	113381.36	8573.10	41996.80	8314.90	0.00	50311.70

Table 3- Summary of analysis of aggregated reported data for the reporting period 01/01/2018 – 31/12/2018
CO_2 Emissions & AER insights

No.	Ship (Type/No.)	Gross Tonnage	DWT	Distance (nm)	Transport Work (based on DWT)	Hrs underway (hrs)	HFO Cons. (MT)	DO/MGO Cons. (MT)	LFO Cons. (MT)	Total Fuel Cons. (MT)	CO_2 Emissions (MT)	EEOI (g/DWT.nm)
1	Oil Tanker No.1	24048	38472	---	---	---	---	---	---	---	---	---
2	Oil Tanker No.2	20121	33755	41808.00	1411229040	3292.00	4077.00	74.00	0.00	4151.00	12933.02	9.164
3	Oil Tanker No.3	56172	105778	10365.00	1096388970	1222.00	8149.00	17.00	0.00	8166.00	25430.49	23.195
4	Oil Tanker No.4	3248	4999	12300.00	61487700	1297.00	0.00	922.00	0.00	922.00	2955.93	48.074
5	Oil Tanker No.5	3248	4999	29309.00	146515691	2744.00	0.00	1164.00	0.00	1164.00	3731.78	25.470
6	Oil Tanker No.6	2865	3543	---	---	---	---	---	---	---	---	---
7	Oil Tanker No.7	61888	11364	16322.00	185479943.6	1468.00	5918.00	33.00	0.00	5951.00	18534.45	99.927
8	Oil Tanker No.8	13666	22062	---	---	---	---	---	---	---	---	---
9	Oil Tanker No.9	8848	14581	---	---	---	---	---	---	---	---	---
10	Oil Tanker No.10	38997	68500	---	---	---	---	---	---	---	---	---
11	Oil Tanker No.11	13425	21081	---	---	---	---	---	---	---	---	---
12	Oil Tanker No.12	27505	46683	---	---	---	---	---	---	---	---	---
13	Oil Tanker No.13	38997	63589	---	---	---	---	---	---	---	---	---
14	Oil Tanker No.14	30109	51215	---	---	---	---	---	---	---	---	---
15	Oil Tanker No.15	30010	49999	19344.00	967180656	2015.00	5338.00	431.00	0.00	5769.00	18004.32	18.615
16	Oil Tanker No.16	42096	74543	54786.00	4083912798	4725.00	5486.00	1757.00	0.00	7243.00	22716.35	5.562
17	Oil Tanker No.17	42096	74543	45957.00	3425772651	3771.00	4987.00	2244.00	0.00	7231.00	22723.78	6.633
18	Container No.1	6406	8715	65785.00	573316275	5204.00	3270.00	406.00	0.00	3676.00	11484.42	20.032
19	Container No.2	6385	8672	63811.00	553368992	5155.00	2954.00	235.00	0.00	3189.00	9952.17	17.985
20	Other Cargo No.1	9611	12798	25749.00	329535702	3759.00	2328.00	428.00	0.00	2756.00	8621.56	26.163
21	Bulk Carrier No.1	9961	17013	---	---	---	---	---	---	---	---	---
22	Bulk Carrier No.2	7265	12274	---	---	---	---	---	---	---	---	---
23	Bulk Carrier No.3	40040	76741	45736.00	3509826376	4781.00	5863.00	53.00	0.00	5916.00	18427.30	5.250
24	Bulk Carrier No.4	40040	76737	45999.00	3529825263	4309.00	5458.00	59.00	0.00	5517.00	17185.37	4.869
25	Bulk Carrier No.5	19920	32873	---	---	---	---	---	---	---	---	---
26	Container No.3	37518	42966	83485.00	3587016510	6442.00	1121.00	362.00	0.00	1483.00	4651.37	1.297
27	Container No.4	54304	68599	98658.00	6767840142	6577.00	11608.00	5387.00	496.00	17491.00	54980.93	8.124
28	Container No.5	35954	42183	102214.00	4311693162	6768.00	18425.00	168.00	0.00	18593.00	57914.06	13.432
29	Container No.6	74071	74453	115374.00	8589940422	7154.00	26288.00	1137.00	1255.00	28680.00	89460.56	10.415
30	Container No.7	40108	52806	83194.00	4393142364	6731.00	5877.00	1746.00	3946.00	11569.00	36332.50	8.270
31	Container No.8	54304	68307	100469.00	6862735983	6674.00	11170.00	6561.00	0.00	17731.00	55817.95	8.133
32	Container No.9	48220	56152	75578.00	4243855856	6010.00	9770.00	968.00	0.00	10738.00	33527.19	7.900
33	Container No.10	21586	21370	56930.00	1216594100	6032.00	0.00	1899.00	3733.00	5632.00	17850.88	14.673
34	Container No.11	52181	60350	78853.00	4758778550	6258.00	13995.00	3703.00	0.00	17698.00	55452.25	11.653
35	Container No.12	30280	35848	62812.00	2251684576	6268.00	7719.00	311.00	0.00	8030.00	25034.03	11.118
36	Container No.13	53208	67678	92575.00	6265290850	6154.00	13137.00	105.00	5395.00	18637.00	58244.89	9.296
37	Container No.14	21586	21370	67988.00	1452903560	6274.00	0.00	1578.00	4982.00	6560.00	20757.35	14.287
38	Container No.15	36389	42465	71839.00	3050643135	5899.00	10076.00	0.00	0.00	10076.00	31376.66	10.285
39	Container No.16	53208	67615	107952.00	7299174480	6883.00	13188.00	5944.00	0.00	19132.00	60123.90	8.237
40	Container No.17	54881	68121	96825.00	6595815825	6496.00	13468.00	2029.00	3778.00	19275.00	60348.80	9.150
41	Container No.18	54304	68372	103608.00	7083886176	7088.00	15672.00	4392.00	0.00	20064.00	62883.36	8.877
42	Container No.19	37579	45544	82688.00	3765942272	6421.00	10689.00	386.00	0.00	11075.00	34523.06	9.167

43	**Container No.20**	52181	60350	88084.00	5315869400	6671.00	15543.00	2762.00	0.00	18305.00	57255.87	10.771
44	**Container No.21**	41225	53335	87017.00	4641051695	6022.00	8658.00	6050.00	0.00	14708.00	46357.31	9.989
45	**Container No.22**	52191	67639	81363.00	5503311957	6443.00	15044.00	880.00	0.00	15924.00	49668.30	9.025
46	**Oil Tanker No.18**	28278	46337	16076.00	744913612	1456.40	2860.74	377.10	0.00	3237.84	10117.33	13.582
47	**Chemical Tanker No.1**	27533	45063	14930.00	672790590	1284.00	3062.96	237.48	0.00	3300.44	10299.42	15.309
48	**Chemical Tanker No.2**	27530	44577	20750.00	924972750	1694.00	3763.82	337.50	0.00	4101.32	12802.56	13.841
49	**Oil Tanker No.19**	23298	37269	23805.00	887188545	1740.00	4208.18	377.67	0.00	4585.85	14315.08	16.135
50	**Gas Carrier No.1**	22352	37661	6894.00	259634934	453.00	2285.16	60.28	0.00	2345.44	7309.25	28.152
51	**Chemical Tanker No.3**	30099	51392	19475.00	1000859200	1491.00	3978.54	299.98	0.00	4278.52	13350.91	13.339
52	**Gas Carrier No.2**	23519	29378	6998.00	205587244	503.00	2656.74	45.50	0.00	2702.24	8418.96	40.951
53	**Chemical Tanker No.4**	8259	14298	32456.00	464055888	2965.00	2219.50	282.04	0.00	2501.54	7815.74	16.842
54	**Chemical Tanker No.5**	25507	38847	27258.00	1058891526	2139.00	4335.93	329.50	0.00	4665.43	14558.46	13.749
55	**Chemical Tanker No.6**	25431	49358	23087.00	1139528146	1767.00	4551.69	271.62	0.00	4823.31	15044.78	13.203
56	**LPG Carrier No.1**	10692	13777	---	---	---	---	---	---	---	---	---
57	**Passenger No.1**	128052	10250	115034.71	1179105778	8592.70	35730.54	15260.34	0.00	50990.88	160189.55	135.857
58	**Passenger No.2**	110239	10000	100741.04	1007410400	8582.40	33731.64	3962.48	0.00	37694.12	117744.04	116.878
59	**Passenger No.3**	128251	13815	105129.90	1452369569	8479.10	32392.32	16403.21	0.00	48795.53	153458.38	105.661
60	**Passenger No.4**	70526	7200	93894.17	676038024	8609.60	19423.54	6412.00	0.00	25835.54	81041.78	119.878
61	**Passenger No.5**	70390	7498	81881.53	613947711.9	8522.60	15477.03	4686.28	0.00	20163.31	63219.69	102.972
62	**Passenger No.6**	70367	7200	109079.24	785370528	8528.10	22699.01	9577.38	0.00	32276.39	101389.80	129.098
63	**Passenger No.7**	70538	7180	57038.54	409536717.2	8362.90	11236.27	5701.63	0.00	16937.90	53269.17	130.072
64	**Passenger No.8**	110320	12870	114588.19	1474750005	8483.30	39210.20	11678.19	0.00	50888.39	159540.84	108.182
65	**Passenger No.9**	110239	11100	105239.22	1168155342	8447.00	32661.55	7603.20	0.00	40264.75	126083.93	107.934
66	**Passenger No.10**	133500	11000	89203.43	981237730	6642.10	27179.64	9524.46	0.00	36704.10	115172.82	117.375
67	**Passenger No.11**	70367	7180	46755.85	335707003	8552.30	6912.53	6597.08	0.00	13509.61	42675.86	127.122
68	**Passenger No.12**	70367	7180	50389.27	361794958.6	8478.00	6580.29	6957.03	0.00	13537.32	42795.26	118.286
69	**Passenger No.13**	85942	8983	107042.23	961560352.1	8320.60	28991.38	9195.12	0.00	38186.50	119758.71	124.546
70	**Passenger No.14**	110320	13294	69274.29	920932411.3	8593.10	20902.55	5909.27	0.00	26811.82	84035.66	91.251
71	**Passenger No.15**	128048	13800	100154.81	1382136378	7661.90	45417.42	8412.37	0.00	53829.79	168399.90	121.840
72	**Passenger No.16**	85942	7089	98257.79	696549473.3	8342.50	31844.88	5222.24	0.00	37067.12	115907.46	166.402
73	**Passenger No.17**	70390	6894	91583.31	631375339.1	7889.60	21739.59	3337.91	0.00	25077.50	78398.42	124.171
74	**Passenger No.18**	85920	7200	111031.61	799427592	7789.10	29598.65	17201.03	0.00	46799.68	147316.70	184.278
75	**Passenger No.19**	70538	6870	103623.94	711896467.8	8525.20	22887.10	4570.53	0.00	27457.63	85923.55	120.697
76	**Passenger No.20**	85920	7200	102165.48	735591456	8245.40	34779.54	1657.03	0.00	36436.57	113615.93	154.455
77	**Passenger No.21**	113323	11843	120744.25	1429974153	8534.70	45562.09	8155.61	0.00	53717.70	168027.23	117.504
78	**Passenger No.22**	103881	11142	109248.38	1217245450	8328.00	37167.13	5049.76	0.00	42216.89	131927.97	108.382
79	**Passenger No.23**	101509	10984	---	---	---	---	---	---	---	---	---
80	**Passenger No.24**	110000	13294	116270.48	1545699761	8510.80	36777.89	10075.80	0.00	46853.69	146829.36	94.992
81	**Passenger No.25**	101509	11774	74303.11	874844817.1	8238.80	20051.76	7823.08	0.00	27874.84	87521.98	100.043
82	**Passenger No.26**	133500	11000	113381.36	1247194960	8573.10	41996.80	8314.90	0.00	50311.70	157435.60	126.232

Table 4- Summary on AER & average energy efficiency results of participating ships

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Last Hull maintenance	Hrs underway (hrs)	Anchor/Port (hrs)	Total Fuel Cons. (MT)	CO_2 Emissions (MT)	EEOI (g/DWT.nm)	Average Energy Efficiency			
											Fuel Cons. per Dist. (kg/nm)	Fuel Cons. per Tr. Work (g/MT.nm)	CO_2 Em. per Dist. (kg/nm)	CO_2 Em. per Tr. Work (g/MT.nm)
1	Oil Tanker No.1	24048	38472	2005	01/02/2018	---	---	---	---	---	---	---	---	---
2	Oil Tanker No.2	20121	33755	2010	08/01/2018	3292.00	5468.00	4151.00	12933.02	9.164	99.287	2.941	309.343	9.164
3	Oil Tanker No.3	56172	105778	2004	13/06/2016	1222.00	7538.00	8166.00	25430.49	23.195	787.844	7.448	2453.496	23.195
4	Oil Tanker No.4	3248	4999	2005	11/08/2017	---	---	---	---	---	74.959	14.995	240.320	48.074
5	Oil Tanker No.5	3248	4999	2005	08/11/2017	---	---	---	---	---	39.715	7.945	127.326	25.470
6	Oil Tanker No.6	2865	3543	2006	23/06/2018	---	---	---	---	---	---	---	---	---
7	Oil Tanker No.7	61888	11364	2017	01/03/2017	1468.00	7292.00	5951.00	18534.45	99.927	364.600	32.084	1135.550	99.927
8	Oil Tanker No.8	13666	22062	2008	06/06/2018	---	---	---	---	---	---	---	---	---
9	Oil Tanker No.9	8848	14581	1999	09/02/2017	---	---	---	---	---	---	---	---	---
10	Oil Tanker No.10	38997	68500	2008	26/03/2018	---	---	---	---	---	---	---	---	---
11	Oil Tanker No.11	13425	21081	2003	16/05/2018	---	---	---	---	---	---	---	---	---
12	Oil Tanker No.12	27505	46683	2004	20/07/2017	---	---	---	---	---	---	---	---	---
13	Oil Tanker No.13	38997	63589	2008	07/12/2018	---	---	---	---	---	---	---	---	---
14	Oil Tanker No.14	30109	51215	2009	06/07/2014	---	---	---	---	---	---	---	---	---
15	Oil Tanker No.15	30010	49999	2009	15/09/2014	2015.00	6745.00	5769.00	18004.32	18.615	298.232	5.965	930.744	18.615
16	Oil Tanker No.16	42096	74543	2006	08/12/2018	4725.00	4035.00	7243.00	22716.35	5.562	132.205	1.774	414.638	5.562
17	Oil Tanker No.17	42096	74543	2006	22/12/2018	3771.00	4989.00	7231.00	22723.78	6.633	157.343	2.111	494.457	6.633
18	Container No.1	6406	8715	1998	20/12/2018	5204.00	3556.00	3676.00	11484.42	20.032	55.879	6.412	174.575	20.032
19	Container No.2	6385	8672	2000	02/02/2016	5155.00	3605.00	3189.00	9952.17	17.985	49.976	5.763	155.963	17.985
20	Other Cargo No.1	9611	12798	2004	01/10/2018	3759.00	5001.00	2756.00	8621.56	26.163	107.033	8.363	334.831	26.163
21	Bulk Carrier No.1	9961	17013	2007	09/09/2018	---	---	---	---	---	---	---	---	---
22	Bulk Carrier No.2	7265	12274	2001	16/02/2016	---	---	---	---	---	---	---	---	---
23	Bulk Carrier No.3	40040	76741	2006	05/11/2015	4781.00	3979.00	5916.00	18427.30	5.250	129.351	1.686	402.906	5.250
24	Bulk Carrier No.4	40040	76737	2004	21/01/2018	4309.00	4451.00	5517.00	17185.37	4.869	119.937	1.563	373.603	4.869
25	Bulk Carrier No.5	19920	32873	2000	01/11/2017	---	---	---	---	---	---	---	---	---
26	Container No.3	37518	42966	1996	29/10/2015	6442.00	2318.00	1483.00	4651.37	1.297	17.764	0.413	55.715	1.297
27	Container No.4	54304	68599	2004	04/06/2017	6577.00	2183.00	17491.00	54980.93	8.124	177.289	2.584	557.288	8.124
28	Container No.5	35954	42183	2004	28/12/2016	6768.00	1992.00	18593.00	57914.06	13.432	181.903	4.312	566.596	13.432
29	Container No.6	74071	74453	2002	10/07/2016	7154.00	1606.00	28680.00	89460.56	10.415	248.583	3.339	775.396	10.415
30	Container No.7	40108	52806	2002	25/11/2016	6731.00	2029.00	11569.00	36332.50	8.270	139.061	2.633	436.720	8.270
31	Container No.8	54304	68307	2004	07/08/2017	6674.00	2086.00	17731.00	55817.95	8.133	176.482	2.584	555.574	8.133
32	Container No.9	48220	56152	1993	04/06/2018	6010.00	2750.00	10738.00	33527.19	7.900	142.078	2.530	443.610	7.900
33	Container No.10	21586	21370	1982	21/11/2018	6032.00	2728.00	5632.00	17850.88	14.673	98.929	4.629	313.558	14.673
34	Container No.11	52181	60350	1990	22/02/2018	6258.00	2502.00	17698.00	55452.25	11.653	224.443	3.719	703.236	11.653
35	Container No.12	30280	35848	1998	27/11/2016	6268.00	2492.00	8030.00	25034.03	11.118	127.842	3.566	398.555	11.118
36	Container No.13	53208	67678	1999	07/08/2017	6154.00	2606.00	18637.00	58244.89	9.296	201.318	2.975	629.164	9.296
37	Container No.14	21586	21370	1982	31/08/2016	6274.00	2486.00	6560.00	20757.35	14.287	96.488	4.515	305.309	14.287
38	Container No.15	36389	42465	1988	05/09/2016	5899.00	2861.00	10076.00	31376.66	10.285	140.258	3.303	436.764	10.285
39	Container No.16	53208	67615	1999	14/09/2017	6883.00	1877.00	19132.00	60123.90	8.237	177.227	2.621	556.950	8.237
40	Container No.17	54881	68121	2004	02/05/2017	6496.00	2264.00	19275.00	60348.80	9.150	199.070	2.922	623.277	9.150
41	Container No.18	54304	68372	2004	25/05/2017	7088.00	1672.00	20064.00	62883.36	8.877	193.653	2.832	606.935	8.877
42	Container No.19	37579	45544	1997	08/09/2017	6421.00	2339.00	11075.00	34523.06	9.167	133.937	2.941	417.510	9.167

43	**Container No.20**	52181	60350	1990	20/06/2017	6671.00	2089.00	18305.00	57255.87	10.771	207.813	3.443	650.014	10.771
44	**Container No.21**	41225	53335	2008	22/06/2018	6022.00	2738.00	14708.00	46357.31	9.989	169.024	3.169	532.739	9.989
45	**Container No.22**	52191	67639	1989	06/04/2018	6443.00	2317.00	15924.00	49668.30	9.025	195.715	2.894	610.453	9.025
46	**Oil Tanker No.18**	28278	46337	2000	00/01/1900	1456.40	7303.60	3237.84	10117.33	13.582	201.408	4.347	629.344	13.582
47	**Chemical Tanker No.1**	27533	45063	1999	08/11/2018	1284.00	7476.00	3300.44	10299.42	15.309	221.061	4.906	689.847	15.309
48	**Chemical Tanker No.2**	27530	44577	1999	12/06/2016	1694.00	7066.00	4101.32	12802.56	13.841	197.654	4.434	616.991	13.841
49	**Oil Tanker No.19**	23298	37269	2005	24/08/2015	1740.00	7020.00	4585.85	14315.08	16.135	192.642	5.169	601.348	16.135
50	**Gas Carrier No.1**	22352	37661	1997	29/01/2017	453.00	8307.00	2345.44	7309.25	28.152	340.215	9.034	1060.233	28.152
51	**Chemical Tanker No.3**	30099	51392	2008	26/09/2016	1491.00	7269.00	4278.52	13350.91	13.339	219.693	4.275	685.541	13.339
52	**Gas Carrier No.2**	23519	29378	1996	15/01/2016	503.00	8257.00	2702.24	8418.96	40.951	386.145	13.144	1203.052	40.951
53	**Chemical Tanker No.4**	8259	14298	2002	02/11/2016	2965.00	5795.00	2501.54	7815.74	16.842	77.075	5.391	240.810	16.842
54	**Chemical Tanker No.5**	25507	38847	2004	23/06/2017	2139.00	6621.00	4665.43	14558.46	13.749	171.158	4.406	534.099	13.749
55	**Chemical Tanker No.6**	25431	49358	2005	07/07/2018	1767.00	6993.00	4823.31	15044.78	13.203	208.919	4.233	651.656	13.203
56	**LPG Carrier No.1**	10692	13777	1998	2018	---	---	---	---	---	---	---	---	---
57	**Passenger No.1**	128052	10250	2012	30/04/2017	8592.70	167.30	50990.88	160189.55	135.857	443.265	43.245	1392.532	135.857
58	**Passenger No.2**	110239	10000	2002	14/10/2017	8582.40	177.60	37694.12	117744.04	116.878	374.168	37.417	1168.779	116.878
59	**Passenger No.3**	128251	13815	2009	10/02/2017	8479.10	280.90	48795.53	153458.38	105.661	464.145	33.597	1459.702	105.661
60	**Passenger No.4**	70526	7200	1991	23/01/2017	8609.60	150.40	25835.54	81041.78	119.878	275.156	38.216	863.118	119.878
61	**Passenger No.5**	70390	7498	1998	27/09/2017	8522.60	237.40	20163.31	63219.69	102.972	246.250	32.842	772.087	102.972
62	**Passenger No.6**	70367	7200	1990	19/02/2016	8528.10	231.90	32276.39	101389.80	129.098	295.899	41.097	929.506	129.098
63	**Passenger No.7**	70538	7180	1994	16/02/2018	8362.90	397.10	16937.90	53269.17	130.072	296.955	41.359	933.915	130.072
64	**Passenger No.8**	110320	12870	2007	03/05/2014	8483.30	276.70	50888.39	159540.84	108.182	444.098	34.506	1392.297	108.182
65	**Passenger No.9**	110239	11100	2003	10/03/2017	8447.00	313.00	40264.75	126083.93	107.934	382.602	34.469	1198.070	107.934
66	**Passenger No.10**	133500	11000	2018	2018	6642.10	2117.90	36704.10	115172.82	117.375	411.465	37.406	1291.125	117.375
67	**Passenger No.11**	70367	7180	1995	19/09/2016	8552.30	207.70	13509.61	42675.86	127.122	288.939	40.242	912.738	127.122
68	**Passenger No.12**	70367	7180	1996	03/02/2016	8478.00	282.00	13537.32	42795.26	118.286	268.655	37.417	849.293	118.286
69	**Passenger No.13**	85942	8983	2002	15/05/2018	8320.60	439.40	38186.50	119758.71	124.546	356.742	39.713	1118.799	124.546
70	**Passenger No.14**	110320	13294	2005	15/12/2016	8593.10	166.90	26811.82	84035.66	91.251	387.039	29.114	1213.086	91.251
71	**Passenger No.15**	128048	13800	2011	04/03/2016	7661.90	1098.10	53829.79	168399.90	121.840	537.466	38.947	1681.396	121.840
72	**Passenger No.16**	85942	7089	2004	19/03/2015	8342.50	417.50	37067.12	115907.46	166.402	377.244	53.215	1179.626	166.402
73	**Passenger No.17**	70390	6894	1998	24/03/2018	7889.60	870.40	25077.50	78398.42	124.171	273.822	39.719	856.034	124.171
74	**Passenger No.18**	85920	7200	2001	08/11/2014	7789.10	970.90	46799.68	147316.70	184.278	421.499	58.541	1326.800	184.278
75	**Passenger No.19**	70538	6870	1993	22/02/2017	8525.20	234.80	27457.63	85923.55	120.697	264.974	38.570	829.186	120.697
76	**Passenger No.20**	85920	7200	2001	06/06/2018	8245.40	514.60	36436.57	113615.93	154.455	356.643	49.534	1112.077	154.455
77	**Passenger No.21**	113323	11843	2008	19/03/2016	8534.70	225.30	53717.70	168027.23	117.504	444.888	37.566	1391.596	117.504
78	**Passenger No.22**	103881	11142	1996	19/05/2016	8328.00	432.00	42216.89	131927.97	108.382	386.430	34.682	1207.597	108.382
79	**Passenger No.23**	101509	10984	1999	02/04/2016	---	---	---	---	---	---	---	---	---
80	**Passenger No.24**	110000	13294	2004	07/05/2016	8510.80	249.20	46853.69	146829.36	94.992	402.972	30.312	1262.826	94.992
81	**Passenger No.25**	101509	11774	2000	20/01/2018	8238.80	521.20	27874.84	87521.98	100.043	375.150	31.863	1177.905	100.043
82	**Passenger No.26**	133500	11000	2016	2016	8573.10	186.90	50311.70	157435.60	126.232	443.739	40.340	1388.549	126.232

Table 5- Summary on fuel consumption data results of participating ships, per ship type

Ship Type	Nos.	Distance (nm)	Hrs u/w (hrs)	anchor/port (hrs)	HFO Cons. (MT)	DO/MGO Cons. (MT)	LFO Cons. (MT)	Total FO Cons. (MT)	CO2 Emissions (MT)	Transport Work (DWT.nm)
Passenger Ships	25	2386056.13	207832.90	19927.10	700951.34	199287.93	0.00	900239.27	2821679.58	23599852376.61
Bulk Carriers	2	91735.00	9090.00	8430.00	11321.00	112.00	0.00	11433.00	35612.67	7039651639.00
Oil Tankers	10	270072.00	23730.40	63869.60	41023.92	7396.77	0.00	48420.69	151462.53	13010069606.60
Chemical Tankers	6	137956.00	11340.00	41220.00	21912.44	1758.12	0.00	23670.56	73871.87	5261098100.00
Container Ships	22	1867102.00	139624.00	53096.00	227672.00	47009.00	23585.00	298266.00	933997.80	99083856282.00
Gas Carriers	2	13892.00	956.00	16564.00	4941.90	105.78	0.00	5047.68	15728.21	465222178.00
Other	1	25749.00	3759.00	5001.00	2328.00	428.00	0.00	2756.00	8621.56	329535702.00
Total Fleet	**68**	**4792562.13**	**396332.30**	**208107.70**	**1010150.60**	**256097.60**	**23585.00**	**1289833.20**	**4040974.21**	**148789285884.21**

(b) Qualitative Analysis

Qualitative analysis took place for the analysis of text data from the filled in forms and the ships responses for the energy efficient measures implemented onboard.

A total of 80 reports with data on fuel consumers available onboard and energy efficient measures implemented onboard ships of various types over 5000GT, covering the period between 01/01/2018 – 31/12/2018 were obtained, for analysis.

Results are reflected at the following tables:

Table 6 – Summary of details on fuel consumers available onboard participating ships

Table 7 – Summary on Energy Efficient Measures implemented onboard participating ships

Table 8 – Analysis of trends: Energy efficient measures implemented onboard the vessels of Pilot Project 2, with reference to their technical characteristics / cost (Ref. made to GloMEEP information on energy efficient measures)

Table 6- Summary of details on fuel consumers available onboard participating ships

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Main Engine(s) Total Rated Power (kW)	Auxiliary Engine(s) Total Rated Power (kW)	Other Fuel Consumers		
							Boiler(s)	IGG(s)	Gas Turbine(s)
1	**Oil Tanker No.1**	24048	38472	2005	9480.00	960.00	Yes	Yes	---
2	**Oil Tanker No.2**	20121	33755	2010	9480.00	960.00	Yes	---	---
3	**Oil Tanker No.3**	56172	105778	2004	12000.00	710.00	Yes	---	---
4	**Oil Tanker No.4**	3248	4999	2005	2400.00	460.00	Yes	---	---
5	**Oil Tanker No.5**	3248	4999	2005	2400.00	460.00	Yes	---	---
6	**Oil Tanker No.6**	2865	3543	2006	2400.00	460.00	Yes	---	---
7	**Oil Tanker No.7**	61888	11364	2017	12420.00	950.00	Yes	---	---
8	**Oil Tanker No.8**	13666	22062	2008	8733.00	875.00	Yes	---	---
9	**Oil Tanker No.9**	8848	14581	1999	6150.00	587.00	Yes	---	---
10	**Oil Tanker No.10**	38997	68500	2008	13746.00	900.00	Yes	Yes	---
11	**Oil Tanker No.11**	13425	21081	2003	9480.00	650.00	Yes	---	---
12	**Oil Tanker No.12**	27505	46683	2004	8310.00	1360.00	Yes	Yes	---
13	**Oil Tanker No.13**	38997	63589	2008	13560.00	960.00	Yes	Yes	---
14	**Oil Tanker No.14**	30109	51215	2009	9480.00	960.00	Yes	Yes	---
15	**Oil Tanker No.15**	30010	49999	2009	9480.00	960.00	Yes	Yes	---
16	**Oil Tanker No.16**	42096	74543	2006	9710.00	1890.00	Yes	Yes	---
17	**Oil Tanker No.17**	42096	74543	2006	9710.00	1890.00	Yes	Yes	---
18	**Container No.1**	6406	8715	1998	5700.00	2536.00	Yes	---	---
19	**Container No.2**	6385	8672	2000	5000.00	780.00	Yes	---	---
20	**Other Cargo No.1**	9611	12798	2004	5400.00	487.00	Yes	---	---
21	**Bulk Carrier No.1**	9961	17013	2007	4440.00	1365.00	Yes	---	---
22	**Bulk Carrier No.2**	7265	12274	2001	3603.00	1050.00	Yes	---	---
23	**Bulk Carrier No.3**	40040	76741	2006	9230.00	441.00	Yes	---	---
24	**Bulk Carrier No.4**	40040	76737	2004	9230.00	441.00	Yes	---	---
25	**Bulk Carrier No.5**	19920	32873	2000	6711.30	400.00	Yes	---	---
26	**Container No.3**	37518	42966	1996	28370.00	5400.00	Yes	---	---

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Main Engine(s) Total Rated Power (kW)	Auxiliary Engine(s) Total Rated Power (kW)	Other Fuel Consumers Boiler(s)	 IGG(s)	 Gas Turbine(s)
27	**Container No.4**	54304	68599	2004	41107.00	7280.00	Yes	---	---
28	**Container No.5**	35954	42183	2004	31900.00	5264.00	Yes	---	---
29	**Container No.6**	74071	74453	2002	60390.00	8800.00	Yes	---	---
30	**Container No.7**	40108	52806	2002	36473.00	6800.00	Yes	---	---
31	**Container No.8**	54304	68307	2004	41107.00	8000.00	Yes	---	---
32	**Container No.9**	48220	56152	1993	30576.00	3660.00	Yes	---	---
33	**Container No.10**	21586	21370	1982	15890.00	3420.00	Yes	---	---
34	**Container No.11**	52181	60350	1990	42440.00	4800.00	Yes	---	---
35	**Container No.12**	30280	35848	1998	25036.00	4854.00	Yes	---	---
36	**Container No.13**	53208	67678	1999	41173.00	5500.00	Yes	---	---
37	**Container No.14**	21586	21370	1982	15890.00	3420.00	Yes	---	---
38	**Container No.15**	36389	42465	1988	23168.00	6700.00	Yes	---	---
39	**Container No.16**	53208	67615	1999	41173.00	5500.00	Yes	---	---
40	**Container No.17**	54881	68121	2004	41107.00	6456.00	Yes	---	---
41	**Container No.18**	54304	68372	2004	41107.00	7280.00	Yes	---	---
42	**Container No.19**	37579	45544	1997	28578.00	3920.00	Yes	---	---
43	**Container No.20**	52181	60350	1990	42438.00	4869.00	Yes	---	---
44	**Container No.21**	41225	53335	2008	36560.00	8800.00	Yes	---	---
45	**Container No.22**	52191	67639	1989	39420.00	4869.00	Yes	---	---
46	**Oil Tanker No.18**	28278	46337	2000	7578.00	1000.00	Yes	Yes	---
47	**Chemical Tanker No.1**	27533	45063	1999	8240.00	680.00	Yes	Yes	---
48	**Chemical Tanker No.2**	27530	44577	1999	8240.00	680.00	Yes	Yes	---
49	**Oil Tanker No.19**	23298	37269	2005	9604.00	790.00	Yes	Yes	---
50	**Gas Carrier No.1**	22352	37661	1997	9627.00	640.00	Yes	Yes	---
51	**Chemical Tanker No.3**	30099	51392	2008	9480.00	960.00	Yes	Yes	---
52	**Gas Carrier No.2**	23519	29378	1996	10200.00	956.00	Yes	Yes	---
53	**Chemical Tanker No.4**	8259	14298	2002	4440.00	660.00	Yes	Yes	---
54	**Chemical Tanker No.5**	25507	38847	2004	7860.00	967.00	Yes	Yes	---

No.	Ship (Type/No.)	Gross Tonnage	DWT	YOB	Main Engine(s) Total Rated Power (kW)	Auxiliary Engine(s) Total Rated Power (kW)	Other Fuel Consumers		
							Boiler(s)	IGG(s)	Gas Turbine(s)
55	**Chemical Tanker No.6**	25431	49358	2005	11060.00	785.00	Yes	Yes	---
56	**LPG Carrier No.1**	10692	13777	1998	7980.00	1040.00	---	---	---
57	**Passenger No.1**	128052	10250	2012	75600.00	N/A	Yes	---	---
58	**Passenger No.2**	110239	10000	2002	61600.00	N/A	Yes	---	---
59	**Passenger No.3**	128251	13815	2009	75600.00	N/A	Yes	---	---
60	**Passenger No.4**	70526	7200	1991	42240.00	N/A	Yes	---	---
61	**Passenger No.5**	70390	7498	1998	47520.00	N/A	Yes	---	---
62	**Passenger No.6**	70367	7200	1990	42240.00	N/A	Yes	---	---
63	**Passenger No.7**	70538	7180	1994	42240.00	N/A	Yes	---	---
64	**Passenger No.8**	110320	12870	2007	75600.00	N/A	Yes	---	---
65	**Passenger No.9**	110239	11100	2003	61600.00	N/A	Yes	---	---
66	**Passenger No.10**	133500	11000	2018	62400.00	N/A	Yes	---	---
67	**Passenger No.11**	70367	7180	1995	42240.00	N/A	Yes	---	---
68	**Passenger No.12**	70367	7180	1996	42240.00	N/A	Yes	---	---
69	**Passenger No.13**	85942	8983	2002	61200.00	N/A	Yes	---	---
70	**Passenger No.14**	110320	13294	2005	75600.00	N/A	Yes	---	---
71	**Passenger No.15**	128048	13800	2011	75600.00	N/A	Yes	---	---
72	**Passenger No.16**	85942	7089	2004	61200.00	N/A	Yes	---	---
73	**Passenger No.17**	70390	6894	1998	47520.00	N/A	Yes	---	---
74	**Passenger No.18**	85920	7200	2001	61200.00	N/A	Yes	---	---
75	**Passenger No.19**	70538	6870	1993	42240.00	N/A	Yes	---	---
76	**Passenger No.20**	85920	7200	2001	61200.00	N/A	Yes	---	---
77	**Passenger No.21**	113323	11843	2008	75600.00	N/A	Yes	---	---
78	**Passenger No.22**	103881	11142	1996	61600.00	N/A	Yes	---	---
79	**Passenger No.23**	101509	10984	1999	61600.00	N/A	Yes	---	---
80	**Passenger No.24**	110000	13294	2004	61600.00	N/A	Yes	---	---
81	**Passenger No.25**	101509	11774	2000	61600.00	N/A	Yes	---	---
82	**Passenger No.26**	133500	11000	2016	62400.00	N/A	Yes	---	---

Table 7- Summary on Energy Efficient Measures implemented onboard participating ships

No.	Ship (Type/No.)	GT	DWT	YOB	Last Hull Maint.	EEOI (g/DWT.nm)	Energy Savings Technologies Utilized During the Voyages within the reporting period												
							Hull Air Lubrication	Waste Heat Recovery	Solar Electricity	Wind Power	Weather Routing	Autopilot	Trim/Draft Optimization	Optimum Ballast Condition	Other : New Propeller	Other : PBCF / EPF	Other : Efficient hull coating	Other : Podded Propulsion	Other : Ducktail
1	Oil Tanker No.1	24048	38472	2005	01/02/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
2	Oil Tanker No.2	20121	33755	2010	08/01/2018	9.164	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
3	Oil Tanker No.3	56172	105778	2004	13/06/2016	23.195	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
4	Oil Tanker No.4	3248	4999	2005	11/08/2017	---	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
5	Oil Tanker No.5	3248	4999	2005	08/11/2017	25.470	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
6	Oil Tanker No.6	2865	3543	2006	23/06/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
7	Oil Tanker No.7	61888	11364	2017	01/03/2017	99.927	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
8	Oil Tanker No.8	13666	22062	2008	06/06/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
9	Oil Tanker No.9	8848	14581	1999	09/02/2017	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
10	Oil Tanker No.10	38997	68500	2008	26/03/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
11	Oil Tanker No.11	13425	21081	2003	16/05/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
12	Oil Tanker No.12	27505	46683	2004	20/07/2017	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
13	Oil Tanker No.13	38997	63589	2008	07/12/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
14	Oil Tanker No.14	30109	51215	2009	06/07/2014	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
15	Oil Tanker No.15	30010	49999	2009	15/09/2014	18.615	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
16	Oil Tanker No.16	42096	74543	2006	08/12/2018	5.562	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
17	Oil Tanker No.17	42096	74543	2006	22/12/2018	6.633	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
18	Container No.1	6406	8715	1998	20/12/2018	20.032	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
19	Container No.2	6385	8672	2000	02/02/2016	17.985	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
20	Other Cargo No.1	9611	12798	2004	01/10/2018	26.163	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
21	Bulk Carrier No.1	9961	17013	2007	09/09/2018	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
22	Bulk Carrier No.2	7265	12274	2001	16/02/2016	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
23	Bulk Carrier No.3	40040	76741	2006	05/11/2015	5.250	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
24	Bulk Carrier No.4	40040	76737	2004	21/01/2018	4.869	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
25	Bulk Carrier No.5	19920	32873	2000	01/11/2017	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes	---	---
26	Container No.3	37518	42966	1996	29/10/2015	1.297	---	Yes	---	---	Yes	Yes	---	Yes	---	Yes	Yes	---	---
27	Container No.4	54304	68599	2004	04/06/2017	8.124	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
28	Container No.5	35954	42183	2004	28/12/2016	13.432	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
29	Container No.6	74071	74453	2002	10/07/2016	10.415	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
30	Container No.7	40108	52806	2002	25/11/2016	8.270	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
31	Container No.8	54304	68307	2004	07/08/2017	8.133	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
32	Container No.9	48220	56152	1993	04/06/2018	7.900	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
33	Container No.10	21586	21370	1982	21/11/2018	14.673	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
34	Container No.11	52181	60350	1990	22/02/2018	11.653	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
35	Container No.12	30280	35848	1998	27/11/2016	11.118	---	Yes	---	---	Yes	Yes	---	Yes	---	Yes	Yes	---	---
36	Container No.13	53208	67678	1999	07/08/2017	9.296	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
37	Container No.14	21586	21370	1982	31/08/2016	14.287	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
38	Container No.15	36389	42465	1988	05/09/2016	10.285	---	Yes	---	---	Yes	Yes	---	Yes	---	Yes	Yes	---	---
39	Container No.16	53208	67615	1999	14/09/2017	8.237	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
40	Container No.17	54881	68121	2004	02/05/2017	9.150	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
41	Container No.18	54304	68372	2004	25/05/2017	8.877	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
42	Container No.19	37579	45544	1997	08/09/2017	9.167	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---

43	**Container No.20**	52181	60350	1990	20/06/2017	10.771	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
44	**Container No.21**	41225	53335	2008	22/06/2018	9.989	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
45	**Container No.22**	52191	67639	1989	06/04/2018	9.025	---	Yes	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes	---	---
46	**Oil Tanker No.18**	28278	46337	2000	00/01/1900	13.582	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
47	**Chemical Tanker No.1**	27533	45063	1999	08/11/2018	15.309	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
48	**Chemical Tanker No.2**	27530	44577	1999	12/06/2016	13.841	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
49	**Oil Tanker No.19**	23298	37269	2005	24/08/2015	16.135	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
50	**Gas Carrier No.1**	22352	37661	1997	29/01/2017	28.152	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
51	**Chemical Tanker No.3**	30099	51392	2008	26/09/2016	13.339	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
52	**Gas Carrier No.2**	23519	29378	1996	15/01/2016	40.951	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
53	**Chemical Tanker No.4**	8259	14298	2002	02/11/2016	16.842	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
54	**Chemical Tanker No.5**	25507	38847	2004	23/06/2017	13.749	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
55	**Chemical Tanker No.6**	25431	49358	2005	07/07/2018	13.203	---	---	---	---	Yes	Yes	---	---	---	---	Yes	---	---
56	**LPG Carrier No.1**	10692	13777	1998	2018	---	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
57	**Passenger No.1**	128052	10250	2012	30/04/2017	135.857	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
58	**Passenger No.2**	110239	10000	2002	14/10/2017	116.878	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
59	**Passenger No.3**	128251	13815	2009	10/02/2017	105.661	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
60	**Passenger No.4**	70526	7200	1991	23/01/2017	119.878	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
61	**Passenger No.5**	70390	7498	1998	27/09/2017	102.972	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	Yes
62	**Passenger No.6**	70367	7200	1990	19/02/2016	129.098	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
63	**Passenger No.7**	70538	7180	1994	16/02/2018	130.072	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
64	**Passenger No.8**	110320	12870	2007	03/05/2014	108.182	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
65	**Passenger No.9**	110239	11100	2003	10/03/2017	107.934	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
66	**Passenger No.10**	133500	11000	2018	2018	117.375	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	Yes
67	**Passenger No.11**	70367	7180	1995	19/09/2016	127.122	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
68	**Passenger No.12**	70367	7180	1996	03/02/2016	118.286	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
69	**Passenger No.13**	85942	8983	2002	15/05/2018	124.546	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	---
70	**Passenger No.14**	110320	13294	2005	15/12/2016	91.251	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
71	**Passenger No.15**	128048	13800	2011	04/03/2016	121.840	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
72	**Passenger No.16**	85942	7089	2004	19/03/2015	166.402	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	---
73	**Passenger No.17**	70390	6894	1998	24/03/2018	124.171	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	Yes
74	**Passenger No.18**	85920	7200	2001	08/11/2014	184.278	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	---
75	**Passenger No.19**	70538	6870	1993	22/02/2017	120.697	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
76	**Passenger No.20**	85920	7200	2001	06/06/2018	154.455	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	Yes
77	**Passenger No.21**	113323	11843	2008	19/03/2016	117.504	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
78	**Passenger No.22**	103881	11142	1996	19/05/2016	108.382	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
79	**Passenger No.23**	101509	10984	1999	02/04/2016	---	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
80	**Passenger No.24**	110000	13294	2004	07/05/2016	94.992	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
81	**Passenger No.25**	101509	11774	2000	20/01/2018	100.043	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	---	---
82	**Passenger No.26**	133500	11000	2016	2016	126.232	---	Yes	---	---	Yes	Yes	Yes	Yes	---	---	Yes	Yes	Yes

Table 8- Analysis of trends: Energy efficient measures implemented onboard the vessels of Pilot Project 2, with reference to their technical characteristics / cost (ref. made to GloMEEP information on energy efficient measures)

	Hull Coating	Hull Air Lubrication	Waste Heat Recovery	Solar Electricity	Wind Power (kite)	Weather Routing	Autopilot	Trim/Draft Optimization	Speed management	EEOI as a tool
Range of Cost of implementation	$30,000 to $500,000	2-3% of newbuilding cost	$5,000,000 to $9,500,000	$420,000* to $450,000*	$280,000 to $3,420,000	$15,000	no cost (installed)	$15,000 to $75,000	$15,000 to $75,000	$0 requires only personnel effort
Reduction Potential (%)	1 to 4	3-5* to 7-10*	3 to 8	0.5* to 2*	1 to 5	0 to 5	0.25 to 1.5	0.5 to 3-5*	10 to 50	10 to 50
System technological maturity	mature	semi-mature	semi-mature	not mature	not mature	mature	mature	semi-mature	semi-mature	mature
Describe use: obligatory available tech cheap solution	**obligatory available tech ---**	--- available tech ---	--- available tech ---	--- available tech ---	--- available tech ---	**--- available tech cheap solution**	**--- available tech cheap solution**	**--- available tech cheap solution**	**--- available tech cheap solution**	**--- available tech cheap solution**
Utilized % on participating ships	100%	0%	59%	0%	0%	100%	100%	52.50%	100%	100%
Potential utilization through enabler	---	---	---	---	---	**yes**	**no**	**yes**	**yes**	**yes**
Comments on cost:	2.5 - 5yearly cost	*dep.on ship type/size	dep.on ship type/size	*dep.on installation	dep.on installation	annual maint. cost	maintenance cost	annual maint. cost	annual maint. cost	relies on acc. reports

c. Pilot Project 2 Outcomes:

1. Data collection techniques and processes identified and agreed with stakeholders

Sample forms were developed and distributed to the participating organizations, to facilitate the necessary data collection. In particular, the recommended IMO Sample format for Fuel Oil Consumption data was used, along with a form on General Particulars of the vessels, containing the information necessary for compliance with IMO DCS.

2. Collection of data for the pilot project conducted

Data collection covered the period 01/01/2018 - 31/12/2018, in order to simulate an entire reporting period in line with the IMO DCS requirements. 68 Ships participated. Flying the flags of 3 participating countries.
The reported data were received daily, weekly or in specific time periods (coinciding with voyage major event ie departure / arrival / anchor)

3. Data analysis and reporting finalized

The data analysis was conducted in ways to simulate:

a. the verification process
b. the flag data aggregation for reporting to IMO
c. the utilization of data for enhanced decision making on all levels

4. Training session about the results of this pilot project during the second regional workshop conducted

Training session to communicate the results of this pilot project during the second regional workshop could not be delivered due to the cancellation of the event taking into account the political condition in Chile.

However, the training material has been developed, disseminated through the MTCC channels.

5. Participation of MTCC-Latin America representatives in four dissemination activities to communicate the results, lessons and experiences learned during this pilot project finalized.

Dissemination material was drafted and dissemination activities of project results were ongoing, throughout the project's implementation to maximize interest and engagement of stakeholders.

This was achieved through continuous development and updating of the training material (Appendix 2 of this study) and other dissemination materials (Appendix 3 of this study), to reflect the outcomes, experience gained and lessons learned through the project implementation up to the specific point, and their effective dissemination through the project's dedicated website, social media as well as through interpersonal interactions and capacity building activities.

Workshops carried out for collecting information for this pilot project were:

1. MTCC Latin America: First Regional Workshop (13th-15th March 2018, Panama City - Panama)
2. MTCC Latin America: First National Workshop (13th-15th June 2018, Panama City - Panama)
3. MTCC Latin America: Second National Workshop (22nd-24th August 2018, Cartagena - Colombia)
4. MTCC Latin America: Third National Workshop (14th-16th November 2018, Lima - Peru)
5. MTCC Latin America: Fourth National Workshop (13th-15th March 2019, Mexico City – Mexico)

d. Dissemination of Project results

The study aimed at gaining experience and learn lessons in the process of collecting and analyzing data regarding ships fuel oil consumption, the analysis of such data and reporting to relevant stakeholders in the region, thus providing them with useful methodologies and processes when implementing provisions on data collection system for fuel oil consumption of ships included in MARPOL Annex VI. The lessons learned during this pilot project form the backbone of the recommendations for regulatory implementation by all parties involved in the IMO DCS regulatory process (ship managers, flag administrations and independent verifiers delegated to act on their behalf) as well as decision-makers and policy-makers on national level (national authorities) and international level (IMO) and were disseminated accordingly.

Furthermore, this pilot project compares results, lessons learned and recommendations, and incorporated them into the dissemination material and dissemination activities, organized by the MTCC-Latin America in the region for dissemination purposes.

Based on the collected and analyzed data, MTCC Latin America prepared relevant dissemination material including a summary of the project, training material on the project and its results, brochures and one article on achievements of Pilot Project 2, which were disseminated through the regional/national workshops and online

(website, newsletter, communications via emails etc.) and even through personal meetings/interactions with participants, to return an output of the results.

Full details and evidence on dissemination activities and the final training material, are included in Appendix 3 – Other dissemination material and Appendix 2 – Training Material, respectively.

More specifically, MTCC Latin America organized and participated in more than four (4) dissemination activities to communicate the results, lessons and experiences learned from Pilot Project 2.

Primarily, through the four (4) National Workshops and one (1) Regional Workshop, through which MTCC Latin America had the chance to interact and engage the key stakeholders of the organizing country, thus effectively communicating the results, lessons and experiences learned from Pilot Project 2.

Secondly, through dissemination of results through other means: website, newsletter, communications via emails etc.

Lastly, through personal meetings/interactions with participants, to return an output of the results

Dissemination activities (including dissemination of the final project report) will continue to be carried out after the project's completion as well, mainly through the MTCC Latin America's website and social media channels, to maximize the project's impact.

It is of importance to mention that on the 14th of January 2020, the developed training course for Combined IMO DCS and EU MRV Regulations was delivered as a webinar to key personnel of the Honduras Flag Administration, in an attempt to support the implementation of the IMO DCS regulation.

5. Conclusions

(1) Standardization is key for data optimum exploitation, and availability of the primary reported data to all interested parties is key for increased transparency and enhanced decision making.

(2) The primary data collected are valuable, however lost in the process, as only aggregated data reach the flag administrations and decision makers of IMO. These data are necessary for more advanced analysis and more effective and targeted decision making.

(3) The reported data accuracy was assessed through their comparison against estimated/calculated data through use of other independent data sources and empirical estimations, for final acceptance of reported values on a per voyage basis. The personnel simulating the verification was comparing the reported data to the estimated data (based on AIS historic data for each voyage) and if found within acceptable limits, same were accepted as reported, without need to keep other records.
Port calls accuracy was found without important deviations and distance / hours underway estimated using AIS data were found within acceptable tolerances (+/- 5%).

(3) Current capabilities and current practices onboard ships (ie AIS equipment, noon reporting systems) can be utilized to ensure effective and fast enforcement, through optimizing and automating as far as practicable the overall process.

(4) Noting that IMO DCS requires actual fuel consumption measurement and analysis based on these data, during the simulation of verification activity it was evident that distance sailed, hours underway and in anchor/port calculations can be very accurate with AIS data monitoring, and perhaps this (or LRIT data received 4 times a day) can be utilized to automate and facilitate the verification process from the flag administration. In addition, fuel consumption models can be developed based on ship type, DWT, age, M/E & A/E power and other fuel consumers details, utilizing speed details, for providing a tool for rough assessment of the reported values. This specific conclusion is included herein to provide an insight on possible automation/optimization of the verification process.

(5) Although the Flag Administrations may use other elements to verify the reported data (cf 2017 Guidelines), experience indicates that details on port calls and time spent at anchor and at berth per voyage, will be required for the verification process (regardless of the use of daily reporting or reporting per any specific time interval (monthly, per voyage etc)). The reason is that these data (whether provided by the company through noon, departure and arrival reports or through AIS and port calls

data from other sources) are necessary for assessing and establishing the correctness and accuracy of reported data on distance sailed, hours underway and anticipated fuel consumption. Even with the use of the IMO standardized forms, which do not require the port calls, anchorage and berth stay details, it will be impossible to verify the data without details on the port calls coming from either the ship reporting or other sources (ie AIS).

(6) Other Key Insights:

(1) According to the EU MRV regulation 2018 results analysis (reflected in detail in Appendix 1), the Panama flag ships account for the 11.18% of the ships that have reported **in 2018 in line with the EU MRV Regulation**

(2) According to Paris MOU data, for the period between 01/01/2019 – 20/11/2019, 1310 ships of over 5000GT flying the Panama flag have been inspected in European Ports.

(3) Based on the 2018 results and taking into account this fact as well, it is anticipated that approximately 30% of the Panama flag fleet above 5000 GT, will have to report for both regulations (EU MRV & IMO DCS) in 2019.

Based on the above, it is evident that ship operators need to seek ways for enhanced combined regulatory compliance, minimizing the administrative burden onboard and ashore at the extend possible.

(4) Slow adoption of new technologies is evident. Companies tend to make use of energy efficient measures that require low cost, are easy to implement and maintain, which do not cause major changes in vessel's schedule for installation. Primarily software, and also hull coating (AFS, which they either way do in common practice).

a. Lessons Learned:

(1) The implementation of the regulatory requirements for IMO DCS, comprises of many actors, that need to effectively cooperate for efficient regulatory implementation.

(2) The need for capacity building (training activities) for enhanced regulatory compliance with both EU MRV & IMO DCS regulations is evident.
Ship owners / operators are anticipating to receive relevant support by the Flag Administrations.
MTCC Latin America, with the experience gained through Pilot Project 2, can support all parties involved in the regulatory process (Ship owners / operators, ROs, Flag Administrations) in the Latin America region.

(3) The real value for enhanced decision-making lies within the disaggregated and supporting data, which are submitted for the verification process. Those data (which will include reference on port calls and time at berth/anchorage either from ship reporting or other sources), do not pass from that stage of the process to the next in the cases that the verification duties have been delegated to independent verifiers. In such cases, for example PMA, the flag administration only receives a recommendation

from the verifier to issue a Statement of Compliance, based on the verified data. Therefore, the chance for utilization of regulatory benefits in full is wasted, although the effort necessary and the data (disaggregated and supporting) are there, during the verification process. Data availability at all stages of the regulatory process, would for sure increase transparency and assist in effective decision-making based on more comprehensive data sets.

(4) Automation and optimization of the regulatory compliance process, may offer great value to all parties involved. It is basically the same principal as with recent IMO data standardization: If data are available in one place, then they can be manipulated and extracted in a standardized format. Furthermore, the tool that is containing and analyzing these data, can provide secure access to all interested parties, at various levels of authorization to view and make use of data, increasing transparency.

(5) An interesting finding, is that by effectively using existing technology (IT ashore and whatever technology implemented onboard), the overall process could be enhanced and facilitated in a far more effective way. At the same time, the same infrastructure and data sets can be utilized for ship performance optimization activities by the ship operators.

(6) Slow steaming and just-in-time arrival benefits in fuel savings, can be neutralized if not sufficient transparency exists between ship-shore.

(7) Slow adoption of new technologies is evident. Companies tend to make use of energy efficient measures that require low cost, are easy to implement and maintain, which do not cause major changes in vessel's schedule for installation. Primarily software, and also hull coating (AFS, which they either way do in common practice). However, by incentivizing, enabling them through technology enablers and also through raising awareness, this can change.

b. Recommendations

(1) The results of Pilot Project 2, reveal that existing technologies and reporting systems implemented onboard, if utilized correctly, may offer immediate positive impact.

The shipping sector's contribution towards tackling climate change, can only be facilitated and enhanced through a combination of the below:
-enhanced regulatory compliance
-ship performance optimization

Regulatory compliance may be the key for ship performance optimization, if effectively implemented and results exploited.

With the exact same data sets utilized for regulatory compliance (and the exact same effort and burden by companies and crew), and the utilization of existing technology onboard (AIS), it is possible to automate and optimize the regulatory process.
Adding in the equation a common digital platform (acting as a technology enabler), it is possible to serve all regulatory requirements and all involved parties´ needs.
Data are valuable, but useless unless properly interpreted for providing actionable insights.

(2) Pilot Project 2 goes beyond simple data collection: we tried to get a glimpse on how the regulations could better be implemented, for all parties involved. How to take the most, out of what currently exists.

To have a meaningful impact, it is not sufficient to move ahead with some of the ships, with standard technology levels and sufficient resources. We need to address shipping as a whole, and offer the means (as incentives) to all companies/ships, to make the most out of their data. This will change the mentality of addressing regulatory compliance as unnecessary paperwork and workload.

(3) General views and recommendations for MTCC Latin America:

It is highly recommended that MTCC Latin America continues its research activities on fuel consumption and GHG emissions from ships, since the experience, knowhow and data collected enable to expand the scope of research and analysis.

Proposed activities include:

-Training activities, for raising the environmental and technical awareness in the region
-Research and development activities, including:
-Ships fuel consumption and GHG emissions for automating the data collection process as far as practicable.
-Ports / regional monitoring of ship traffic and emissions

Especially under a capacity of a Research Institution, the MTCC Latin America is possible to:

(i) Support effectively the region’s activities, thus maintaining its dominating position, exploiting its relations and partnerships and raising its status.
(ii) Gain access (through International & EU strategic co-operations) to funding programmes, thus creating revenue for supporting its activities and ensuring its self-sustainability.

Other Proposed future activities:

MTCC Latin America may explore the possibility of utilizing a digital maritime platform, with capabilities to combine, automate as much as possible and optimize the overall regulatory compliance process (EU MRV, IMO DCS and Ship Energy Efficiency Management) for all parties involved (Ship owners / operators, Independent Verifiers, Flag Administrations).

Such a maritime digital platform could serve as a technology enabler by:

(a) Increasing the support to the ship owners / operators for simultaneous regulatory compliance thus reducing the administrative burden and costs.
(b) Providing the means to the ship owners / operators to utilize the data reported for regulatory compliance for optimizing their ships performance, thus saving fuel.
(c) Offering an incentive to ship owners / operators, as they can gain access to a tool that can unlock the benefits of digitalization for them, and thus cut fuel costs (and at the time reduce their ships fuel consumption and CO2 emissions)

The above mentioned maritime digital maritime platform may provide MTCC Latin America with the potential to:

1. Become involved in Research activities (on its own and/or in cooperation with other partners) on fuel consumption and GHG emissions for ships and in ports/regions, thus generating revenue for its self-sustainability and continuously increase its capabilities. Achieving a research institution status, unlocks potentials for engagement in significant projects, possible to be funded by the EU funding programmes.

2. Offer services to the Latin America countries Flag Administrations and/or ports on regulatory compliance issues, thus generating revenue, ensuring its self-sustainability.

Appendix 1 – ANALYSIS OF RESULTS OF FIRST REPORTING PERIOD (2018) OF EU MRV REGULATION - EXPERIENCE GAINED AND LESSONS LEARNED

APPENDIX 1 - ANALYSIS OF RESULTS OF FIRST REPORTING PERIOD (2018) OF EU MRV REGULATION - EXPERIENCE GAINED AND LESSONS LEARNED

A. EU MRV Regulation – Analysis of the first reporting period results (2018)

To offer valuable insights on the actual effect of international regulations on Fuel Oil Consumption and CO2 Emissions (EU MRV), an effort was made to take advantage of the results reported, experience gained and lessons learned from the first year of implementation of the EU MRV regulation.
For this purpose, the publicly available data at EMSA Thetis MRV Portal have been analysed, and the analysis results are reflected in the below tables.

Table A.1 – Ships that reported in 2018 in line with the EU MRV Regulation (by ship type)

Ship Type	No. of ships that reported as per EU MRV (2018)
Bulk Carriers	3,640
Container Ships	1,726
Oil Tankers	1,721
Chemical Tankers	1,302
General Cargo Ships	1,027
Vehicle Carriers	439
RoPax Ships	339
Gas Carriers	300
RoRo Ships	255
LNG Carriers	196
Passenger Ships	150
Other Ships	112
Refrigerated Cargo Carriers	145
Container – RoRo Cargo Ship	70
Combination Carriers	7
Total Fleet	**11,429**

Figure A.1-Ships that reported in 2018 in line with the EU MRV Regulation (by ship type)

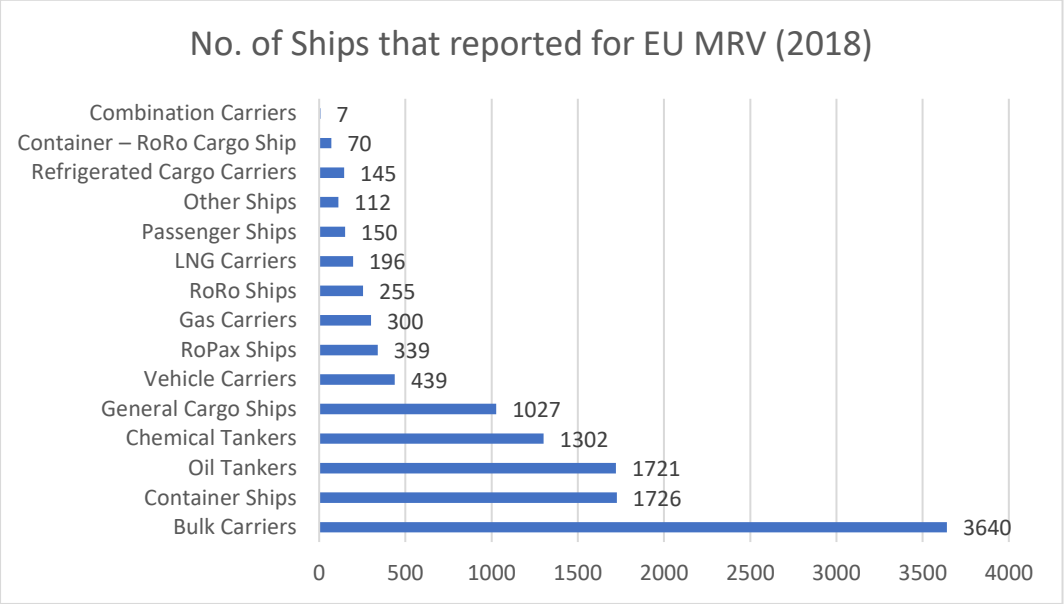


Table A.2 – Summary of Methods Used for fuel consumption monitoring on ships that reported in 2018 in line with the EU MRV Regulation

Fuel Oil Consumption Monitoring Method Used onboard	**No. of Ships that utilized the Method (alone and/or in combination with other Methods)**
Method A	4,788
Method B	3,632
Method C	3,664
Method D	0
Combination of Fuel Oil Consumption Monitoring Methods Used onboard	**No. of Ships that utilized the specific Combination of Methods**
Combination Methods A & B	399
Combination Methods A & C	173
Combination Methods B & C	1,036
Combination Methods A & B & C	118

In the above table, the Methods mentioned correspond to the EU MRV regulation Methods, as below:
Method A: BDN and periodic stocktakes of fuel tanks
Method B: Bunker fuel tank monitoring on board
Method C: Flow meters for applicable combustion processes
Method D: Direct CO2 emissions measurements

Table A.3 – Ships total fuel consumption and CO2 emissions as reported in line with the EU MRV Regulation (2018)

No. of Ships	Total Fuel Cons. (metric tonnes)	Total CO2 emissions (metric tonnes)
11,429	**43,687,641.60***	**139,443,871.02***

*The above values reflect only the total fuel consumption and CO2 emissions of ships of over 5000GT regardless of flag, and only covering voyages that:
-departure was from EU Port
-arrival was to EU Port
-voyage was between EU ports
for commercial purposes (loading/unloading cargo and / or passengers)

Figure A.2-Annual fuel consumption reported in 2018 in line with the EU MRV Regulation (by ship type)

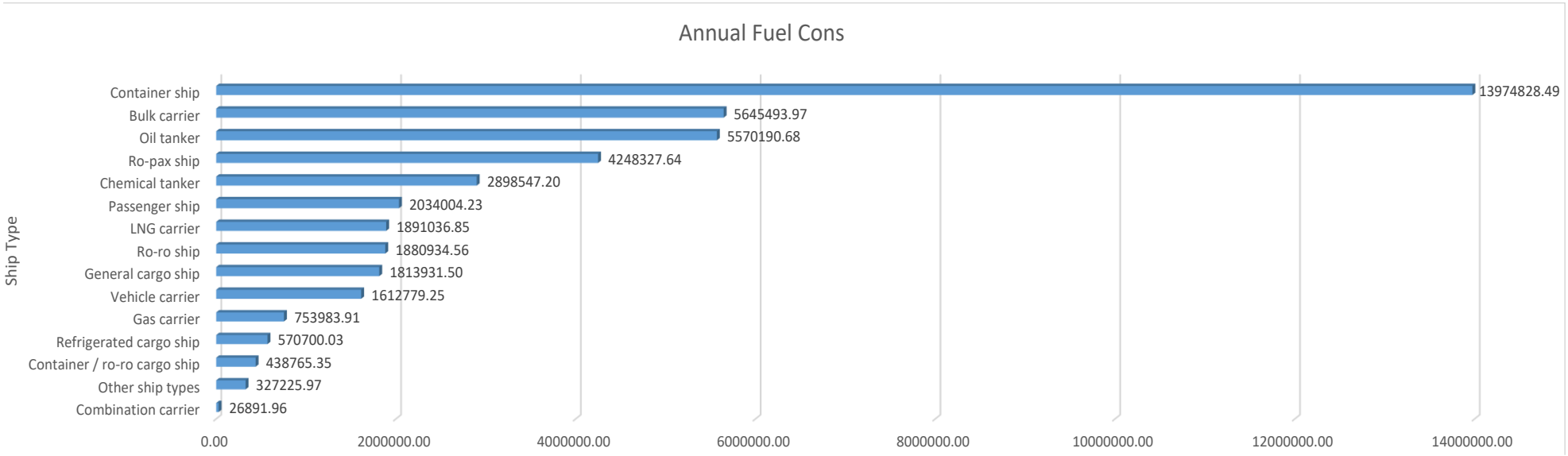
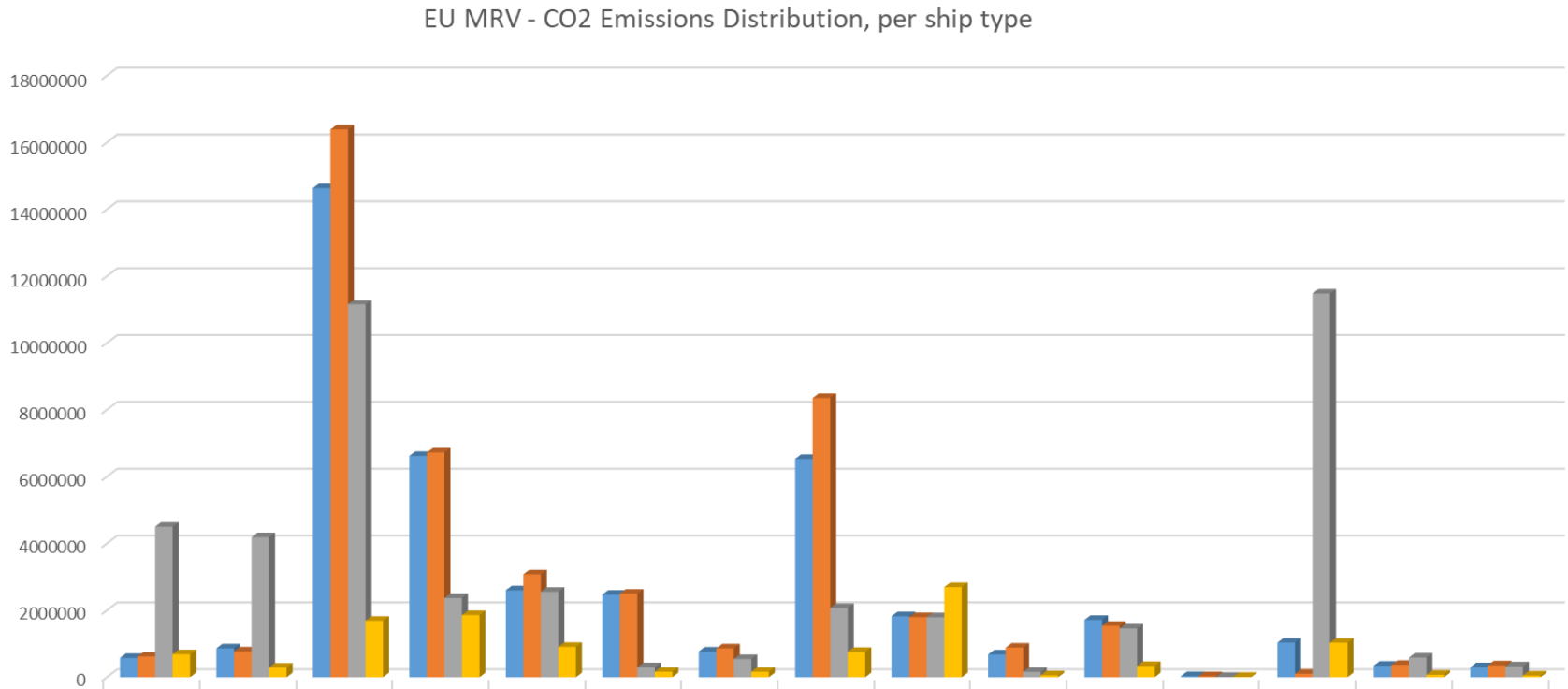


Figure A.3-Table A.4-Summary of ships total CO2 emissions distribution as reported in line with the EU MRV Regulation (2018)-per ship type



	Passenger ship	Ro-ro ship	Container ship	Oil tanker	Chemical tanker	LNG carrier	Gas carrier	Bulk carrier	General cargo ship	Refrigerated cargo ship	Vehicle carrier	Combination carrier	Ro-pax ship	Container / ro-ro cargo ship	Other ship types
CO2 from EU ports	577416.14	863099.08	14634322.78	6623795.39	2600573.15	2471642.63	769433.13	6533714.98	1826404.84	680497.83	1717567.93	32638.19	1036574.75	343403.87	298032.71
CO2 to EU ports	623578.71	774164.41	16389925.47	6723671.39	3077385.12	2498922.67	862803.07	8355066.85	1798592.46	885759.14	1540299.89	31193.06	101284.00	369549.76	354171.92
CO2 between EU ports	4504110.26	4190355.14	11159214.92	2367817.05	2557635.01	297232.27	544333.21	2072037.04	1795758.58	159994.94	1458766.44	9939.68	11480974.87	587584.13	324028.05
CO2 EU ports at berth	686167.39	288024.68	1689898.33	1858688.69	908010	162151.95	163012.61	759050.41	2697399.23	55935.37	336227.53	10317.08	1033612.65	73041.5	48560.87

B. EU MRV Regulation – Analysis of its impact on Panama flagged ships

To offer valuable insights on the actual effect of international regulations on Fuel Oil Consumption (IMO DCS) and CO2 Emissions (EU MRV) to the Latin American region vessels, an effort was made to take advantage of the results reported, experience gained, and lessons learned from the first year of implementation of the EU MRV regulation.

For this purpose, the publicly available data at EMSA Thetis MRV Portal have been analyzed, and the analysis results are reflected in the below tables.

Taken into account along with the data of Pilot Project 2, they can provide enhanced insights on the impact of regulatory implementation for the ships flying the flag of Panama.

Table B.1 – Panama flag vessels that reported in 2018 in line with the EU MRV Regulation (by ship type)

Ship Type	No. of ships that reported as per EU MRV (2018)
Bulk Carriers	634
Container Ships	201
Vehicle Carriers	124
Chemical Tankers	97
Oil Tankers	78
General Cargo Ships	60
Gas Carriers	28
RoRo Ships	20
Passenger Ships	14
Other Ships	13
Refrigerated Cargo Carriers	7
LNG Carriers	2
Total Fleet	**1,278**

Figure B.1-Panama flag vessels that reported in 2018 in line with the EU MRV Regulation (by ship type)

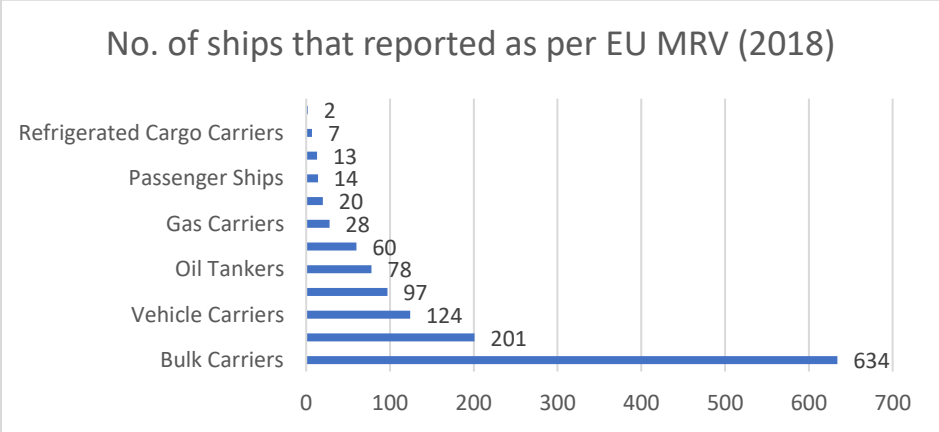


Table B.2 – Summary of Methods Used for fuel consumption monitoring on Panama flag ships that reported in 2018 in line with the EU MRV Regulation

Fuel Oil Consumption Monitoring Method Used onboard	**No. of Ships that utilized the Method (alone and/or in combination with other Methods)**
Method A	549
Method B	310
Method C	656
Method D	0
Combination of Fuel Oil Consumption Monitoring Methods Used onboard	**No. of Ships that utilized the specific Combination of Methods**
Combination Methods A & B	19
Combination Methods A & C	44
Combination Methods B & C	96
Combination Methods A & B & C	58

In the above table, the Methods mentioned correspond to the EU MRV regulation Methods, as below:
Method A: BDN and periodic stocktakes of fuel tanks
Method B: Bunker fuel tank monitoring on board
Method C: Flow meters for applicable combustion processes
Method D: Direct CO2 emissions measurements

Table B.3 – Panama flag ships total fuel consumption and CO2 emissions as reported in line with the EU MRV Regulation (2018)

No. of Ships	Total Fuel Cons. (MT)	Total CO2 emissions (MT)
1,278	**4,275,859.37***	**13,391,167.75***

*The above values reflect only the total fuel consumption and CO2 emissions of Panama flag ships of over 5000GT, and only covering voyages that:
-departure was from EU Port
-arrival was to EU Port
-voyage was between EU ports for commercial purposes (loading/unloading cargo and / or passengers)

C. CONCLUSIONS

Key Insights:

(4) According to the above analysis of EU MRV regulation 2018 results, the Panama flag ships account for the 11.18% of the ships that have reported **in 2018 in line with the EU MRV Regulation**

(5) According to Paris MOU data, for the period between 01/01/2019 – 20/11/2019, 1310 ships of over 5000GT flying the Panama flag have been inspected in European Ports.

(6) Based on the 2018 results and taking into account this fact as well, it is anticipated that approximately 30% of the Panama flag fleet, will have to report for both regulations (EU MRV & IMO DCS) in 2019.

D. LESSONS LEARNED

The need for capacity building (training activities) for enhanced regulatory compliance with both EU MRV & IMO DCS regulations is evident. MTCC Latin America, with the experience gained through Pilot Project 2, can support all parties involved in the regulatory process (Ship owners / operators, ROs, Flag Administrations) in the Latin America region.

Actions taken by MTCC Latin America:

With the assistance of Syndeseas Integrated Solutions Ltd (experts on EU MRV regulation monitoring, reporting and verification), a model training course on effective combined regulatory compliance with both IMO DCS & EU MRV regulations has been developed.

This training course incorporates the regulatory requirements as well as the experiences gained and lessons learned through the first year of EU MRV regulation implementation (2018).

The model training course will be utilized by MTCC Latin America, for Training activities ie capacity building as well as in support of the ship owners / operators of the Latin American region countries.

E. RECOMMENDATIONS

Proposed future activity:

MTCC Latin America may explore the possibility of utilizing a digital maritime platform, with capabilities to combine, automate as much as possible and optimize the overall regulatory compliance process (EU MRV, IMO DCS and Ship Energy Efficiency Management) for all parties involved (Ship owners / operators, Independent Verifiers, Flag Administrations).

Such a maritime digital platform could serve as a technology enabler by:

(d) Increasing the support to the ship owners / operators for simultaneous regulatory compliance thus reducing the administrative burden and costs.

(e) Providing the means to the ship owners / operators to utilize the data reported for regulatory compliance for optimizing their ships performance, thus saving fuel.

(f) Offering an incentive to ship owners / operators, as they can gain access to a tool that can unlock the benefits of digitalization for them, and thus cut fuel costs (and at the time reduce their ships fuel consumption and CO2 emissions)

The above mentioned maritime digital maritime platform may provide MTCC Latin America with the potential to:

3. Become involved in Research activities (on its own and/or in cooperation with other partners) on fuel consumption and GHG emissions for ships and in ports/regions, thus generating revenue for its self-sustainability and continuously increase its capabilities. Achieving a research institution status, unlocks potentials for engagement in significant projects, possible to be funded by the EU funding programmes.

4. Offer services to the Latin America countries Flag Administrations and/or ports on regulatory compliance issues, thus generating revenue, ensuring its self-sustainability.

Appendix 2 - Training Material

(i) Training Material for Pilot Project 2
(ii) Combined EU MRV & IMO DCS Regulatory Compliance Training Course
See documents attached to this report

Appendix 3 - Other dissemination Material

See document attached to this report