BACHELOR THESIS & COLLOQUIUM – ME 184841

DEVELOPMENT OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) MEASUREMENT TOOL IN RESPONSE TO SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) REGULATION

ADHE TRIA PRAMANA
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DOUBLE DEGREE PROGRAM
DEPARTMENT OF MARINE ENGINEERING
FACULTY OF MARINE TECHNOLOGY
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2020

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TUGAS AKHIR – ME 184841

PENGEMBANGAN ALAT PENGUKURAN ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) DALAM MENANGGAPI PERATURAN DARI SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

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2020

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APPROVAL FORM

DEVELOPMENT OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) MEASUREMENT TOOL IN RESPONSE TO SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) REGULATION

BACHELOR THESIS

Submitted to Comply One of The Requirement to Obtain a Bachelor Engineering Degree

On

Digital Marine Operation and Maintenance (DMOM)

Bachelor Program Department of Marine Engineering

Faculty of Marine Technology

Institut Teknologi Sepuluh Nopember

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Department	:	Marine Engineering

If there is a plagiarism act in the future, I will fully responsible and receive the penalty given by ITS according to the regulation applied.

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DEVELOPMENT OF ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) MEASUREMENT TOOL IN RESPONSE TO SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP) REGULATION

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ABSTRACT

The proportion of air pollutants and greenhouse gasses emitted from the ships are getting higher, demands of energy efficiency, and reducing emission in the shipping sector are becoming popular due to those factors. As a result, The International Maritime Organization (IMO) regulated the limitation of emission is getting tighter. Energy Efficiency Operational Indicator (EEOI) is a representative value of the energy efficiency of the ship operation related to the CO_2 emission. Improving energy efficiency is one of the critical ways of achieving cleaner shipping. The statistical approach used to predict some of the parameters determining the EEOI value. The expected result in this thesis is that the EEOI measurement tool is generated and can be used for finding the EEOI value. The analysis is done with 100 container ships around the world. The maximum fuel oil consumption is 2467.9 Tons of fuel, and it has 0.0001074 Ton CO2/TEU nm EEOI value. The highest EEOI value of a ship is 0.0005485 Ton CO2/TEU nm and consumed 102.03 Tons of fuel oil. The maximum average speed is 20.21 knots, and the EEOI value is 0.0000919 Ton CO2/TEU nm. The highest EEOI value of a ship sailed with an average speed of 12.46 knots. The maximum container capacity is 20,568 TEU capacity. The EEOI value is different each trip, from Ningbo Zhoushan to Yangshan generate 0.0000045 Ton CO2/TEU nm of EEOI, from Tianjin to Busan generate 0.0000340 Ton CO2/TEU nm of EEOI, from Busan to Ningbo Zhoushan generate 0.0000384 Ton CO2/TEU nm of EEOI, from Yangshan to Yantian generate 0.0000717 Ton CO2/TEU nm of EEOI, and from Yantian to Tanjung Pelepas generate 0.0000919 Ton CO2/TEU nm of EEOI. The highest EEOI value of a ship carried 1005 TEU containers. The longest distance sailed is 10,290.87 nm of distance, and the EEOI value is 0.0000994 Ton CO2/TEU nm. The highest EEOI value of a ship is sailed with 593.41 nm of distance. Improvement of cargo management and the sailing speed could be made based on the resulted EEOI value, and it shows that the cargo is significantly affected the EEOI value. In terms of ship operational conditions, ship operators of the ships should monitor and evaluate which operational mode suits the best against the sea condition at that specific time.

Keywords: (Air Pollutant, Limitation, Shipping, Energy, Efficiency, Emission, EEOI, Measurement Tool)

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PENGEMBANGAN ALAT PENGUKURAN ENERGY EFFICIENCY OPERATIONAL INDICATOR (EEOI) DALAM MENANGGAPI PERATURAN DARI SHIP ENERGY EFFICIENCY MANAGEMENT PLAN (SEEMP)

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ABSTRAK

Tingkat proporsi dari pencemaran udara dan gas rumah kaca yang dihasilkan dari kapal semakin tinggi, tuntutan efisiensi energi, dan pengurangan emisi di sektor perkapalan menjadi popular karena faktor-faktor tersebut. Alhasil, *International Maritime Organization (IMO)* memperketat pembatasan emisi. *Energy Efficiency Operational Indicator (EEOI)* adalah salah satu yang mewakili dari efisiensi energi dari operasi kapal yang terkait dengan emisi CO2. Meningkatkan efisiensi energi adalah salah satu cara penting untuk mencapai pelayaran yang lebih bebas polusi. Pendekatan statistik digunakan untuk memprediksi beberapa parameter yang menentukan nilai *EEOI*. Hasil yang diharapkan dalam skripsi ini adalah menghasilkan alat ukur EEOI yang dapat digunakan untuk menemukan nilai *EEOI*. Analisa telah dilakukan pada 100 kapal container yang tersebar di seluruh dunia. Konsumsi bahan bakar maksimum adalah 2467,9 Ton, dan memiliki 0,0001074 Ton CO2 / TEU nm nilai EEOI. Nilai EEOI tertinggi dari sebuah kapal adalah 0,0005485 Ton CO2 / TEU nm dan mengkonsumsi 102,03 Ton bahan bakar minyak. Kecepatan rata-rata maksimum adalah 20,21 knot, dan nilai *EEOI* adalah 0,0000919 Ton CO2 / TEU nm. Nilai *EEOI* tertinggi dari sebuah kapal berlayar dengan kecepatan rata-rata 12,46 knot. Kapasitas kontainer maksimum adalah 20.568 TEU. Nilai *EEOI* berbeda setiap perjalanan, dari Ningbo Zhoushan ke Yangshan menghasilkan 0,0000045 Ton CO2 / TEU nm dari *EEOI*, dari Tianjin ke Busan menghasilkan 0,0000340 Ton CO2 / TEU nm dari *EEOI*, dari Busan ke Ningbo Zhoushan menghasilkan 0,0000384 Ton CO2 / TEU nm dari *EEOI*, dari Yangshan ke Yantian menghasilkan 0,0000717 Ton CO2 / TEU nm dari EEOI, dan dari Yantian ke Tanjung Pelepas menghasilkan 0,0000919 Ton CO2 / TEU nm dari *EEOI*. Nilai *EEOI* tertinggi dari sebuah kapal membawa 1005 TEU kontainer. Jarak terjauh yang ditempuh adalah jarak 10.290,87 nm, dan nilai *EEOI* adalah 0,0000994 Ton CO2 / TEU nm. Nilai *EEOI* tertinggi dari sebuah kapal berlayar dengan jarak 593,41 nm. Peningkatan manajemen kargo dan kecepatan berlayar dapat dilakukan berdasarkan nilai *EEOI* yang dihasilkan, dan ini menunjukkan bahwa kargo secara signifikan mempengaruhi nilai *EEOI*. Dalam hal kondisi operasional kapal, operator kapal harus memantau dan mengevaluasi mode operasional mana yang paling sesuai dengan kondisi laut pada waktu tertentu.

Kata Kunci: (Pencemaran Udara, Pembatasan, Perkapalan, Energi, Efisiensi, Emisi, *EEOI*, Alat Ukur)

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PREFACE

All praise to the Almighty God, for all his blessings, the author can start, work, finish this bachelor thesis.

For the author, this bachelor thesis represents an attempt to contribute to efforts in reducing greenhouse gasses emission. Nowadays, global warming and climate change have become a major issue that we face together. The planet sustainability is our responsibility for the next generation to come, and this thesis is the author's small effort for our better future living and future generation.

This thesis could not be completed without helps from others. The author would like to acknowledge people who helped and contributed in the process of this bachelor thesis completion, among others:

1. The author's beloved parents, for all their unconditional love, prayers, and supports.
2. Ir. Hari Prastowo, M.Sc., and Dr. Eng. Trika Pitana, S.T., M.Sc. as supervisors that have spent the time giving guidance and direction in this thesis completion.
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9. All Marine Engineering Students batch 2016 (Voyage 2016) for all their supports and advice.

The author hopes that the writing of the Final Project Proposal can be useful and provide information to the reader. Because of the limitations of the author, constructive criticisms and suggestions are indispensable for perfection in this report.

Malang, July 2020

Adhe Tria Pramana

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CHAPTER 1

INTRODUCTION

1.1 Background

Contribution of the shipping sector to the greenhouse gases are increasing from 2.4% to 3%, and those are IMO estimation from 2007 to 2050. In the following graphic, it was showing the predictions on the greenhouse effect gases emitted from the maritime sector represent from the 1.6% to 4.1% of the world CO2 emissions coming from bunker burning (Sin & Oses, 2014).

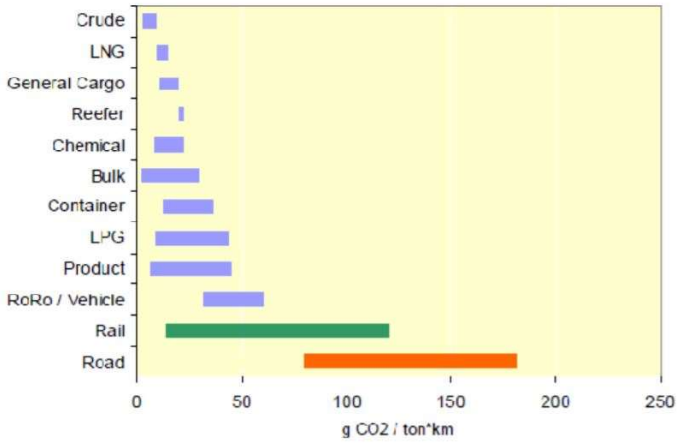

Figure 1.1 Range of Typical CO2 Efficiencies for Various Cargo Carriers in gram CO2 per ton kilometer

Source : (Sin & Oses, 2014).

The maritime sector in 2005 contributed 10% of the greenhouse gas emissions of the overall transport sector, which were headed by road transport with 73% of total CO_2 contribution (Sin & Oses, 2014).

To reduce the greenhouse gas emission that came from the shipping sector, the Marine Environment Protection Committee (MEPC) from the International Maritime Organization (IMO) proposed a control framework. One of them is the Energy Efficiency Operational Indicator (EEOI).

EEOI is a branch from the Ship Energy Efficiency Management Plan (SEEMP). It is a tool to achieve cleaner shipping in terms of operational managing. Other tools could be used for calculating the energy efficiency, but IMO suggest the EEOI. EEOI is based on the emission of CO_2 that measured the ship's energy efficiency. The parameters of EEOI are the amount of cargo of the ships, fuel consumption, distance, and the carbon factor of the fuel. EEOI could change after the ship finishes each voyage due to outside factors, such as weather, sea-going area, environment condition, and others.

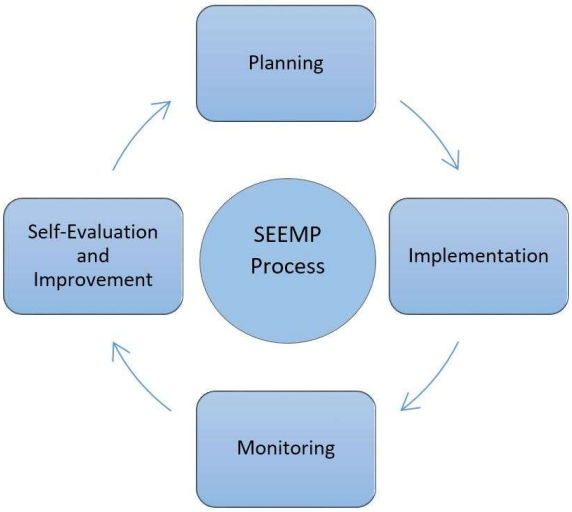

Figure 1.2 Ship Energy Efficiency Management Plan (SEEMP) Process
Source: (Tien, 2016).

SEEMP processes are in 4 phases, the planning, implementation, monitoring, self-evaluation, and improvement. The processes are addressed and described together. Each process was taken from the SEEMP guidelines (MEPC). The main aim of SEEMP is to establish a mechanism for a shipping company and/or a ship to improve the energy efficiency of a ship's operation (Tien, 2016).

Cargo and distance are the parameters stated in the IMO guidelines for EEOI calculation. Each voyage, cargo, and distance are changing depending on the contract of the cargo owners and the weather or environment condition. That could be led to the different values of EEOI in each voyage.

Nowadays, the operating condition to achieve the low value of EEOI by cargo management is the trim optimization. This method will affect not only the ship resistance but also fuel oil consumption. Trim optimization is a relatively new concept recommended by the International Maritime Organization, which requires no ship structural modification and can be attained simply by ballast water management and load distribution (Islam & Soares, 2019).

Improving energy efficiency is a path to cleaner shipping, which means that energy efficiency is reducing emissions while also reducing energy consumption.

1.2 Problem Analysis

Based on the background above, problems that possible to discuss further are:

1. What are the relations between the ship's cargo, ship’s voyage distance, ship's speed, power, and fuel oil consumption?

2. What are the steps to calculate EEOI?
3. How is the ship's cargo, ship's voyage distance, ship's speed, power, and fuel oil consumption affecting the EEOI value?
4. How to generate the EEOI measurement tool?

1.3 Objectives

Purposes aimed from this research are:

1. To know the relation of the cargo amount, resistance, power of the ship, and the fuel oil consumption.
2. To make the steps for calculation of the EEOI.
3. To analyze the effect of the cargo amount ship's speed, power, and fuel oil consumption to the EEOI value.
4. To propose the EEOI measurement tool.

1.4 Scopes and Limitations

Scopes and limitations in this bachelor thesis are:

1. Some of the parameters are predicted using the statistical approach.
2. EEOI, as a monitoring tool within the SEEMP framework, is based on CO_2 produced by ship.
3. Data acquiring is done using the AIS database and only in merchant ships, mainly container ships.
4. All data is assumed to be correct.

1.5 Deliverable

This bachelor thesis proposed to determine the impact of the ship's cargo, ship's distance, power, and speed changes in the ship's operation to the EEOI value and then generating the EEOI measurement tool as a reference for determining the EEOI value.

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CHAPTER 2

LITERATURE REVIEW

2.1 Problem Overview

Shipping is the crucial path to develop and grow the economy of the nation. There are so many ships that are operating and carrying full cargoes all over the world, that kind of transports bringing incomes and other benefits for each country. To obtain the rate of environmental pollution and for further development of green shipping, the ship's operation is a big part of it. In fact that shipping is contributing the most environmentally friendly form with only 2.7% to the Greenhouse Gases (GHG) emission, and for the marine pollution, only emitted 12% of the total pollution (Tien, 2016).

It is IMO established the Marine Environmental Protection Committee (MEPC) in 1973 to manage marine pollution due to the shipping sector. Not only the MEPC, the International Convention for the Prevention of Pollution from the ship (MARPOL) also inaugurated in the same year for the same reason. The MARPOL convention addresses several marine pollution issues due to the shipping industry, i.e., marine pollution due to the oil spill, noxious liquid substances, and other harmful substances transporting, sewage, garbage, and ship air pollution.

In 1997, MARPOL Annex VI was introduced. The purpose is to prevent the air pollution that came from the shipping sector and gave limitation for the ship's exhaust gas emissions. Then in 2011, the new chapter of MARPOL Annex VI was established. The purpose is to prevent GHG emissions.

IMO has made several guidelines to reduce GHG emissions. These guidelines are the Energy Efficiency Design Index (EEDI), the Ship Energy Efficiency Management Plan (SEEMP), and the Energy Efficiency Operational Indicator (EEOI).

EEOI is a tool for determining the CO_2 gas emission to the environment per transport or voyage work. So it means that it could represent the actual voyage efficiency of ship operation. It also could be used to evaluate fleet management for better emissions control.

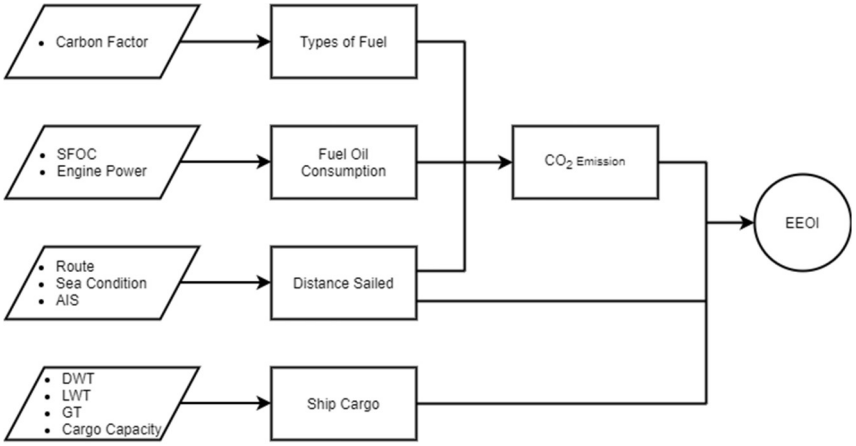


Figure 2.1 EEOI Conceptual Framework

Due to the high cost of clean fuel, Indonesia will not enforce the IMO regulation for emissions prevention on the domestic fleet. They were allowing Indonesian-flagged ships to continue burning fuels with a maximum 3.5% Sulphur content in its territorial waters past 2020 without having scrubbers until the domestic supply of low-Sulphur fuel improves. So by this, it means that fleet management has significant rules for the emissions control. In EEOI guidelines, the parameters are fuel consumption, carbon factor of the fuel, the distance of voyage, and amount of the cargo. Suppose the shipping company is still using the fuel that the high content of sulfur and carbon, the amount of cargo, and the distance of the voyage can be considered as the control of emissions. Those two parameters could be changed by the external factor, such as environmental conditions, the fleet contract, etc.

2.2 Ship's Cargo

Any kind of goods and materials that transports from one to another port by the ships are called ship cargo. Shipping is considered as the best transportation for transferring goods, materials, or any kind of business items due to the efficiency of the cost. If they compared with other kinds of transportation, it is stood as the best mode of transportation due to capacity and cost-efficiency.

There are several types of ship's cargo, the containerized cargo, liquid bulk, dry bulk, breakbulk, and the Ro-ro. These different types of cargo require their method of transport or packaging. By that, it is also mean the cargo are mounted to the different type of ships.

The containerized cargo is commonly used for electronics and everyday goods, such as clothing, computers, televisions, toys, etc. They can be transported in large quantities. The containers have standardized dimensions. The main handling equipment is a crane, but a specialized forklift could also handle it.

Liquid bulk is handled through the pipeline, and it could be using several types of pumps. A tanker ship is designed for carrying or storing this kind of goods. Fuel oil, vegetable oil, and crude oil are the example of the liquid bulk cargoes.

Sugar, sand, coal, iron ore, cement refers to the dry bulk cargoes. It is referred to as granular materials or particular forms as a mass of relatively small solids. They transported in large quantities and unpackaged, it is poured in the hold of the ships.

Paper, wood, spare parts, rolls of steel are the products specified as breakbulk cargoes. The break terms came from the breaking, which is why the cargoes are break easily. The cargoes could be packaged on a pallet, in crates, or racks. The handling equipment for these types of cargo is a crane or a forklift truck.

Roll-on / roll-off (Ro-ro) is suites for the kind of cargo that can be driven, such as cars, busses, trucks, etc. The trained drivers only make the cargo arrangements inside the ships.

Ship's cargo is changing every voyage due to the contract of the fleet/shipping company to the owner of the goods. By this change, it means that the draught of the ships is also changing, then it could be affecting the wetted surface of the ship that related to the ship's total resistance.

2.3 Ship's Speed

The speed of the ships is changeable. There were so many factors that could affect the speed changes, such as trim, draft, sea condition, hull surface, and the propeller condition, and those factors are related to the ship resistance. Those factors are affecting the ship's speed, and it is significantly increased by the terms of the ship's age.

The speed of the cargo ship significantly influences the earning potential of the ship, hence there is a tendency to increase it. While defining the speed requirements of the new ship, we must remember that the strength of the shaft is proportional to the speed cube and that a higher speed equals a higher cost.

In the old days, container ships were constructed to reach the speed of 30 knots, but the fuel crisis put this practice to an end. Nowadays, giant container ships sail with a speed of 25 knots, and further reductions are affected by the increase of the fuel cost. It happens that a ship designed to move with the speed of 25 knots in practice does not move faster than 18 knots. (Babicz, 2015)

In practice, service speed is an indicator used to express the average speed of ships operating for an extended period. For ships whose service speed has been determined, a surplus of power is needed for the main engine of the ship, called the sea margin. This sea margin depends on the route the ship or the area the ship operates. Based on the required service speed and the area in which the ship is transporting, the design bureau must set the necessary sea margins and design speed for the design of the trial preparation. The shipyard accepts this parameter. Very important about the Technical

Specifications which contain correct information about the speed provided and the speed of service. Unfortunately, such notes are often wrong, showing no practical value in questionable consideration.

2.4 Ship Engine

The critical part of the ship operation is the ship's main engine, which is like the vital human organ. At sea, the ship operators must be monitored the ship's performance continuously. There are three main parts of the ship propulsion, which are direct-coupled diesel engine, diesel engine with gearbox, and steam turbine with gearbox (Taylor, 1990).

The general engine which is used for ship propulsion is diesel engines, mainly for merchant ships. Some advantages that diesel engine has than the other types of engine are higher thermal efficiency compared to gasoline engines and capable of running on residual fuel, which is essential since it could consume tons of fuel per day. However, other choices of ship's engines are available for different requirements. For example, gas turbines are to fulfill the need for speed and exceptional reliability. Cruise ships also used gas turbines because of their lack of noise in operation.

Fundamentally, chemical energy inside the fuel converted by the process of internal combustion, which is petroleum-based. Inside the combustion chamber, thermal energy is formed from the fuel by combustion. Through the expansion of the working fluid, thermal energy is converted to mechanical work as an output (Naber & Johnson, 2014). Theoretically, perfect combustion will create a chemical reaction as follow:

$$\mathbf{C_xH_y + O_2 \rightarrow CO_2 + H_2O}$$

Since atmospheric air is instead drawn in during combustion than pure O_2, it formed other substances. High cylinder temperature and pressure are formed the nitrogen oxide (NO_x). Sulfur content inside the fuel forming a sulfur oxide (SO_x). Other substances are typically formed from imperfect combustion, such as carbon monoxide (CO) and particulate matter (PM).

There are two types of cycles in internal combustion engine operation, which are two-stroke and four-stroke operational cycles. Those types of cycles are based on the number of crankshaft revolution for each power stroke. There is one power stroke for one rotation of the crankshaft, while four-stroke needs two rotations of crankshaft for one power stroke, making the two-stroke cycle could provide double with the power for the same size engine theoretically (Naber & Johnson, 2014).

Brake Horsepower (BHP) is a quantity that purchased from the engine manufacturer. To determine the amount of BHP, must be through the concept of Effective Horsepower (EHP) (Eq. 1). EHP is the power required to move the ship's hull at a given speed in the absence of propeller action.

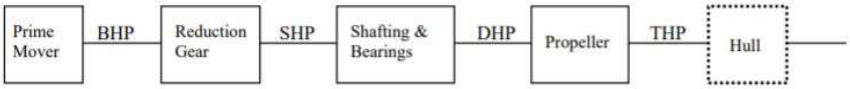


Figure 2.2 Brake Horsepower (BHP) Framework
Source: (Roh & Lee, 2018).

$$\boldsymbol{EHP = R_T \, . V} \tag{1}$$

Where:

R_T : Total Resistance

V : Ship's speed

Some losses are generated in each stage:

$$\eta_{gear} = \frac{SHP}{BHP} \approx 0.95 - 0.99 \tag{2}$$

$$\eta_{shaft} = \frac{DHP}{SHP} \approx 0.97 - 0.99 \tag{3}$$

$$\eta_{propeller} = \frac{THP}{DHP} \approx 0.65 - 0.75 \tag{4}$$

$$\eta_{hull} = \frac{EHP}{THP} \tag{5}$$

Where:

η_{gear} : Gear Efficiency

η_{shaft} : Shaft Efficiency

$\eta_{propeller}$: Propeller Efficiency

η_{hull} : Hull Efficiency

SHP : Shaft Horsepower

DHP : Delivered Horsepower

THP : Thrust Horsepower

2.5 Fuel Oil Consumption

Fuel oil consumption of a ship is one of the critical parameters which effected the energy efficiencies based on the operational condition. This parameter also could be used for controlling the greenhouse gasses (GHG) emission. Nowadays, the shipping sector is strengthening the regulation about GHG emission, and preparing the green shipping with less emission emitted. Minimizing fuel oil consumption is one of the solutions for better emission control soon. So reducing energy consumption equalize to reducing emissions.

2.5.1 Fuel Oil Consumption Estimation Method

Based on data-driven, Ship Traffic Emission Model (STEAM) method's applied. J.-P. Jalkanen proposes this method. Automatic Identification System (AIS) data is used for presenting this estimation method. The predictions of fuel consumption were compared with the actual values obtained from the shipowners. For instance, the annual fuel consumption (neglecting wave effects) is within 5% of the reported values for the RoPax5 ship in 2007 (Jalkanen, et al., 2009).

Table 2.1. The input data of the STEAM model regarding the properties of ships. Source: (Jalkanen, et al., 2009).

Identification	Physical Properties	Main Engine Properties	Auxiliary Engine Properties
Ship Name	Length	ME, Fuel Sulphur Content	AE, installed kW
IMO Registry Number	Breadth	ME, Abatement Technique	Number of AE
MMSI Code	Draught	ME, SFOC	AE, Fuel Type
Ship Type	Build Year	ME, Design	AE, Fuel Sulphur Content
Gross Tonnage	Design Speed	ME, Model	AE, SFOC
Deadweight Tonnage	Number of Cabins	ME, Stroke Type	AE, Abatement Technique
	Hull Type	ME, Rpm	
		Number of ME	
		ME, Installed kW	
		ME, Fuel Type1	
		ME, Fuel Type2	
		Measured EFs	

The notation: MMSI = Mobile Maritime Service Identity, ME = Main engine, AE = Auxiliary engine, rpm = crankshaft revolutions per minute, SFOC = Specific Fuel Oil Consumption, Measured EF = Experimental value for emission factors of NOx, SOx, CO and PM

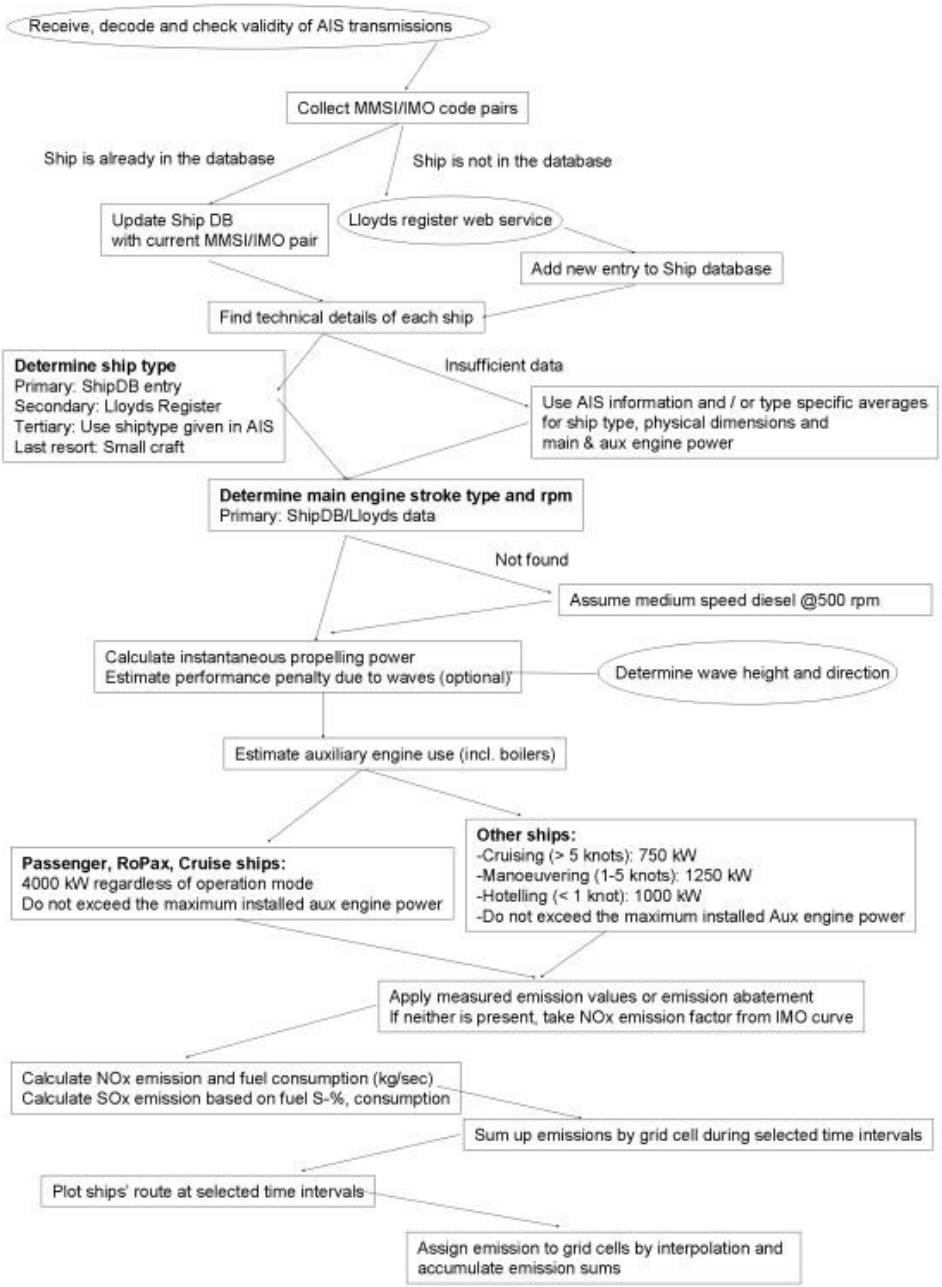


Figure 2.3 The Schematic Main Algorithm of STEAM Model
Source: (Jalkanen, et al., 2009)

Other input data of the STEAM model is extracted from the AIS data center, J.-P. Jalkanen acquires from the Helsinki Commission (HELCOM). Then the technical detail of the ships is taken from ship register data. The specific fuel oil consumption (SFOC) of 200g/kWh is used for analysis as a template value, and this

value is taken from the MAN Diesel and Turbo Guide without any correction. This model could be applied universally if the AIS global coverage is achieved.

The calculation for the fuel estimation begins with the power P calculation, as

$$\boldsymbol{P_{transient} = CF + CR + CA + CAA(\frac{1}{2}V^3S)\frac{1}{\varepsilon_0}} \tag{6}$$

Where:

CF : Frictional Resistance
CR : Residual Resistance
CA : Appendage Resistance
CAA : Air Resistance
V : Design Speed
ε_0 : Propulsive Coefficient
S : Wetted Surface Area

These parameters cannot be found in the available database, so the solution for this is to simplify the Eq. (6) by assuming that $\boldsymbol{CF}$, $\boldsymbol{CR}$, $\boldsymbol{CA}$, $\boldsymbol{CAA}$, $\boldsymbol{S}$ and $\boldsymbol{\varepsilon_0}$ are ship-specific constants. Then in that case, it can be written only as:

$$\boldsymbol{P_{transient} = \frac{kV^3_{transient}}{0.514^3}} \tag{7}$$

Where $\boldsymbol{k}$ is defined as:

$$\boldsymbol{k = 0.514^3 * \frac{\varepsilon_p * P_{installed}}{(V_{design} + V_{safety})}} \tag{8}$$

Where:

$P_{transient}$: Instantaneous power for calculation
k : The simplified quantity of
$$\boldsymbol{CF + CR + CA + CAA(\frac{1}{2}V^3S)\frac{1}{\varepsilon_0}}$$
ε_p : Main engine load at the maximum continuous rating of the main engine
$P_{installed}$: Total installed power (kW) of the main engines
V_{design} : Design speed (m/s)
V_{safety} : Safety margin (m/s)

2.6 Ship's Air Pollutants

The shipping sector is one of the contributors to global pollution. The main contributor to emission in the shipping sector is from the exhaust gas of the ship's main engine. The products are Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Carbon Dioxide (CO_2), Oxides of Sulfur (SO_x), Volatile Organic Compounds (VOC), and Particulate Matter (PM).

Ships are responsible for 80% of world trade or goods transportation volume, and they count less than 2% of the total CO_2 emissions (MEPC, 1998). The total contribution for the NO_x about 7% on a global scale and about 4% of SO_x (ICS, 1999). Ship NOx emissions result in a more than 100-fold increase in surface NOx concentrations in heavily traversed ocean regions because the atmosphere overlying the ocean is very sensitive to air pollution (G. & J., 1999). In the Asia continent, the SO_x emitted is 11.7% of total SO_x emissions (Streets, et al., 2002).

IMO made a regulation due to the pollution from the shipping sector to prevent further increases in the rate of pollutions. The chapter that is issuing air pollution is written in Annex VI in addition to the International Convention for the Prevention of Pollution from Ships (MARPOL). Annex VI regulates airborne emissions, which is further explained by IMO as any substances that are released into the atmosphere or sea, which could create hazards to human health, ecosystems, and marine life. MARPOL Annex VI sets limits on sulfur oxide and nitrogen oxide emissions from ship exhaust gases and prohibits deliberate emissions of ozone-depleting substances. The annex includes a global cap of 3.5% on the sulfur content of fuel oil from January 1st, 2012, and this will further reduce to 0.5% in January 2020.

2.6.1 Carbon Dioxide (CO_2)

Carbon dioxide is the main product of burning fossil fuels because carbon accounts for 60-90 percent of the mass of fuel burned. Carbon dioxide is formed from fuels containing the elements carbon and hydrogen and reacts with oxygen. Carbon dioxide is a non-combustible substance and therefore needs to be taken from the combustion chamber.

2.6.2 Carbon Monoxide (CO)

Carbon monoxide, or CO, is a colorless and odorless gas that forms when the carbon in fuel doesn't burn completely. The reaction occurs when there is a lack of oxygen (O_2) in the room. The highest CO levels in the outside air usually occur during the cold months of the year when inversion conditions are more frequent. Inversion is an atmospheric condition that occurs when air pollutants are trapped near the ground under a layer of warm air.

2.6.3 Oxides of Nitrogen (NO_X)

This term covers the combinations of nitrogen and oxygen produced as a by-product of the combustion of fuel in the air. The gases produced are predominately nitric oxide (NO) and nitrogen dioxide (NO_2) with traces of other complex chemicals, including nitrous oxide (N_2O) and nitrates (NO_3). The amount produced is directly related to the combustion temperature – the greater the peak temperature, the higher the level generated. Although these gases also occur in boiler flue gas, the lower flame temperature results in lower percentages being produced. The high temperatures and pressures that occur in diesel engine cylinders combine to produce relatively high levels of these toxic gases.

All of these gases combine with water and oxygen in the atmosphere to produce nitrous and nitric acids, which are highly corrosive. Nitrogen dioxide is a reddish-brown, highly toxic gas that causes lung damage. At sea level, these gases react with organic compounds to produce low-level ozone (O_3), a significant pollutant and creator of smog. In the upper atmosphere, these same gases, especially NO_2, react to remove ozone. As these gases readily travel great distances from the actual source of production, the impact of the resulting pollution (smog, acid rain, etc.) can be many miles away from the source.

2.6.4 Oxides of Sulfur (SO_X)

SO_2 or Sulfur dioxide belongs to the family of sulfur oxide gases (SO_x). These gases dissolve quickly in water. Sulfur is common in all raw materials, including coal, crude oil, and ores that contain metals, such as iron, aluminum, lead, zinc, and copper. The fuel that containing sulfur will forming SO_x gases, such as oil and coal, is combusted, and when gasoline is extracted from oil, or metals are extracted from the ore. Acid formed by SO_2 when dissolved in the water vapor and formed into sulfates and other products when interacts with other gases and particles in the air.

2.6.5 Volatile Organic Compounds (VOC) or Hydrocarbons (HC)

VOCs are contained in the lighter fractions released from petrochemical and oil products, including crude oil, during cargo operations, and tank cleaning. At sea level, these compounds react with oxides of nitrogen to produce low-level ozone (O3), a significant pollutant and creator of smog. Ozone is a profound lung irritant. VOCs also play a significant role in forming other photochemical oxidants which are responsible for numerous chemical and physical atmospheric reactions. Where possible, these should be discharged to shore through the vapor return line. A small unrecoverable amount of vapor will be released from the vessel fuel oil system, especially when heating fuel oil.

2.6.6 Particulate Matter (PM)

Particulate matter (PM) is usually divided into two classes based on particle size and comprising soot, ash and unburnt fuel, together with secondary sulfate and nitrate particles. Most of the particles are lightweight, that they are airborne, and could be transported to quite a distance. Particles could be reduced by running the engine on a higher grade of distillate fuel, but still could not be eliminated from combustion result.

2.7 Fuel Oil Consumption to CO_2 Emission Conversion Factor

Fuel oil consumption calculation is done using the STEAM method proposed by J.-P. Jalkanen, then came to CO_2 calculation using the conversion table from the IMO guidelines for EEOI. Each type of fuel has it's own carbon chain the chemical properties, so the value from one to another slightly different. The conversion factor is used to calculate the amount of CO_2 released from combustion for a specific volume of fuel oil

burned. Fuel mass to CO_2 mass conversion factors (C_F) is released by IMO in the guidelines of EEOI, with value as follow:

Table 2.2 Fuel Mass to CO_2 Mass Conversion Factors (C_f)
Source: (International Maritime Organization, 2009)

Type of Fuel	Reference	Carbon Content	C_F (ton-CO_2/ton-fuel)
Diesel/Gas Oil	ISO 8217 Grades DMX through DMC	0.875	3.206000
Light Fuel Oil	ISO 8217 Grades RMA through RMD	0.860	3.151040
Heavy Fuel Oil	ISO 8217 Grades RME through RMK	0.850	3.114400
Liquified Petroleum Gas (LPG)	Propane Butane	0.819	3.000000
		0.827	3.030000
Liquified Natural Gas (LNG)		0.750	2.750000

2.8 Energy Efficiency Operational Indicator (EEOI)

The Marine Environment Protection Committee, at its fifty-ninth session (13 to 17 July 2009), agreed to circulate the Guidelines for voluntary use of the Ship Energy Efficiency Operational Indicator (EEOI) as set out in the annex.

Monitoring tools for managing ship and fleet efficiency performance over time is the usage of EEOI. Marine Environment Protection Committee (MEPC) was urged to develop the EEOI to achieve reduction of Greenhouse Gas (GHG) emission from international shipping, and become one of the Ship Energy Efficiency Management Plan (SEEMP) mechanism.

Ship Energy Efficiency Management Plan is an operational measure to create a mechanism to improve the ship's energy efficiency. According to (The International Maritime Organization, 2016), even though it is voluntary, the approach of applying SEEMP into a ship or fleet could assist ship owners, ship operators, and other parties that are concerned in the evaluation of the performance of their ship or fleet. SEEMP is designed to be implemented for all ships.

Monitoring is a part of the SEEMP framework, which is done quantitatively. This value is determined using a calculation. EEOI is developed in purpose for making international standards for energy efficiency calculation, which EEOI could be considered as a primary tool for monitoring. IMO considers other quantitative measures aside from EEOI that may be appropriate too.

The EEOI calculation was based on guidelines for voluntary use of the ship's EEOI. Detailed from the formula given by MEPC.1/Circ.684, EEOI is defined as the ratio of the mass of CO_2 emitted per unit of transport work:

$$\boldsymbol{EEOI = \frac{\Sigma_j FC_j \times C_{Fj}}{m_{cargo} \times D}} \tag{9}$$

$$\boldsymbol{Average\ EEOI = \frac{\Sigma_i \Sigma_j \times (FC_{ij} \times C_{Fj})}{\Sigma_i (m_{cargo} \times D)}} \tag{10}$$

j	: fuel type
i	: voyage number
FC_{ij}	: the mass of consumed fuel j at voyage i
C_{Fj}	: fuel mass to a CO_2 conversion factor of fuel j
m_{cargo}	: cargo carried, or work is done (tonnes, TEU, passengers) or gross tonnage of passenger ships
D	: distance traveled

2.9 Automatic Identification System (AIS)

The Automatic Identification System (AIS) is an automated, autonomous tracking system that is mostly used in the maritime sector for the exchange of navigational information between AIS-equipped terminals. AIS is installed onboard the ship as well as onshore Vessel Traffic Service (VTS) systems to monitor vessel movements around the world.

The International Maritime Organization (IMO) originally developed AIS as a standard that would help vessels avoid collisions and help port authorities to control marine traffic more efficiently. As a result of the relative mandate from SOLAS 2002, from December 2004, IMO requires all passenger vessels as well as commercial vessels over 299 gross tonnages (GT) that sail internationally to carry a class A AIS transponder that transmits and receives AIS data.

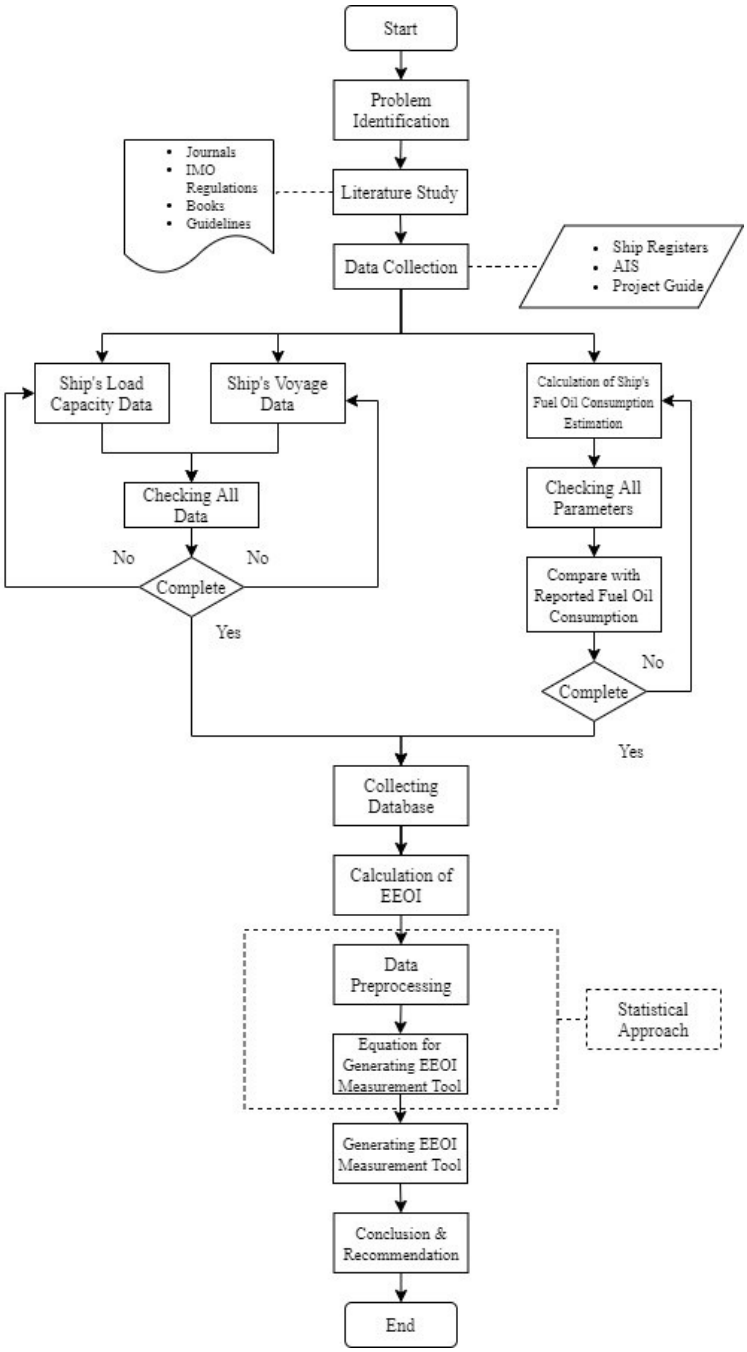
AIS works using GPS that collects the subject vessel's position and movement details, as well as dynamic and static information regarding the vessel's detail such as draft and type of cargo. Those details are automatically broadcasted at regular intervals.

FleetMon is one of an open database of ships and ports worldwide. This web-based database is providing real-time AIS position data, technical information, and photos from ships around the world. All of the data is acquired through this web-based database.

CHAPTER 3

METHODOLOGY

3.1 Flow Chart



3.2 Explanation of Methodology Flow Chart

3.2.1 Problem Identification

Problem identification is the first step in writing this thesis. Research questions are obtained through problem identification. The main problem comes from the existing condition compared to the required condition by regulation. In this stage, problems are identified explicitly to determine the specific objectives of this thesis. Therefore, the purpose of this thesis could be acknowledged.

3.2.2 Literature Study

After problems are identified, the literature study needs to be done to obtain information as a scientific base and to support the analysis of the research. The literature study is done by extensively reading journals, IMO regulations, books, and websites.

3.2.3 Collecting Data

Then, after a literature study is done, data for this research needs to be collected. Data collection is done by gathering information from the ship's operational data. Then, it will be used for estimating fuel consumption and for calculating the EEOI to generate the EEOI measurement tool.

a. Ship's Load Capacity Data

Ship's load capacity data presents the amount of maximum cargo capacity of the ship. This data will be used as one of the EEOI variables to determine its value. Data on the ship's load capacity is planned to be acquired from the Automatic Identification System (AIS) database.

b. Ship's Voyage Data

Ship's voyage data presents the amount of distance done by the ship, as one of the variables of the EEOI calculation equation. Ship's voyage data is planned to be collected from the Automatic Identification System (AIS) database.

c. Calculation of Ship's Fuel Oil Consumption Estimation

Fuel oil consumption presents the amount of fuel oil consumed to achieve the ship's operational demands. Data on fuel oil consumption is planned to be predicted by a STEAM method.

d. Comparing the Estimated Fuel Oil Consumption with Actual Fuel Oil Consumption

A comparison between estimated value with actual fuel oil consumption value presents the error rate of the estimated value according to the actual value. The error rates needed for determining the reliability of the estimation method. The data will be acquired by calculating the value of estimated fuel oil consumption and the actual value using the Mean Absolute Percentage Error (MAPE).

3.2.4 Calculation of EEOI

The calculation of the EEOI is using all data from the database to achieve the ship's operational indicator. In this stage, a ship's operational efficiency could be determined.

3.2.5 Data Preprocessing

Data preprocessing is the data preparation before it can be used to generate the equation for the EEOI measurement tool. This process is using the statistical approach.

3.2.6 Generating Equation for EEOI Measurement Tool

Generating the equation for the EEOI measurement tool is presents the equation that will be used as the EEOI measurement tool. Planned using Multiple Linear Regression (MLR).

3.2.7 Generating EEOI Measurement Tool

Generating and design the EEOI measurement tool to create an android based application for calculating EEOI value based on the variables that have been chosen. These variables must be easy to acquire by the port authorities, and the application design must be easy to use.

3.2.8 Conclusion

At this stage of writing, conclusions and suggestions are carried out as the purpose of this thesis

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CHAPTER 4
DATA ANALYSIS

4.1 Data Collection

For completion of this research, data is collected, and calculation was done. The source of the data was from many sources, among others are from the AIS online database using fleetmon.com, ship register, journals, books, project guides, and some of the maritime regulations according to the research topic.

4.1.1 Ship's Particular

This research is using 100 ship data for calculation and analysis. The online AIS database acquires those data from FleetMon and the ship's register. For better estimation value, the range of the ship's dimension should diverge from small-sized ships to the large-sized ships.

Table 4.1 Ship Dimension Data
Source: Ship Particulars & FleetMon

Numb.	IMO Number	Ship's Name	Ship's Dimension				Vs (knot)	Froude Number (Fn)
			LOA (m)	B (m)	H (m)	T (m)		
1	9116797	Meratus Sangatta	87.9	12.8	7.1	5.5	13.9	0.243440883
2	8812899	Territory Trader	91	14.7	7.6	5	12	0.206554044
3	8807337	Multi Express	91	14.7	7.6	4.98	12	0.206554044
4	9070278	Tanto Abadi	93.5	17.6	7.6	5.8	14.5	0.246226816
5	9018311	Meratus Sabang	98	16.5	7.8	5.4	11.9	0.197381787
6	9018244	Meratus Sibolga	98	16.5	7.8	5.4	14.32	0.237521612
7	8910328	Tanto Ceria	98.84	16	7.1	5.73	15.34	0.253356554
8	9197014	Meratus Project 1	99.95	18.2	8.4	5.7	12.6	0.206943742
9	9520493	Meratus Padang	100.58	18.8	8.4	6.65	17.8	0.291432069
10	8324270	Tanto Sentosa	105	20	8.7	6.71	14.3	0.229147193
11	9286815	Vitoria S	106.6	16.8	9.1	7.1	11.5	0.182891024
12	9509231	Merartus Benoa	106.68	20.6	5.8	4.21	10.5	0.166924832
13	9569865	Meratus Bontang	106.68	20.6	5.8	4.21	10.5	0.166924832
14	9458547	Meratus Barito	106.68	20.6	5.8	11	12.3	0.195540518
15	9085699	Tanto Alam	107	17.2	8.3	6.54	12	0.190485758
16	9085704	Tanto Aman	107	17.2	8.3	6.54	12	0.190485758

Numb.	IMO Number	Ship's Name	Ship's Dimension				Vs (knot)	Froude Number (Fn)
			LOA (m)	B (m)	H (m)	T (m)		
17	9046992	Meratus Ultima 2	107	18.2	8.8	11.1	14.2	0.225408147
18	9056428	Meratus Ultima 1	108	18.2	8.8	9.1	14.7	0.23226224
19	9055498	Tanto Subur I	113	19	8.5	6.5	14	0.216252913
20	9055503	Tanto Subur II	113	19	8.5	6.5	12.5	0.193082958
21	9271921	Meratus Palembang	117	19.7	8.5	6.45	14.8	0.224668371
22	9393515	Goteborg	117	19.7	8.5	6.5	15	0.227704431
23	9147124	Meratus Dili	118	18.8	8.5	6.47	14.3	0.216156444
24	9064695	Meratus Kendari 1	120	19.6	8	6.16	12.5	0.187366758
25	9379076	Viola	123.1	21	7.1	7.1	17	0.25158981
26	9157961	Meratus Kalabahi	128.84	23	11.2	7.8	18	0.260387601
27	9155511	Meratus Kupang	128.84	23	11.2	7.8	16.4	0.237242036
28	9157973	Meratus Kelimutu	128.84	23	11.2	7.8	16.1	0.232902243
29	9376036	Ruth	134.4	22.5	11.3	8.7	18.5	0.262026519
30	9131814	Meratus Batam	138.87	23.9	11.85	9.15	15.3	0.213186827
31	9103154	Tanto Express	144.02	21.8	10.7	7.72	18	0.246282898
32	9282170	New York Trader	146.5	22.7	11.2	6.5	20	0.271321579
33	9332676	Maersk Regensburg	147.8	23.3	11.5	7.3	20	0.270125716
34	9332688	Maersk Roubaix	147.9	23.3	11.5	7.3	20	0.27003438
35	9106649	Meratus Mamiri	149.58	23.1	12.8	8.6	16	0.214810928
36	9106637	Meratus Makassar	149.6	23.1	12.8	8.57	18.5	0.248358532
37	9106625	Meratus Malino	149.6	23.1	12.8	8.6	16	0.214796568
38	9483669	X-Press Elbe	151.7	23.4	11.8	8	19	0.253299285
39	9477294	Juliana	161.3	25	14.9	9.5	20	0.258574661
40	9386976	Wybelsum	161.4	25	13.9	9.9	19	0.245569818
41	9202895	Meratus Gorontalo	161.85	25.6	12.9	9.06	11.4	0.147136917
42	9410296	Maersk Wolfsburg	175.1	27.9	13.8	8.5	20	0.248176169
43	9410260	AS Samanta	175.1	27.9	13.8	8.5	20	0.248176169
44	9410284	Maersk Winnipeg	175.1	27.9	13.8	8.5	20	0.248176169
45	9373486	RHL Agilitas	175.5	27.4	14.3	10.9	20.5	0.254090515
46	9333369	Viona	178.6	27.6	14.6	10.7	21.3	0.261705005
47	9411381	Maersk Vallvik	179.7	27.6	15.9	9	20.2	0.247428934
48	9408956	Maersk Vilnius	179.9	27.6	15.9	9	20.2	0.247291359
49	9411367	Maersk Visby	179.9	27.6	15.9	9	20.2	0.247291359
50	9415959	Bernard A	184	24.5	14.2	9	19	0.229994707
51	9014092	Meratus Medan - 2	186.03	27.6	14	9.53	18.5	0.22271701
52	9220885	Nexo Maersk	198.6	30.2	17.5	10.5	21.8	0.254003689

Numb.	IMO Number	Ship's Name	Ship's Dimension				Vs (knot)	Froude Number (Fn)
			LOA (m)	B (m)	H (m)	T (m)		
53	9192442	Nele Maersk	198.6	30.2	17.5	10.5	21.8	0.254003689
54	9259381	Tanto Nusantara	199.3	32.2	16.6	11.3	21	0.244252377
55	9213105	EMS Trader	199.9	29.8	16.5	8.8	22	0.255499136
56	9251846	Miami Trader	199.9	29.8	16.5	11.6	21.5	0.249692338
57	9349368	Happy Helena	200	32.2	16.6	11.2	21	0.24382456
58	9325441	X-Press Machu Piccu	200	32.2	16.6	8.9	21	0.24382456
59	9220328	JPO Aires	207.4	29.8	16.4	11.4	21.5	0.24513608
60	9241451	Nordatlantic	207.4	29.8	16.4	11.4	22.9	0.261098429
61	9603609	Ballenita	208.9	29.8	16.4	11.6	22	0.249934733
62	9356139	Maersk Norfolk	210.5	29.8	16.4	10.1	21.5	0.243324345
63	9356127	Maersk Newport	210.5	29.8	16.4	10.1	21.5	0.243324345
64	9434462	City of Hongkong	211.9	29.8	16.7	10.1	22	0.248159186
65	9409352	Maersk Brani	222.5	32.2	19.3	10.8	22.1	0.243276646
66	9481520	Porto	225.3	29.8	16.4	11.4	22.5	0.246135964
67	9372872	Burgundy	228.6	32.2	18.6	12.2	23.3	0.253041038
68	9391799	Northern Discovery	230.9	32.2	18.8	12	23.4	0.252858201
69	9348168	Maersk Izmir	232	32.2	16.6	10.8	23.5	0.253336066
70	9323039	Nordautumn	246.8	32.2	19.3	12.3	23.4	0.244577461
71	9525493	Maersk Cabinda	249.1	37.4	22.1	12.5	21.5	0.223678761
72	9694567	Maersk Euphrates	255	37.3	22	12	21	0.21593466
73	9694529	Wide Alpha	255	37.3	22	12	21	0.21593466
74	9694555	Maersk Indus	255	37.3	22	12	21	0.21593466
75	9618599	Kyparissia	255.1	37.3	19.6	11	21.5	0.221032626
76	9618587	Leonidio	255.1	37.3	19.6	11	21.5	0.221032626
77	9464716	ALS Ceres	260.3	32.2	19.2	12.6	24	0.244257164
78	9484534	Rosa	260.3	32.2	19.2	12.6	24	0.244257164
79	9484522	Lana	260.3	32.2	19.2	11	24	0.244257164
80	9456965	Schubert	262	32.2	19.5	12.5	24.1	0.244477868
81	9348455	Northern Guard	264.2	32.2	19.5	12.8	23	0.232345669
82	9677026	Kea	270	42.8	24.8	14.5	22.5	0.22484011
83	9278088	YM Wealth	274.8	40	24.2	14	26	0.257536113
84	9214226	E R France	277	40	24.3	14	24.9	0.245658964
85	9302578	SC Mara	294.1	32.2	21.6	13.5	23.7	0.226920633
86	9302580	Fan Ya Guangzhou	294.1	32.2	21.6	13.5	23.7	0.226920633
87	9348663	Miami	294.1	32.2	21.6	13.5	24.3	0.232665459
88	9332987	Maersk Columbus	299.5	40	24.6	12	25	0.237200035

Numb.	IMO Number	Ship's Name	Ship's Dimension				Vs (knot)	Froude Number (Fn)
			LOA (m)	B (m)	H (m)	T (m)		
89	9332999	Maersk Denver	299.5	40	24.6	12	25	0.237200035
90	9332975	Maersk Chicago	299.5	40	24.6	12	25	0.237200035
91	9526887	Maersk Lirquen	299.9	45.2	24.2	12.5	22.5	0.213337616
92	9290476	Maersk Kowloon	300.1	42.8	24.6	13	24.3	0.230327837
93	9450337	Northern Jubilee	333.6	43.3	24.5	14	24.5	0.220255223
94	9352028	Maersk Savannah	334.1	42.8	24.8	13	25.6	0.229971957
95	9289946	Maersk Sarnia	335.5	42.8	24.4	14	24.5	0.219630664
96	9245770	Clementine Maersk	347	42.8	24.1	12.2	24.6	0.216842059
97	9260419	Axel Maersk	352.2	42.8	24.1	12.2	24.6	0.215235342
98	9302891	Gunvor Maersk	367.3	42.8	24.1	12.2	25	0.214191729
99	9321483	Emma Maersk	397.6	55.9	24.1	14	25.5	0.209985905
100	9778806	Munich Maersk	399	58.6	33.2	15	21	0.172625917

4.1.2 Ship's Machinery

The machinery data of all of the ships are acquired from the AIS and the ship register of all ships, including BKI ship register, ABS ship register, Lloyd ship register, and CCS ship register.

Table 4.2 Ship Machinery Data
Source: Ship Particulars & FleetMon

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
1	Meratus Sangatta	1998	MAK 8M 332 C	MAN D2866 LE MAN D2866 LE	312 312	MDO
2	Territory Trader	2300	MAN-B & W 4 L 35 MCE	Deutz MWM TBD 234 V 08 Deutz MWM TBD 234 V 08 Deutz MWM TBD 234 V 08	255 255 255	MDO
3	Multi Express	2447	HD-MAN B&W 4L 35 MCE	MWM-DEUTZ TBD 234 V 08 MWM-DEUTZ TBD 234 V 08 MWM-DEUTZ TBD 234 V 08	347 347 347	MDO
4	Tanto Abadi	3807	MAN B & W 5 L 35 MC	DEMP MAN B&W D 2866 LE DEMP MAN B&W D 2866 LE DEMP MAN B&W D 2866 LE	272 272 272	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
5	Meratus Sabang	2050	MAN-B & W 5 S 26 MC	Yanmar 6KHL-STN Yanmar 6KHL-STN Yanmar 6KHL-STN	360 360 360	MDO
6	Meratus Sibolga	2050	MITSUI B & W 4L 35 MCE	Yanmar 6 LAAL-DTN Yanmar 6 LAAL-DTN Yanmar 6 LAAL-DTN	360 360 360	MDO
7	Tanto Ceria	4200	AKASAKA 6 VEC 37 LA 3090	Yanmar S 165 L-T Yanmar S 165 L-T	300 300	MDO
8	Meratus Project 1	5875	MAK 9M32	MAN D2842LE MAN D2842LE	488 488	MDO
9	Meratus Padang	5384	MAN B&W 9L32/40	MAN B&W 6L 16/24 MAN B&W 6L 16/24	816 816	MDO
10	Tanto Sentosa	5500	MITSUBISHI 6 UEC 45 HA	Yanmar S 185 L-UT Yanmar S 185 L-UT Yanmar S 185 L-UT	540 540 540	MDO
11	Vitoria S	3219	MAN B&W 6S 26MC-MK6	Generators x Generators x Generators x	250 250 250	MDO
12	Merartus Benoa	2610 2610	Yanmar 6 EY 26 Yanmar 6 EY 26	HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8	371 371 371 371	MDO
13	Meratus Bontang	2610 2610	Yanmar 6 EY 26 Yanmar 6 EY 26	HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8	371 371 371 371	MDO
14	Meratus Barito	2610 2610	Yanmar 6EY26 Yanmar 6EY26	HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8	375 375 375 375	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
15	Tanto Alam	5322	MAN B&W 7L35MC	Yanmar S 165 L-UN Yanmar S 165 L-UN	479 479	MDO
16	Tanto Aman	5322	MAN B&W 7L35MC	Yanmar S 165 L-UN Yanmar S 165 L-UN	479 479	MDO
17	Meratus Ultima 2	5600	AKASAKA 5 EUC 45 LA	Yanmar S 165-EN Yanmar S 165-EN	600 600	MDO
18	Meratus Ultima 1	5600	MITSUBISHI 5 UEC 45 LA	Yanmar S 165L-EN Yanmar S 165L-EN	600 600	MDO
19	Tanto Subur I	4556	MAN B&W 6 L 35 MC	Yanmar S 185 DL-ST Yanmar S 185 DL-ST Yanmar S 185 DL-ST	480 480 480	MDO
20	Tanto Subur II	4559	MAN B&W 6 L 35 MC	Yanmar S 185 DL-ST Yanmar S 185 DL-ST Yanmar S 185 DL-ST	480 480 480	MDO
21	Meratus Palembang	3401 3401	SXD-DAIHATSU 8 DKM 28 L SXD-DAIHATSU 8 DKM 28 L	HND MWM TBD 234 V8 HND MWM TBD 234 V8 HND MWM TBD 234 V8	402 402 402	MDO
22	Goteborg	6705 6705	Daihatsu 8DKM28 Daihatsu 8DKM28	MWM-DEUTZ TBD 234 V 08 MWM-DEUTZ TBD 234 V 08 MWM-DEUTZ TBD 234 V 08	276 276 276	MDO
23	Meratus Dili	8027	MAK 8 M 552 C	CAT 3408 DITA CAT 3408 DITA CAT 3408 DITA	514 514 514	MDO
24	Meratus Kendari 1	4487	MAK 9M453C	MAN D2840LE MAN D2840LE	435 435	MDO
25	Viola	6155	MaK 6M43	Volvo Penta D30 MT Volvo Penta D30 MT	480 480	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
26	Meratus Kalabahi	9910	HYUNDAI MAN B&W 7S 42 MC-VI	Yanmar 6N165 L-EN Yanmar 6N165 L-EN Yanmar 6N165 L-EN	720 720 720	MDO
27	Meratus Kupang	9765	MAN B&W 7 S 42 MC-VI	Yanmar 6N165 L-EN Yanmar 6N165 L-EN Yanmar 6N165 L-EN	720 720 720	MDO
28	Meratus Kelimutu	9765	MAN B&W 7 S 42 MC-VI	Yanmar 6N165 L-EN Yanmar 6N165 L-EN Yanmar 6N165 L-EN	720 720 720	MDO
29	Ruth	11265	Mak 9M43C	Caterpillar Caterpillar Caterpillar	1488 1112 924	MDO
30	Meratus Batam	13596	MAK 8M601C	Deutz MWM TBD 604 B16 Deutz MWM TBD 604 B16 Deutz MWM TBD 604 B16	639 639 639	MDO
31	Tanto Express	10800	KOBE MITSUI 6UEC 52 LS	Yanmar M220L-SN Yanmar M220L-SN Yanmar M220L-SN	900 900 900	MDO
32	New York Trader	13048	MAN B&W 7L58/64	MAN B&W 6L 16/24 MAN B&W 6L 16/24 MAN B&W 6L 16/24	764 764 764	MDO
33	Maersk Regensburg	13048	MAN B&W 7L58/64	MAN B&W 6L 16/24 MAN B&W 6L 16/24 MAN B&W 6L 16/24	764 764 764	MDO
34	Maersk Roubaix	13048	MAN B&W 7L58/64	MAN B&W 6L 16/24 MAN B&W 6L 16/24 MAN B&W 6L 16/24	764 764 764	MDO
35	Meratus Mamiri	13610	MAN B&W 7S 50 MC	Sulzer 6 S20 Sulzer 6 S20 Sulzer 8 S20	1061 1061 1400	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
36	Meratus Makassar	13614	MAN B&W 7S 50 MC	Sulzer 6 S20 Sulzer 6 S20 Sulzer 8 S20	1060 1060 1414	MDO
37	Meratus Malino	13610	MAN B&W 7S 50 - MC	Sulzer 6 S 20 HW Sulzer 6 S 20 HW Sulzer 6 S 20 HW	1061 1061 1061	MDO
38	X-Press Elbe	12069	MAN B&W 8L4860	Generators x Generators x Generators x	842 550 2279	MDO
39	Juliana	16950	MAN B&W 8S 50 ME-C	Yanmar 8N21AL-GV Yanmar 8N21AL-GV Yanmar 8N21AL-GV Yanmar 8N21AL-GV	1743 1743 1743 1743	MDO
40	Wybelsum	18184	MAN B&W 6S60MC-C	Generators x Generators x Generators x	1287 1287 1287	MDO
41	Meratus Gorontalo	15520	MAN B&W 8S 50 MC	Yanmar M220 AL-EN Yanmar M220 AL-EN Yanmar M220 AL-EN	1200 1200 1200	MDO
42	Maersk Wolfsburg	21214	MAN B&W 7S60 MC-C	Generators x Generators x Generators x	2011 2011 2011	MDO
43	AS Samanta	21214	MAN B&W 7S60 MC-C	Generators x Generators x Generators x	2010 2010 2010	MDO
44	Maersk Winnipeg	21214	MAN B&W 7S60 MC-C	Generators x Generators x Generators x	2011 2011 2011	MDO
45	RHL Agilitas	22341	MAN B&W 7S60 MC-C	MAN B&W 8L21/31H MAN B&W 8L21/31H	2038 2038	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
				MAN B&W 8L21/31H Generators x	2038 228	
46	Viona	22770	MAN B&W 6L70 ME-C	Yanmar 6N21AL-EV Yanmar 6N21AL-EV Yanmar 6N21AL-EV Yanmar 6N21AL-EV	1378 1378 1378 1378	MDO
47	Maersk Vallvik	22260	MAN B&W 7S60ME	Yanmar 6EY26L Yanmar 6EY26L Yanmar 6EY26L	2293 2293 2293	MDO
48	Maersk Vilnius	22260	MAN B&W 7S60ME	Yanmar 6EY26L Yanmar 6EY26L Yanmar 6EY26L	2293 2293 2293	MDO
49	Maersk Visby	22260	MAN B&W 7S60ME	Yanmar 6EY26L Yanmar 6EY26L Yanmar 6EY26L	2293 2293 2293	MDO
50	Bernard A	17808	MAN B&W 8S50MC-C	MAN B&W 6L 23/30H MAN B&W 6L 23/30H MAN B&W 6L 23/30H MAN B&W 6L 23/30H	992 992 992 992	MDO
51	Meratus Medan - 2	14400	MAN B&W 6S 60 MC	Yanmar T 260 L-ST Yanmar T 260 L-ST Yanmar T 260 L-ST	1400 1400 1400	MDO
52	Nexo Maersk	38570	Sulzer 7RTA84C	MAN B&W 8L27/38 MAN B&W 8L27/38 MAN B&W 6L27/38 MAN B&W 6L27/38	3218 3218 2413 2413	MDO
53	Nele Maersk	38570	Sulzer 7RTA84C	MAN B&W 8L27/38 MAN B&W 8L27/38 MAN B&W 6L27/38 MAN B&W 6L27/38	3218 3218 2413 2413	MDO
54	Tanto Nusantara	29147	MAN B&W 7S70MC-C	Wartsila 9 L 20	1931	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
				Wartsila 9 L 20 Wartsila 9 L 20	1931 1931	
55	EMS Trader	26565	MAN B&W 7L70MC MkVI	Mak 8M20 Mak 8M20 Mak 8M20	1732 1732 1732	MDO
56	Miami Trader	28067	MAN B&W 7L70MC	Mak 6M25 Mak 6M25 Mak 6M25	2306 2306 2306	MDO
57	Happy Helena	29147	MAN B&W 7S70MC-C	Generators x Generators x Generators x Generators x	1703 1703 1703 1703	MDO
58	X-Press Machu Piccu	29147	MAN B&W 7S70MC-C	Generators x Generators x Generators x Generators x	1703 1703 1703 1703	MDO
59	JPO Aires	26565	MAN B&W 7L70MC	Generators x Generators x Generators x	2023 2023 2023	MDO
60	Nordatlantic	28912	Wartsila 7RTA72U-B	Wartsila 9L20C Wartsila 9L20C Wartsila 9L20C Generators x	2016 2016 2016 235	MDO
61	Ballenita	28818	Sulzer 7RT-Flex68B	MAN B&W 9L21/21H MAN B&W 9L21/21H MAN B&W 8L21/31H MAN B&W 8L21/31H	2293 2293 2038 2038	MDO
62	Maersk Norfolk	29194	MAN B&W 7L70ME-C	MAN B&W 9L28/32H MAN B&W 9L28/32H MAN B&W 6L28/32H	2673 2673 1737	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
63	Maersk Newport	29194	MAN B&W 7L70ME-C	MAN B&W 9L28/32H MAN B&W 9L28/32H MAN B&W 6L28/32H	2673 2673 1737	MDO
64	City of Hongkong	28912	Sulzer 7RTA72U-B	Generators x Generators x Generators x	3218 3218 3218	MDO
65	Maersk Brani	38728	MAN B&W 8K80ME-C	HimSen 9H25/33 HimSen 9H25/33 HimSen 9H25/33 HimSen 7H25/33	2896 2896 2896 2252	MDO
66	Porto	29194	MAN B&W 7L70MC-C	Wartsila 8L20 Wartsila 8L20 Wartsila 6L20	1823 1823 1367	MDO
67	Burgundy	38728	MAN B&W 8K80MC-C	MaK 8M25 MaK 8M25 MaK 6mM25	2982 2982 2306	MDO
68	Northern Discovery	42805	MAN B&W 7K90MC-C	HimSen 7H21/32 HimSen 7H21/33 HimSen 7H21/34 HimSen 7H21/35	1764 1764 1764 1764	MDO
69	Maersk Izmir	38728	MAN B&W 8K80MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	2574 2574 2574 2574	MDO
70	Nordautumn	43569	MAN B&W STX 9K80MC-C	MAN B&W 9L28/32H MAN B&W 9L28/32H MAN B&W 9L28/32H MAN B&W 9L28/32H	2413 2413 2413 2413	MDO
71	Maersk Cabinda	36288	MAN B&W 6S80ME-C	Generators x Generators x Generators x	3218 3218 2360	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
72	Maersk Euphrates	33096	MAN B&W 6G80ME-C	HimSen 7H25/33 HimSen 7H25/33 HimSen 7H25/33 HimSen 6H25/33	2802 2802 2802 2145	MDO
73	Wide Alpha	33096	MAN B&W 6G80ME-C	HimSen 7H25/33 HimSen 7H25/33 HimSen 7H25/33 HimSen 6H25/33	2802 2802 2802 2145	MDO
74	Maersk Indus	33096	MAN B&W 6G80ME-C	HimSen 7H25/33 HimSen 7H25/33 HimSen 7H25/33 HimSen 6H25/33	2802 2802 2802 2145	MDO
75	Kyparissia	36288	MAN B&W 6S80ME-C	Generators x Generators x Generators x Generators x	2950 2950 1904 1904	MDO
76	Leonidio	36288	MAN B&W 6S80ME-C	Generators x Generators x Generators x Generators x	2950 2950 1904 1904	MDO
77	ALS Ceres	49027	MAN B&W 8K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	3261 3261 3261	MDO
78	Rosa	49027	MAN B&W 8K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	3261 3261 3261	MDO
79	Lana	49027	MAN B&W 8K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	3261 3261 3261	MDO
80	Schubert	48491	Sulzer 8RTA82C	HimSen 8H25/33 HimSen 8H25/33	3218 3218	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
				HimSen 6H25/33 HimSen 6H25/33	2413 2413	
81	Northern Guard	49027	MAN B&W 8K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	2400 2400 2400 2400	MDO
82	Kea	45152	Sulzer 8RT-Flex82T	HimSen 9H25/33 HimSen 9H25/33 HimSen 8H25/33 HimSen 8H25/33	3352 3352 3205 3205	MDO
83	YM Wealth	73622	Sulzer 10RTA96C	MAN B&W 7L27.38 MAN B&W 7L27.38 MAN B&W 7L27.38 MAN B&W 7L27.38	2816 2816 2816 2816	MDO
84	E R France	73541	MAN B&W 12K90MC	MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40	4130 4130 4130	MDO
85	SC Mara	55156	MAN B&W 9K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	2400 2400 2400 2400	MDO
86	Fan Ya Guangzhou	55424	MAN B&W 9K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	2400 2400 2400 2400	MDO
87	Miami	55424	MAN B&W 9K90MC-C	HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33 HimSen 8H25/33	2400 2400 2400 2400	MDO
88	Maersk Columbus	73622	Sulzer 10RT-Flex96C B	MAN B&W 6L32/40 MAN B&W 6L32/40 MAN B&W 6L32/40	3888 3888 3888	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
89	Maersk Denver	73622	Sulzer 10RT-Flex96C B	MAN B&W 6L32/40 MAN B&W 6L32/40 MAN B&W 6L32/40	3888 3888 3888	MDO
90	Maersk Chicago	73622	Sulzer 10RT-Flex96C B	MAN B&W 6L32/40 MAN B&W 6L32/40 MAN B&W 6L32/40	3888 3888 3888	MDO
91	Maersk Lirquen	61391	MAN B&W 9S90ME-C8	MAN B&W 9L32/40CD MAN B&W 9L32/40CD MAN B&W 9L32/40CD MAN B&W 6L32/40CD	6034 6034 6034 3754	MDO
92	Maersk Kowloon	91886	MAN B&W 12 K98MC-C	MAN B&W 9L27/38 MAN B&W 9L27/38 MAN B&W 7L27/38 MAN B&W 7L27/38	3669 3669 2853 2853	MDO
93	Northern Jubilee	76572	MAN B&W 10K98ME-C	MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40	4291 4291 4291 4291	MDO
94	Maersk Savannah	92047	MAN B&W 12K98ME	MAN B&W 6L32/40 MAN B&W 6L32/40 MAN B&W 6L32/40 MAN B&W 6L32/40	3754 3754 3754 3754	MDO
95	Maersk Sarnia	82982	Sulzer 12RT-Flex96C	MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40	4291 4291 4291 4291	MDO
96	Clementine Maersk	85714	Sulzer 12RTA96C	MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40 MAN B&W 7L32/40	4190 4190 4190 4190 4190	MDO

Numb.	Ship	BHP Main Engine (hp)	Main Engine & Type	Aux Engine	BHP Aux (hp)	Fuel Type
97	Axel Maersk	85714	Sulzer 12RTA96C	Wartsila 8L32 Wartsila 8L32 Wartsila 8L32 Wartsila 6L32	4633 4633 4633 3473	MDO
98	Gunvor Maersk	92047	Sulzer 12RT-Flex96C	Wartsila 8L32 Wartsila 8L32 Wartsila 8L32	4633 4633 4633	MDO
99	Emma Maersk	108354	Sulzer 14RT-Flex96C	Mak 9M32C Mak 9M32C Mak 9M32C Mak 9M32C Mak 9M32C Mak 9M32C	5551 5551 5551 5551 5551 5551	MDO
100	Munich Maersk	62518 62518	MAN B&W 7G80ME-C9.5 MAN B&W 7G80ME-C9.5	Generators x Generators x Generators x Generators x	5149 5149 3862 3862	MDO

4.1.3 Ship's Load Capacity

This particular data are available in the AIS database in FleetMon. But not all of them have shared the completed data. Many of them are not available in the AIS database and also the ship registers.

Table 4.3 Ship Load Capacity Data
Source: Ship Particulars & FleetMon

Numb.	IMO Number	Ship	Load Capacity					
			LT (Ton)	GT (Ton)	NT (Ton)	DWT (Ton)	Container Capacity (TEU)	Reefer Container (TEU)
1	9116797	Meratus Sangatta	1595	2532	1351	3447	167	
2	8812899	Territory Trader	118	2826	1716	3194	256	35
3	8807337	Multi Express	118	2826	1716	3194	256	35
4	9070278	Tanto Abadi	1811	3577	1520	4323	270	

Numb.	IMO Number	Ship	Load Capacity					
			LT (Ton)	GT (Ton)	NT (Ton)	DWT (Ton)	Container Capacity (TEU)	Reefer Container (TEU)
5	9018311	Meratus Sabang	2415	3256	1604	3650	136	
6	9018244	Meratus Sibolga	2415	3256	1604	3650	136	
7	8910328	Tanto Ceria	1396	3461	1903	4419	361	
8	9197014	Meratus Project 1	1408	4447	2221	5350	512	
9	9520493	Meratus Padang	1464	4450	2140	5581	630	60
10	8324270	Tanto Sentosa	2020	4870	2802	6829	256	
11	9286815	Vitoria S		4564	2926	6917	285	
12	9509231	Merartus Benoa	1434	3668	1100	5108	368	
13	9569865	Meratus Bontang	1434	3668	1100	5108	368	
14	9458547	Meratus Barito	1434	3668	1100	5073	368	20
15	9085699	Tanto Alam	1796	3594	2017	5880	338	
16	9085704	Tanto Aman	1790	3994	2017	5880	338	
17	9046992	Meratus Ultima 2	2520	4896	2187	6013	455	
18	9056428	Meratus Ultima 1	2520	4896	2187	6013	455	
19	9055498	Tanto Subur I	2021	4811	2410	6797	385	
20	9055503	Tanto Subur II	2021	4811	2410	6797	385	
21	9271921	Meratus Palembang	2092	5612	2916	7852	630	60
22	9393515	Goteborg		5338	2309	7709	618	
23	9147124	Meratus Dili	2058	5553	2471	6800	600	
24	9064695	Meratus Kendari 1	1360	5737	2962	7416	599	
25	9379076	Viola		6479		8152	713	
26	9157961	Meratus Kalabahi	3424	8203	3682	10532	831	50
27	9155511	Meratus Kupang	3424	8170	3682	10478	802	50
28	9157973	Meratus Kelimutu	3424	8203	3665	10457	831	50
29	9376036	Ruth		9981	6006	11405	868	
30	9131814	Meratus Batam	2715	9993	5015	12950	910	174
31	9103154	Tanto Express	3015	9179	3970	11244	662	
32	9282170	New York Trader		9528	4703	12920	1102	200
33	9332676	Maersk Regensburg		9957	5032	13760	1118	
34	9332688	Maersk Roubaix		9957	5032	13801	1118	
35	9106649	Meratus Mamiri	4228	11964	4931	14464	1104	150
36	9106637	Meratus Makassar	4228	11964	4931	14464	1104	
37	9106625	Meratus Malino	4288	11964	4931	14454	1104	150

Numb.	IMO Number	Ship	Load Capacity					
			LT (Ton)	GT (Ton)	NT (Ton)	DWT (Ton)	Container Capacity (TEU)	Reefer Container (TEU)
38	9483669	X-Press Elbe		10318	5391	13031	1036	
39	9477294	Juliana		16137	6128	17197	1338	
40	9386976	Wybelsum		15597	6717	17083	1306	258
41	9202895	Meratus Gorontalo	3878	13444	7341	17791	1005	150
42	9410296	Maersk Wolfsburg		18123	7996	22000	1713	
43	9410260	AS Samanta		18123	7996	22314	1713	
44	9410284	Maersk Winnipeg		18123	7996	22000	1713	
45	9373486	RHL Agilitas		18480	10277	23665	1732	
46	9333369	Viona		17360	9038	22248	1719	
47	9411381	Maersk Vallvik		20987	8601	25500	1800	
48	9408956	Maersk Vilnius		20927	8602	26020	1810	
49	9411367	Maersk Visby		20987	8585	26036	1810	
50	9415959	Bernard A		17687	6711	21988	1604	
51	9014092	Meratus Medan - 2	4530	17610	7904	22219	1380	200
52	9220885	Nexo Maersk		27733	10032	31500	2230	
53	9192442	Nele Maersk		27733	10032	30420	2230	
54	9259381	Tanto Nusantara		27227	11848	33232	2312	
55	9213105	EMS Trader		25535	12454	33917	2452	400
56	9251846	Miami Trader		25587	12454	33940	2462	
57	9349368	Happy Helena		27191	11840	33355	2529	
58	9325441	X-Press Machu Piccu		27191	11840	33011	2529	300
59	9220328	JPO Aires		25361	12733	33937	2470	
60	9241451	Nordatlantic		25407	12733	33853	2478	
61	9603609	Ballenita		26412	12990	33000	2546	
62	9356139	Maersk Norfolk		25888	12688	34100	2478	352
63	9356127	Maersk Newport		25888	12688	35205	2478	
64	9434462	City of Hongkong		26936	12017	34296	2578	342
65	9409352	Maersk Brani		35835	17696	43133	3398	
66	9481520	Porto		28561	13745	39268	2798	400
67	9372872	Burgundy		36087	15774	42567	3476	500
68	9391799	Northern Discovery		36007	15938	41977	3534	500
69	9348168	Maersk Izmir		35491	17415	41281	3460	700
70	9323039	Nordautumn		38332	21924	46000	3586	500

Numb.	IMO Number	Ship	Load Capacity					
			LT (Ton)	GT (Ton)	NT (Ton)	DWT (Ton)	Container Capacity (TEU)	Reefer Container (TEU)
71	9525493	Maersk Cabinda		50869	28991	61570	4496	150
72	9694567	Maersk Euphrates		51872	29415	65165	5400	650
73	9694529	Wide Alpha		51872	29515	65152	5400	650
74	9694555	Maersk Indus		51872	29515	65000	5400	650
75	9618599	Kyparissia		48338	19957	58087	4770	600
76	9618587	Leonidio		48338	19957	58087	4770	600
77	9464716	ALS Ceres		42110	25378	50000	4300	
78	9484534	Rosa		42112	25378	50000	4380	
79	9484522	Lana		54344	25378	54344	4387	500
80	9456965	Schubert		41331	23882	51687	4255	
81	9348455	Northern Guard		41835	25488	53860	4294	400
82	9677026	Kea		71112	41072	80229	6900	800
83	9278088	YM Wealth		64254	35137	68280	5551	400
84	9214226	E R France		66289	33235	67591	5762	656
85	9302578	SC Mara		54214	31226	55150	5089	454
86	9302580	Fan Ya Guangzhou		54214	31226	68000	5089	454
87	9348663	Miami		54675	31705	68463	5085	482
88	9332987	Maersk Columbus		74642	40098	84500	6188	
89	9332999	Maersk Denver		74642	40098	84500	6188	
90	9332975	Maersk Chicago		74642	40098	84500	6188	
91	9526887	Maersk Lirquen		89097	51991	106043	8850	1707
92	9290476	Maersk Kowloon		82794	48047	93546	7455	500
93	9450337	Northern Jubilee		94419	54884	108770	8814	700
94	9352028	Maersk Savannah		91427	58211	107978	9662	700
95	9289946	Maersk Sarnia		94724	50521	97543	8478	701
96	9245770	Clementine Maersk		91921	53625	110000	7226	700
97	9260419	Axel Maersk		93496	49741	104696	7226	817
98	9302891	Gunvor Maersk		97933	51978	115700	9930	
99	9321483	Emma Maersk		154907	55396	170794	13460	1000
100	9778806	Munich Maersk		206000	78834	214286	20568	1004

4.1.4 Ship's Voyage Data

The voyage data are taken from the AIS database that recording the ship's trip using live satellite tracking. This data helps the calculation of fuel oil consumption estimation.

Table 4.4 Ship Voyage Data
Source: FleetMon

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	612.68	9	4.77	4.96
		Port Moresby - Tanjung Bara Coal	2149.63	15	7.97	4.3
		Benete - Port Moresby	2708.69	19	7.42	5.08
2	Territory Trader	Surabaya - Sorong	1217.44	5	10.25	4.8
		Sorong - Surabaya	1228.04	8	9.34	4.85
3	Multi Express	Tangguh LNG - Gresik	1321.35	16	4.41	5.35
		Tangguh LNG - Ciwadan	1702.42	16	5.57	5.01
4	Tanto Abadi	Gorontalo - Surabaya	999.99	5	7.82	6
		Port of Makassar - Surabaya	436.5	3	7.46	6
		Surabaya - Gorontalo	995.77	5	7.98	6
5	Meratus Sabang	Surabaya - Benoa (Bali)	282.67	2	7.81	3.9
		Benoa (Bali) - Surabaya	283.51	2	7.26	4.11
6	Meratus Sibolga	Surabaya - Benoa (Bali)	285.96	2	7.66	3.8
		Benoa (Bali) - Surabaya	289.24	29 hrs	10.42	3.83
7	Tanto Ceria	Banjarmasin - Gresik	256.49	2	5.62	4.6
		Surabaya - Banjarmasin	264.65	2	5.76	4.66
		Gresik - Surabaya	8.03	2 hrs	4.2	4.6
8	Meratus Project 1	Gresik - Tangguh LNG	1311.97	11	7.25	6.5
		Ciwandan - Surabaya	450.45	3	8.83	6.67
		Tangguh LNG - Ciwandan	1744.94	20	7.15	6.56
9	Meratus Padang	Surabaya - Dili	876.65	5	8.07	6.56
		Dili - Surabaya	880.55	9	4.43	6.3
10	Tanto Sentosa	Surabaya - Gresik	8.24	2 hrs	5.98	6.25
		Surabaya - Port of Makassar	429.49	3	7.5	6.5
		Gresik - Surabaya	7.16	2hrs	5.1	6.05
11	Vitoria S	Istanbul - Galati	414.75	5	4.75	3.77
		Galati - Haifa	1163.32	14	4.68	6.57
12	Merartus Benoa	Semarang - Surabaya	190.78	26 hrs	7.32	4.27
		Kumai - Semarang	284.04	4	7.32	4.09

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Surabaya - Kumai	282.25	4	7.33	4.27
13	Meratus Bontang	Lembar - Ende	396.98	3	8.25	4.5
		Surabaya - Lembar	271.06	35 hrs	8.12	3.1
		Ende - Surabaya	606.15	11	4.66	3.3
14	Meratus Barito	Ende - Surabaya	617.03	9	5.25	3.5
		Lembar - Ende	402.1	2	8.01	4.4
		Surabaya - Lembar	270.79	2	7.63	3.7
15	Tanto Alam	Jakarta - Balikpapan	1579.44	12	7.41	5.4
		Balikpapan - Jakarta	1577.22	13	7.13	6.01
16	Tanto Aman	Jakarta - Balikpapan	1583.33	12	7.58	5.9
		Balikpapan - Jakarta	1585.9	12	6.9	5.77
17	Meratus Ultima 2	Banjarmasin - Surabaya	264.11	29 hrs	9.63	5.28
		Surabaya - Banjarmasin	264.13	30 hrs	9.39	4.5
18	Meratus Ultima 1	Lembar - Surabaya	279.34	3	5.84	5.74
		Surabaya - Lembar	280.96	34 hrs	9.23	6
19	Tanto Subur I	Singapore -Batu Ampar	1.8	1 hrs	1.81	6.5
		Jakarta - Singapore	510.81	3	7.12	6.5
		Batu Ampar - Jakarta	511.41	6	4.77	6.5
20	Tanto Subur II	Surabaya - Balikpapan	966.27	6	9.3	5.93
		Balikpapan - Surabaya	967.54	8	7.98	5.53
21	Meratus Palembang	Banjarmasin - Surabaya	264.91	3	6	5.22
		Surabaya - Dili	856.19	7	6.04	4.71
22	Goteborg	Matadi - Pointe Noire	184.26	5	1.88	5.18
		Pointe Noire - Douala	672.8	4	7.07	5.96
		Pointe Noire - Cabinda	170.08	2	4.1	5.4
		Pointe Noire - Matadi	201.57	2	6.8	6.26
23	Meratus Dili	Surabaya - Dili	875.76	4	10.07	6.1
		Dili - Maumere	244	2	6.8	4.91
		Surabaya - Banjarmasin	264.95	2	6.85	5.46
24	Meratus Kendari 1	Surabaya - Banjarmasin	264.83	3	4.61	4.79
		Surabaya - Ambon	978.26	5	9.08	4.1
		Ambon - Port of Makassar	600.91	3	8.31	4.19
		Banjarmasin - Surabaya	263.66	2	4.42	5.49
25	Viola	Boma - Matadi	27.7	4 hrs	9.43	6.2
		Pointe Noire - Boma	194.23	21 hrs	10.43	6.21
		Matadi - Pointe Noire	230.52	4	3.38	5.91
26	Meratus Kalabahi	Palu - Surabaya	625.72	2	10.92	6.81
		Tolitoli - Palu	162.98	14 hrs	12.11	5.96

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Ambon - Surabaya	984.4	7	11.3	6.12
27	Meratus Kupang	Surabaya - Port of Makassar	437.46	2	9.46	7.3
		Port of Makassar - Surabaya	439.06	3	7.37	7.5
28	Meratus Kelimutu	Palu - Tolitoli	158.08	22 hrs	10.33	7.7
		Palu - Surabaya	626.68	3	9.69	8.09
		Tolitoli - Palu	161.52	17 hrs	9.67	8.1
		Surabaya - Tolitoli	735.98	3	9.96	8.1
29	Ruth	Santa Cruz de Tenerife - Ferrol	1332.9	6	13.09	6.73
		Las Palmas - Santa Cruz de Tenerife	54.18	5 hrs	12.21	7
		Tilbury - Las Palmas	1711.49	5	14.86	7.9
		Rotterdam - Tilbury	177.64	20 hrs	9.99	7.8
		Hamburg - Rotterdam	317.68	28 hrs	12.1	8.11
30	Meratus Batam	Surabaya - Kupang	723.96	3	10.79	6.8
		Kupang - Surabaya	726.32	8	5.05	6.85
31	Tanto Express	Jayapura - Ambon	916.77	4	10.51	5.8
		Surabaya - Port of Makassar	433.79	2	9.22	6.13
		Gresik - Surabaya	8.46	2 hrs	6.54	6
		Ambon - Surabaya	975.62	6	9.25	5.8
32	New York Trader	Evyap - Istanbul	43.66	5 hrs	9.72	6.45
		San Juan - Evyap	5412.36	23	10.09	7.11
		Kingston - San Juan	664.05	4	7.7	6.33
		Port of Spain - Kingston	1005.47	4	11.78	6.6
		Point Lisas - Port of Spain	23.48	16 hrs	2.16	6
33	Maersk Regensburg	Cotonou - Lagos	73.48	7 hrs	10.98	6.3
		Cotonou - Takoradi	283.66	2	9.84	6.3
34	Maersk Roubaix	Port Owendo - Pointe Noire	444.75	7	3.44	5.9
		Tema - Port Owendo	1760.54	13	7.88	6.01
		Pointe Noire - Tema	946.46	3	14.35	6.4
		Porto de Luanda - Pointe Noire	236.75	23 hrs	14.98	8.19
		Pointe Noire - Porto de Luanda	714.48	8	5.2	6.58
35	Meratus Mamiri	Kupang - Surabaya	714.13	6	5.24	5.93
		Surabaya - Port of Makassar	438.33	2	9.76	7.55
36	Meratus Makassar	Surabaya - Port of Makassar	444.44	4	4.98	7.8
		Port of Makassar - Surabaya	442.43	2	10.82	8.84
37	Meratus Malino	Palu - Surabaya	604.39	3	10.68	7.4
		Surabaya - Port of Makassar	437.59	35 hrs	12.56	7.8

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
38	X-Press Elbe	Rotterdam - Antwerp	122.36	15 hrs	8.9	7.49
		Sankt Pettersburg - Riga	462.73	2	10.24	8.1
		Riga - Kiel	555.13	2	15.62	8.88
		Kiel - Brunsbuttel	50.53	8 hrs	6.54	8.9
		Brunsbuttel - Rotterdam	288.69	21 hrs	14.64	8.8
39	Juliana	Panama City (Balboa) - Corinto	713.72	2	15.14	9.1
		Corinto - Panama City (Balboa)	720.72	3	12.58	9.26
		Puerto Caldera - Corinto	277.5	3	5.27	8.18
		Panama City (Balboa) - Puerto Caldera	503.11	2	9.13	9.2
40	Wybelsum	Goteborg - Cuxhaven	363.89	31 hrs	11.91	8.8
		Felixstowe - Goteborg	550.18	2	15.26	8.11
		Bremerhaven - Felixstowe	318.18	31 hrs	11.64	7.8
		Sankt Pettersburg - Bremerhaven	1001.09	8	9.87	9.91
		Kiel - Sankt Pettersburg	784.23	2	15.51	8.3
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	263.78	34 hrs	7.82	7.34
		Port of Makassar - Semarang	593.41	2	12.46	7.5
		Jakarta (Tanjjung Priok) - Surabaya	408.51	4	5.59	5.6
		Jakarta (Tanjung Priok) - Port of Makassar	793.79	4	8.7	7.5
		Surabaya - Bitung	1055.01	3	12.94	5.6
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	231.37	1	10.01	7.5
		Puerto Cortes - Puerto Colon	786.44	3	11.02	8.17
		Santo Tomas De Castilla - Puerto Cortes	64.17	8 hrs	9.23	7.48
		Fort Lauderdale - Santo Tomas De Castilla	893.65	3	14.96	7.4
		Savannah - Fort Lauderdale	391.1	25 hrs	16.13	7.41
43	AS Samanta	Cartagena - Santa Marta	129.22	15 hrs	9.47	7.49
		Barranquilla - Cartagena	101.55	12 hrs	8.97	7.4
		Kingston - Barranquilla	443.18	35 hrs	13.36	7.47
		Port of Miami - Kingston	927.94	3	16.02	7.56
		Puerto De Haina - Port of Miami	1087.71	3	17.51	7.57
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	57.17	8 hrs	10.39	7
		Fort Lauderdale - Santo Tomas de Castilla	897	2	15.66	6.8
		Savannah - Fort Lauderdale	411.68	2	10.76	6.8
		Wilmington (NC) - Savannah	247.95	33 hrs	8.46	7.1

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Gloucester City - Wilmington (NC)	540.28	2	10.78	7.2
45	RHL Agilitas	Halifax - Kingston	1841.17	5	15.01	9.2
		Newark - Halifark	647.08	2	11.87	7.5
		Kingston - Newark	1527.21	5	13.93	8.56
46	Viona	Bremerhaven - Rotterdam	273.68	17 hrs	17.01	9.39
		Arhus - Bremerhaven	496.75	28 hrs	18.37	8.9
		Reykjavik - Arhus	1376.91	3	17.87	9.55
		Grundartangi - Reykjavik	15.55	3 hrs	11.73	8.3
47	Maersk Vallvik	Charleston - Freeport	408.49	30 hrs	14.17	10.3
		Norfolk - Charleston	456.95	2	12.37	9.49
		Freeport - Port Elizabeth	7013.3	19	15.26	10.3
		Port Elizabeth - Durban	395.61	29 hrs	14.59	10.27
48	Maersk Vilnius	Durban - Cape Town	819.94	8	6	7.4
		Salalah - Durban	3628.87	12	14.74	8.18
		Al Duqm - Salalah	352.12	3	8.59	7.07
		Cape Town - Newark	6951.03	22	13.37	7.7
		Newark - Port of Baltimore	429.55	2	11.73	8.21
49	Maersk Visby	Port Elizabeth - Durban	412.78	2	9.45	9.9
		Freeport - Port Elizabeth	7030.25	21	14.77	9.8
		Charleston - Freeport	408.37	28 hrs	14.39	8.79
		Norfolk - Charleston	442.14	2	12.76	8.5
		Durban - Cape Town	817.51	2	17.94	8.7
50	Bernard A	Samsun - Istanbul	395.39	35 hrs	11.34	7.8
		Poti - Samsun	242.18	22 hrs	14.51	7.2
		Istanbul - Poti	630.81	3	8.8	8.49
		Constanta - Istanbul	215.29	32 hrs	10.08	7.7
		Samsun - Constanta	387.73	35 hrs	11.45	7.6
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	253.09	27 hrs	7.99	7.48
		Port of Makassar - Semarang	582.99	2	12.72	7.5
		Surabaya - Port of Makassar	443.11	3	7.79	7.5
52	Nexo Maersk	Tanger Mediterranean - Algeciras	24.19	4 hrs	7.63	10.4
		Vado Ligure - Tanger Mediterranean	883.92	3	10.94	8.9
		For sur mer - Vado Ligure	235.7	2	8.86	8
		Algericas - Montreal	3327.24	10	14.4	10.3
		Tanger Mediterranean - For sur mer	713.53	2	13.75	8

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
53	Nele Maersk	Novorossiysk - Port Said	1307.73	5	12.55	11.29
		Port Said - Novorossiysk	1372.17	8	8.57	8.85
		Istanbul - Novorossiysk	496.12	3	7.36	9.97
		Damietta - Istanbul	770.36	4	15.92	9.84
		Port Said - Damietta	70.86	33 hrs	3.46	9.3
54	Tanto Nusantara	Jakarta - Belawan	869.18	4	10.13	7
		Belawan - Jakarta	902.82	6	8.6	7.54
55	EMS Trader	Puerto Colon - Cartagena	278.18	17 hrs	17.53	9.2
		Puerto Cortes - Puerto Colon	768.94	2	13.67	9.58
		Santo Tomas de Castilla - Puerto Cortes	64.3	15 hrs	6.85	9.5
		Mariel - Santo Tomas De Castilla	603.32	3	9.23	9.65
		New Orleans - Mariel	614.14	2	15.78	10.5
56	Miami Trader	Jawaharlal Nehru Port - Colombo	926.1	3	13.17	10.98
		Mundra - Jawaharlal Nehru Port	423.06	2	10.4	10.45
		Dubai (Jebel Ali) - Mundra	952.39	3	12.2	10.18
		Colombo - Durban	3659.54	15	12.92	11
		Port Louis - Dubai (Jebel Ali)	3032.51	11	11.57	9.5
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	2287.52	7	13.93	7.44
		Djibouti - Salalah	784.31	3	12.9	7.9
		Toamasina - Victoria	909.66	2	17.31	8.5
		Port Louis - Toamasina	476.07	27 hrs	17.97	9.55
		Le Port (Pointe des Galets) - Port Louis	142.29	9	1.37	11.1
58	X-Press Machu Picchu	Puerto Colon - Cartagena	482.62	5	4.09	8.69
		Mariel - Puerto Colon	1005.04	3	13.84	9.49
		Cartagena - Mariel	1058.44	4	13.02	10.69
59	JPO Aries	Valencia - Lisbon	720.55	3	11.06	9.5
		Lisbon - Halifax	2561.35	9	12.29	9.71
		Barcelona - Valencia	177.56	17 hrs	11.3	9.68
60	Nordatlantic	Toamasina - Salalah	2223.83	11	11.92	8.55
		Port Louis - Toamasina	476.55	2	10.19	8.83
		Le Port (Pointe des Galets) - Port Louis	139.6	17 hrs	8.4	10.9
		Salalah - Port Louis	2269.76	9	11.67	11.04
61	Ballenita	Tacoma - Vancouver	178.69	13 hrs	15.83	7.91
		Everett - Tacoma	47.97	4 hrs	14.03	8.7

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Tokyo Ko - Everett	4561.24	13	15.13	9.2
62	Maersk Norfolk	Fos sur mer - Genoa	241.65	2	6.05	7.6
		Tanger Mediterranean - Fos sur mer	709.62	2	14.31	7.69
		Montreal - Tanger Mediterranean	3316.55	12	11.35	9.25
		Tanger Mediterranean - Algericas	169.32	2	3.73	8
		Genoa - Tanger Mediterranean	1146.06	3	11.1	8
63	Maersk Newport	Istanbul - Evyap	57.2	7 hrs	9.47	9.4
		Piraeus (Athens) - Istanbul	352	31 hrs	12.14	10.7
		For sur mer - Piraeus (Athens)	1105.23	3	15.27	11.4
		Barcelona - For sur mer	203.82	27 hrs	7.66	11.3
		Castellon de la Plana - Barcelona	132.16	13 hrs	10.8	9.64
64	City of Hongkong	Conarky - San Pedro	620.77	2	11.34	8
		Dakar - Conarky	504.3	3	7.99	9.92
		Durban - Cape Town	894.88	3	13.87	9.4
		Ngqura - Durban	403.62	27 hrs	15.83	8.3
		San Pedro - Ngqura	3171.3	15	8.93	7.54
65	Maersk Brani	Hamburg - Bremerhaven	122.21	10 hrs	13.31	9
		Antwerp - Hamburg	393.82	30 hrs	14.06	9.4
		Bremerhaven - Altamira	5506.03	14	16.84	11.18
66	Porto	Nagoya Ko - Yokkaichi	12.69	5 hrs	7.45	9.77
		Yokkaichi - Taipei	1064.21	3	17.39	9.09
		Taipei - Taichung	95.25	9 hrs	11.47	9.1
		Taichung - Kaohsiung	151.81	12 hrs	13.13	9.57
		Kaohsiung - Hong Kong	355.56	23 hrs	15.84	10.3
67	Burgundy	Constanta - Istanbul	329.81	3	4.46	9.66
		Odessa - Constanta	204.68	16 hrs	13.36	8.9
		Diliskelesi - Odessa	401.67	36 hrs	11.68	9.49
		Piraeus (Athens) - Diliskelesi	387.11	3	7.33	8.8
		Malta Freeport - Piraeus (Athens)	542.64	2	12.45	8.29
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	89.15	2	10.82	8.88
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	252.58	31 hrs	9.76	11.2
		Shuaiba - Khalifa Bin Salman Port	443.24	3	8.36	9.84
		Khalifa Bin Salman Port - Shuaiba	443.24	1	12.18	11.1
69	Maersk Izmir	Sydney - Melbourne	583.6	2	11.45	8.9

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Tauranga - Sydney	1596.45	4	15.1	9.8
		Panama City - Tauranga	6513.73	18	14.69	10.79
		Cartagena - Panama City	324.8	2	7.56	10.37
		Charleston - Cartagena	1472.67	5	12.01	9.7
70	Nordautumn	Algericas - Tanger Mediterranean	26.14	6 hrs	5.59	11.67
		Dakar Abidjan	1188.65	3	17.43	9.9
		Tanger Mediterranean - Dakar	1526.1	4	17	12.1
		Abidjan - Lome	399.95	23 hrs	17.48	10.05
71	Maersk Cabinda	Lagos - Onne	506.42	2	11.29	11
		Onne - Pointe Noire	824.53	4	10.13	10.07
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	741.33	3	12.62	11.95
		Yangshan - Ningbo Zhousan	127.21	16 hrs	8.8	11.4
		Qingdao - Yangshan	427.97	2	11.9	10.7
		Busan - Qingdao	468.9	34 hrs	16	11.3
		Hong Kong - Sydney	4491.55	13	13.95	12.8
73	Wide Alpha	Yangshan - Ningbo Zhousan	138.21	15 hrs	9.59	11.15
		Qingdao - Yangshan	432.08	28 hrs	15.89	10.39
		Busan - Qingdao	493.93	32 hrs	16.17	11.8
		Osaka - Busan	656.05	2	13.72	11.91
74	Maersk Indus	Colombo - Pointe Noire	6202.31	17	15.65	13.31
		Jawaharlal Nehru Port - Colombo	913.03	2	16.64	13.39
		Mundra - Jawaharlal Nehru Port	410.53	2	10.89	12.23
		Pointe Noire - Cotonou	1266.25	5	13.39	12.03
75	Kyparissia	Walvis Bay - Durban	1558.73	7	9.33	11.4
		Onne - Walvis Bay	1815.59	7	11.25	9.89
		Cotonou - Onne	770.77	4	8.41	10.76
		Durban - Tanjung Pelepas	4888.15	13	15.86	11.59
		Tanjung Pelepas - Nansha	1499.4	6	11.24	9.23
76	Leonidio	Lagos - Cotonou	57.99	8 hrs	7.73	11.3
		Cotonou - Lagos	56.09	8 hrs	7.6	11.3
77	ALS Ceres	Surabaya - Singapore	850.4	6	6.43	8.6
		Jakarta (Tanjung Priok) - Surabaya	423.6	36 hrs	14.78	8.9
		Shenzhen - Jakarta (Tanjung Priok)	1810	5	15.9	11.7
		Shantou - Shenzhen	209.37	20 hrs	10.92	11.21
		Ningbo Zhousan - Shantou	585.05	36 hrs	16.76	10.07

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
78	Rosa	Ningbo Zhousan - Shanghai	184.83	26 hrs	9.38	9.37
		Qingdao - Ningbo Zhousan	480.46	2	11.12	9.68
		Busan - Qingdao	490.82	3	11.99	9.88
		Portland - Busan	4744.9	13	14.95	9.64
79	Lana	Douala - Cotonou	591.41	3	8.38	7.32
		Porto de Luanda - Douala	896.42	5	8.21	7.5
		Pointe Noire - Porto de Luanda	357.41	19 hrs	19.23	9.9
		Algericas - Pointe Noire	3773.44	13	12.53	12.61
		Tanger Mediterranean - Algericas	51.25	23 hrs	2.49	9.26
80	Schubert	Shanghai - Busan	469.78	34 hrs	14.86	10.88
		Ningbo Zhoushan - Shanghai	218.41	35 hrs	6.79	9.3
		Qingdao - Ningbo Zhoushan	559.46	2	13.32	9.6
		Busan - Qingdao	461.63	3	12.59	9.88
		Portland - Busan	4788.62	13	15.09	9.9
81	Northern Guard	Shanghai - Hong Kong	853.31	3	13.19	11.14
		Qingdao - Shanghai	396.59	2	10.85	11.56
		Busan - Qingdao	628.44	3	11.18	10.55
		Hong Kong - Johor	1876.37	7	13.17	1.13
		Johor - Singapore	33.36	22 hrs	3.51	11.89
82	Kea	Rotterdam - Hamburg	322.11	2	8.84	10.5
		Le Havre - Rotterdam	260.99	18 hrs	14.64	10.79
		Hamburg - Newark	3697.55	11	15.26	11.76
83	YM Wealth	Busan - Yangshan	466.83	2	12.65	11.4
		Singapore - Busan	2519.04	6	17.84	11.2
		Jeddah - Singapore	4395.61	14	13.4	10.4
		Sokhna - Jeddah	621.91	2	13.04	10.13
		Al Aqabah - Sokhna	328.29	3	6.3	11.7
84	E R France	Hong Kong - Shenzhen	18.94	3 hrs	9.25	9.7
		Kaohsing - Hong Kong	356.02	29 hrs	12.17	9.7
		Busan - Kaohsiung	935.06	3	13.05	11.1
		Manzanillo - Busan	6397.38	17	16.28	11.4
		Guayaquil - Manzanillo	2011.96	6	12.84	9.8
85	SC Mara	Sydney - Brisbane	554.46	33 hrs	17.2	10.9
		Melbourne - Sydney	588.9	2	14.09	11.48
		Yantian - Melbourne	5033.09	14	14.7	11.2
		Brisbane - Busan	4189.36	10	16.88	10.9
		Shanghai - Yantian	847.67	3	12.97	10.79

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	68.28	34 hrs	2.75	12.62
		Qinzhou - Rizhao	1539.98	7	10.82	11.25
		Lianyungang - Qinzhou	1526.95	8	9.6	12.55
87	Miami	Manzanillo - Los Angeles	1253.54	5	11.3	9.7
		Coronel - San Antonio	233.16	2	7.17	9.37
		Valparaiso - Coronel	276.67	7	2.14	7.6
		Los Angeles - Ningbo Zhoushan	5805.59	19	12.85	10.1
		San Antonio - Manzanillo	3750.36	13	12.23	9.6
88	Maersk Columbus	Algeciras - Port Said	1935.87	5	17.53	14.2
		Tanger Mediterranean - Algericas	114.03	5	2.06	11.99
		Port Said - Salalah	2077.73	5	19.1	14.2
		Salalah - Dubai (Jebel Ali)	957.34	2	17.08	13.42
		Dubai (Jebel Ali) - Muhammad Bin Qasim	785.86	3	13.68	12.46
89	Maersk Denver	Newark - Algericas	3288.34	11	12.37	13.49
		Norfolk - Newark	321.91	33 hrs	10.09	10.83
		Djilbouti - Salalah	753.31	3	12.94	14.11
		Port Said - Djibouti	1382.88	4	16.53	14.5
		Algericas - Port Said	1933.79	5	16.53	14.5
90	Maersk Chicago	Salalah - Algericas	3861.43	10	16.38	14.4
		Algericas - Newark	3238.72	7	19.69	12.8
		Savannah - Houston	1353.07	3	18.33	9.83
		Newark - Charleston	655.63	2	11.63	11.7
		Charleston - Savannah	134.63	20 hrs	7.62	10.59
91	Maersk Lirquen	Hong Kong - Yangshan	826.78	7	9.12	12.06
		Singapore - Hong Kong	1450.51	4	17.28	13.2
92	Maersk Kowloon	Algericas - Sines	277.86	23 hrs	12.22	14
		Valencia - Algericas	464.01	3	6.2	13.03
		Genoa - Valencia	522.24	32 hrs	16.17	12.2
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	1654.37	4	17.2	12.1
		Sines - Gioia Tauro Harbour	1333.46	5	10.79	10.4
		Freeport - Sines	3663.55	12	13.18	10.4
		Charleston - Freeport	405.43	27 hrs	16.37	10.4
		Savannah - Charleston	130.41	15 hrs	9.46	10.4
94	Maersk Savannah	Qingdao - Busan	505.32	2	13.1	13.81
		Yangshan - Qingdao	442.77	2	12.55	13.7

Numb	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg. Speed (knots)	Avg. Draught (m)
		Ningbo Zhoushan - Yangshan	106.25	25 hrs	2.15	13.57
		Shenzhen - Ningbo Zhoushan	808.45	3	14.14	13.5
		Hong Kong - Shenzhen	41.71	9 hrs	7.03	14
95	Maersk Sarnia	Busan - Vancouver	4639.29	12	16.44	12.4
		Yangshan - Busan	515.15	4	9.08	11.78
		Ningbo Zhousan - Yangshan	122.09	20 hrs	10.56	11.27
		Yantian - Ningbo Zhousan	737.77	2	16.47	11.5
		Vancouver - Seattle	165.01	12 hrs	14.34	13.84
96	Clementine Maersk	Busan - Newark	10290.87	23	18.62	13.75
		Yangshan - Busan	465.68	3	10.64	13.79
		Norfolk - Newark	328.83	25 hrs	13.66	11.56
		Port of Baltimore - Norfolk	171.76	13 hrs	13.82	11.5
		Newark - Port of Baltimore	484.37	2	10	11.9
97	Axel Maersk	Port of Miami - Freeport	93.08	14 hrs	6.96	11.9
		Savannah - Port of Miami	463.46	2	9.39	12.78
		Charleston - Savannah	125.89	15 hrs	8.63	12.24
		Newark - Charleston	659.71	2	13.27	13.19
		Singapore - Newark	10193.28	23	19.05	12.99
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3829.42	9	17.5	14.37
		Busan - Yokohama Ko	860.19	2	20.14	14.37
		Yangshan - Busan	478.44	3	8.78	13.6
		Los Angeles - Oakland	388.55	2	10.32	13.11
		Prince Rupert - Loa Angeles	1470.98	5	12.73	14.39
99	Emma Maersk	Tanger Mediterranean - Salalah	3958.94	10	16.72	16.14
		Le Havre - Tanger Mediterranean	1238.14	4	13.38	15.21
		London Gateway Port - Le Havre	253.73	16 hrs	17.13	14.15
		Antwerp - London Gateway Port	186.03	24 hrs	8.32	13.3
		Hamburg - Antwerp	401.8	34 hrs	12.35	10.58
100	Munich Maersk	Yantian - Tanjung Pelepas	1513.2	3	20.21	16.29
		Yangshan - Yantian	822.23	2	17.38	15
		Ningbo Zhoushan - Yangshan	121.62	2	3.65	13.13
		Busan - Ningbo Zhoushan	534.28	2	12.22	13.73
		Tianjin - Busan	750.76	3	11.49	14.15

4.2 Fuel Oil Consumption Estimation (STEAM Method)

The estimated value of fuel oil consumption is mainly aimed at the main engine that installed to the ships on the Maximum Continous Rate (MCR). The fuel oil consumption is estimated using the STEAM method's, that proposed by J.-P. Jalkanen.

This method proposed an assumption to describes the value of resistance coefficients stated as ***k***.

For the ***k*** value each trip from Eq. (8), resulted

Table 4.5 ***k*** Value

No	Ship	Trip	***k***
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	0.399174
		Port Moresby - Tanjung Bara Coal	0.399174
		Benete - Port Moresby	0.399174
2	Territory Trader	Surabaya - Sorong	0.702509
		Sorong - Surabaya	0.702509
3	Multi Express	Tangguh LNG - Gresik	0.747409
		Tangguh LNG - Ciwadan	0.747409
4	Tanto Abadi	Gorontalo - Surabaya	0.67292
		Port of Makassar - Surabaya	0.67292
		Surabaya - Gorontalo	0.67292
5	Meratus Sabang	Surabaya - Benoa (Bali)	0.641421
		Benoa (Bali) - Surabaya	0.641421
6	Meratus Sibolga	Surabaya - Benoa (Bali)	0.375719
		Benoa (Bali) - Surabaya	0.375719
7	Tanto Ceria	Banjarmasin - Gresik	0.630431
		Surabaya - Banjarmasin	0.630431
		Gresik - Surabaya	0.630431
8	Meratus Project 1	Gresik - Tangguh LNG	1.559007
		Ciwandan - Surabaya	1.559007
		Tangguh LNG - Ciwandan	1.559007
9	Meratus Padang	Surabaya - Dili	0.52409
		Dili - Surabaya	0.52409
10	Tanto Sentosa	Surabaya - Gresik	1.012119
		Surabaya - Port of Makassar	1.012119
		Gresik - Surabaya	1.012119
11	Vitoria S	Istanbul - Galati	1.1113
		Galati - Haifa	1.1113

No	Ship	Trip	*k*
12	Merartus Benoa	Semarang - Surabaya	2.339627
		Kumai - Semarang	2.339627
		Surabaya - Kumai	2.339627
13	Meratus Bontang	Lembar - Ende	2.339627
		Surabaya - Lembar	2.339627
		Ende - Surabaya	2.339627
14	Meratus Barito	Ende - Surabaya	1.484892
		Lembar - Ende	1.484892
		Surabaya - Lembar	1.484892
15	Tanto Alam	Jakarta - Balikpapan	1.625545
		Balikpapan - Jakarta	1.625545
16	Tanto Aman	Jakarta - Balikpapan	1.625545
		Balikpapan - Jakarta	1.625545
17	Meratus Ultima 2	Banjarmasin - Surabaya	1.051696
		Surabaya - Banjarmasin	1.051696
18	Meratus Ultima 1	Lembar - Surabaya	0.951287
		Surabaya - Lembar	0.951287
19	Tanto Subur I	Singapore -Batu Ampar	0.891526
		Jakarta - Singapore	0.891526
		Batu Ampar - Jakarta	0.891526
20	Tanto Subur II	Surabaya - Balikpapan	1.237923
		Balikpapan - Surabaya	1.237923
21	Meratus Palembang	Banjarmasin - Surabaya	1.132965
		Surabaya - Dili	1.132965
22	Goteborg	Matadi - Pointe Noire	2.148265
		Pointe Noire - Douala	2.148265
		Pointe Noire - Cabinda	2.148265
		Pointe Noire - Matadi	2.148265
23	Meratus Dili	Surabaya - Dili	1.477142
		Dili - Maumere	1.477142
		Surabaya - Banjarmasin	1.477142
24	Meratus Kendari 1	Surabaya - Banjarmasin	1.218373
		Surabaya - Ambon	1.218373
		Ambon - Port of Makassar	1.218373
		Banjarmasin - Surabaya	1.218373
25	Viola	Boma - Matadi	0.685122
		Pointe Noire - Boma	0.685122
		Matadi - Pointe Noire	0.685122

No	Ship	Trip	*k*
26	Meratus Kalabahi	Palu - Surabaya	0.933711
		Tolitoli - Palu	0.933711
		Ambon - Surabaya	0.933711
27	Meratus Kupang	Surabaya - Port of Makassar	1.206886
		Port of Makassar - Surabaya	1.206886
28	Meratus Kelimutu	Palu - Tolitoli	1.273509
		Palu - Surabaya	1.273509
		Tolitoli - Palu	1.273509
		Surabaya - Tolitoli	1.273509
29	Ruth	Santa Cruz de Tenerife - Ferrol	0.979771
		Las Palmas - Santa Cruz de Tenerife	0.979771
		Tilbury - Las Palmas	0.979771
		Rotterdam - Tilbury	0.979771
		Hamburg - Rotterdam	0.979771
30	Meratus Batam	Surabaya - Kupang	2.056336
		Kupang - Surabaya	2.056336
31	Tanto Express	Jayapura - Ambon	1.017566
		Surabaya - Port of Makassar	1.017566
		Gresik - Surabaya	1.017566
		Ambon - Surabaya	1.017566
32	New York Trader	Evyap - Istanbul	0.903517
		San Juan - Evyap	0.903517
		Kingston - San Juan	0.903517
		Port of Spain - Kingston	0.903517
		Point Lisas - Port of Spain	0.903517
33	Maersk Regensburg	Cotonou - Lagos	0.903517
		Cotonou - Takoradi	0.903517
34	Maersk Roubaix	Port Owendo - Pointe Noire	0.903517
		Tema - Port Owendo	0.903517
		Pointe Noire - Tema	0.903517
		Porto de Luanda - Pointe Noire	0.903517
		Pointe Noire - Porto de Luanda	0.903517
35	Meratus Mamiri	Kupang - Surabaya	1.807426
		Surabaya - Port of Makassar	1.807426
36	Meratus Makassar	Surabaya - Port of Makassar	1.184075
		Port of Makassar - Surabaya	1.184075
37	Meratus Malino	Palu - Surabaya	1.807426
		Surabaya - Port of Makassar	1.807426

No	Ship	Trip	*k*
38	X-Press Elbe	Rotterdam - Antwerp	0.971005
		Sankt Pettersburg - Riga	0.971005
		Riga - Kiel	0.971005
		Kiel - Brunsbuttel	0.971005
		Brunsbuttel - Rotterdam	0.971005
39	Juliana	Panama City (Balboa) - Corinto	1.173714
		Corinto - Panama City (Balboa)	1.173714
		Puerto Caldera - Corinto	1.173714
		Panama City (Balboa) - Puerto Caldera	1.173714
40	Wybelsum	Goteborg - Cuxhaven	1.462984
		Felixstowe - Goteborg	1.462984
		Bremerhaven - Felixstowe	1.462984
		Sankt Pettersburg - Bremerhaven	1.462984
		Kiel - Sankt Pettersburg	1.462984
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	5.494206
		Port of Makassar - Semarang	5.494206
		Jakarta (Tanjjung Priok) - Surabaya	5.494206
		Jakarta (Tanjung Priok) - Port of Makassar	5.494206
		Surabaya - Bitung	5.494206
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	1.468977
		Puerto Cortes - Puerto Colon	1.468977
		Santo Tomas De Castilla - Puerto Cortes	1.468977
		Fort Lauderdale - Santo Tomas De Castilla	1.468977
		Savannah - Fort Lauderdale	1.468977
43	AS Samanta	Cartagena - Santa Marta	1.468977
		Barranquilla - Cartagena	1.468977
		Kingston - Barranquilla	1.468977
		Port of Miami - Kingston	1.468977
		Puerto De Haina - Port of Miami	1.468977
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	1.468977
		Fort Lauderdale - Santo Tomas de Castilla	1.468977
		Savannah - Fort Lauderdale	1.468977
		Wilmington (NC) - Savannah	1.468977
		Gloucester City - Wilmington (NC)	1.468977
45	RHL Agilitas	Halifax - Kingston	1.439126
		Newark - Halifark	1.439126

No	Ship	Trip	***k***
		Kingston - Newark	1.439126
46	Viona	Bremerhaven - Rotterdam	1.311136
		Arhus - Bremerhaven	1.311136
		Reykjavik - Arhus	1.311136
		Grundartangi - Reykjavik	1.311136
47	Maersk Vallvik	Charleston - Freeport	1.49716
		Norfolk - Charleston	1.49716
		Freeport - Port Elizabeth	1.49716
		Port Elizabeth - Durban	1.49716
48	Maersk Vilnius	Durban - Cape Town	1.49716
		Salalah - Durban	1.49716
		Al Duqm - Salalah	1.49716
		Cape Town - Newark	1.49716
		Newark - Port of Baltimore	1.49716
49	Maersk Visby	Port Elizabeth - Durban	1.49716
		Freeport - Port Elizabeth	1.49716
		Charleston - Freeport	1.49716
		Norfolk - Charleston	1.49716
		Durban - Cape Town	1.49716
50	Bernard A	Samsun - Istanbul	1.432734
		Poti - Samsun	1.432734
		Istanbul - Poti	1.432734
		Constanta - Istanbul	1.432734
		Samsun - Constanta	1.432734
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	1.252437
		Port of Makassar - Semarang	1.252437
		Surabaya - Port of Makassar	1.252437
52	Nexo Maersk	Tanger Mediterranean - Algeciras	2.074862
		Vado Ligure - Tanger Mediterranean	2.074862
		For sur mer - Vado Ligure	2.074862
		Algericas - Montreal	2.074862
		Tanger Mediterranean - For sur mer	2.074862
53	Nele Maersk	Novorossiysk - Port Said	2.074862
		Port Said - Novorossiysk	2.074862
		Istanbul - Novorossiysk	2.074862
		Damietta - Istanbul	2.074862
		Port Said - Damietta	2.074862
54	Tanto Nusantara	Jakarta - Belawan	1.749575

No	Ship	Trip	*k*
		Belawan - Jakarta	1.749575
55	EMS Trader	Puerto Colon - Cartagena	1.391286
		Puerto Cortes - Puerto Colon	1.391286
		Santo Tomas de Castilla - Puerto Cortes	1.391286
		Mariel - Santo Tomas De Castilla	1.391286
		New Orleans - Mariel	1.391286
56	Miami Trader	Jawaharlal Nehru Port - Colombo	1.572469
		Mundra - Jawaharlal Nehru Port	1.572469
		Dubai (Jebel Ali) - Mundra	1.572469
		Colombo - Durban	1.572469
		Port Louis - Dubai (Jebel Ali)	1.572469
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	1.749575
		Djibouti - Salalah	1.749575
		Toamasina - Victoria	1.749575
		Port Louis - Toamasina	1.749575
		Le Port (Pointe des Galets) - Port Louis	1.749575
58	X-Press Machu Picchu	Puerto Colon - Cartagena	1.749575
		Mariel - Puerto Colon	1.749575
		Cartagena - Mariel	1.749575
59	JPO Aries	Valencia - Lisbon	1.488319
		Lisbon - Halifax	1.488319
		Barcelona - Valencia	1.488319
60	Nordatlantic	Toamasina - Salalah	1.346123
		Port Louis - Toamasina	1.346123
		Le Port (Pointe des Galets) - Port Louis	1.346123
		Salalah - Port Louis	1.346123
61	Ballenita	Tacoma - Vancouver	1.509282
		Everett - Tacoma	1.509282
		Tokyo Ko - Everett	1.509282
62	Maersk Norfolk	Fos sur mer - Genoa	1.63561
		Tanger Mediterranean - Fos sur mer	1.63561
		Montreal - Tanger Mediterranean	1.63561
		Tanger Mediterranean - Algericas	1.63561
		Genoa - Tanger Mediterranean	1.63561
63	Maersk Newport	Istanbul - Evyap	1.63561
		Piraeus (Athens) - Istanbul	1.63561
		For sur mer - Piraeus (Athens)	1.63561
		Barcelona - For sur mer	1.63561

No	Ship	Trip	*k*
		Castellon de la Plana - Barcelona	1.63561
64	City of Hongkong	Conarky - San Pedro	1.514205
		Dakar - Conarky	1.514205
		Durban - Cape Town	1.514205
		Ngqura - Durban	1.514205
		San Pedro - Ngqura	1.514205
65	Maersk Brani	Hamburg - Bremerhaven	2.001492
		Antwerp - Hamburg	2.001492
		Bremerhaven - Altamira	2.001492
66	Porto	Nagoya Ko - Yokkaichi	1.431411
		Yokkaichi - Taipei	1.431411
		Taipei - Taichung	1.431411
		Taichung - Kaohsiung	1.431411
		Kaohsiung - Hong Kong	1.431411
67	Burgundy	Constanta - Istanbul	1.713753
		Odessa - Constanta	1.713753
		Diliskelesi - Odessa	1.713753
		Piraeus (Athens) - Diliskelesi	1.713753
		Malta Freeport - Piraeus (Athens)	1.713753
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	1.870488
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	1.870488
		Shuaiba - Khalifa Bin Salman Port	1.870488
		Khalifa Bin Salman Port - Shuaiba	1.870488
69	Maersk Izmir	Sydney - Melbourne	1.671266
		Tauranga - Sydney	1.671266
		Panama City - Tauranga	1.671266
		Cartagena - Panama City	1.671266
		Charleston - Cartagena	1.671266
70	Nordautumn	Algericas - Tanger Mediterranean	1.903873
		Dakar Abidjan	1.903873
		Tanger Mediterranean - Dakar	1.903873
		Abidjan - Lome	1.903873
71	Maersk Cabinda	Lagos - Onne	2.033055
		Onne - Pointe Noire	2.033055
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	1.986618
		Yangshan - Ningbo Zhousan	1.986618
		Qingdao - Yangshan	1.986618
		Busan - Qingdao	1.986618

No	Ship	Trip	*k*
		Hong Kong - Sydney	1.986618
73	Wide Alpha	Yangshan - Ningbo Zhousan	1.986618
		Qingdao - Yangshan	1.986618
		Busan - Qingdao	1.986618
		Osaka - Busan	1.986618
74	Maersk Indus	Colombo - Pointe Noire	1.986618
		Jawaharlal Nehru Port - Colombo	1.986618
		Mundra - Jawaharlal Nehru Port	1.986618
		Pointe Noire - Cotonou	1.986618
75	Kyparissia	Walvis Bay - Durban	2.033055
		Onne - Walvis Bay	2.033055
		Cotonou - Onne	2.033055
		Durban - Tanjung Pelepas	2.033055
		Tanjung Pelepas - Nansha	2.033055
76	Leonidio	Lagos - Cotonou	2.033055
		Cotonou - Lagos	2.033055
77	ALS Ceres	Surabaya - Singapore	1.9888
		Jakarta (Tanjung Priok) - Surabaya	1.9888
		Shenzhen - Jakarta (Tanjung Priok)	1.9888
		Shantou - Shenzhen	1.9888
		Ningbo Zhousan - Shantou	1.9888
78	Rosa	Ningbo Zhousan - Shanghai	1.9888
		Qingdao - Ningbo Zhousan	1.9888
		Busan - Qingdao	1.9888
		Portland - Busan	1.9888
79	Lana	Douala - Cotonou	1.9888
		Porto de Luanda - Douala	1.9888
		Pointe Noire - Porto de Luanda	1.9888
		Algericas - Pointe Noire	1.9888
		Tanger Mediterranean - Algericas	1.9888
80	Schubert	Shanghai - Busan	1.943166
		Ningbo Zhoushan - Shanghai	1.943166
		Qingdao - Ningbo Zhoushan	1.943166
		Busan - Qingdao	1.943166
		Portland - Busan	1.943166
81	Northern Guard	Shanghai - Hong Kong	2.253647
		Qingdao - Shanghai	2.253647
		Busan - Qingdao	2.253647

No	Ship	Trip	*k*
		Hong Kong - Johor	2.253647
		Johor - Singapore	2.253647
82	Kea	Rotterdam - Hamburg	2.213847
		Le Havre - Rotterdam	2.213847
		Hamburg - Newark	2.213847
83	YM Wealth	Busan - Yangshan	2.360066
		Singapore - Busan	2.360066
		Jeddah - Singapore	2.360066
		Sokhna - Jeddah	2.360066
		Al Aqabah - Sokhna	2.360066
84	E R France	Hong Kong - Shenzhen	2.67721
		Kaohsing - Hong Kong	2.67721
		Busan - Kaohsiung	2.67721
		Manzanillo - Busan	2.67721
		Guayaquil - Manzanillo	2.67721
85	SC Mara	Sydney - Brisbane	2.321672
		Melbourne - Sydney	2.321672
		Yantian - Melbourne	2.321672
		Brisbane - Busan	2.321672
		Shanghai - Yantian	2.321672
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	2.332953
		Qinzhou - Rizhao	2.332953
		Lianyungang - Qinzhou	2.332953
87	Miami	Manzanillo - Los Angeles	2.167689
		Coronel - San Antonio	2.167689
		Valparaiso - Coronel	2.167689
		Los Angeles - Ningbo Zhoushan	2.167689
		San Antonio - Manzanillo	2.167689
88	Maersk Columbus	Algeciras - Port Said	2.648751
		Tanger Mediterranean - Algericas	2.648751
		Port Said - Salalah	2.648751
		Salalah - Dubai (Jebel Ali)	2.648751
		Dubai (Jebel Ali) - Muhammad Bin Qasim	2.648751
89	Maersk Denver	Newark - Algericas	2.648751
		Norfolk - Newark	2.648751
		Djilbouti - Salalah	2.648751
		Port Said - Djibouti	2.648751
		Algericas - Port Said	2.648751

No	Ship	Trip	*k*
90	Maersk Chicago	Salalah - Algericas	2.648751
		Algericas - Newark	2.648751
		Savannah - Houston	2.648751
		Newark - Charleston	2.648751
		Charleston - Savannah	2.648751
91	Maersk Lirquen	Hong Kong - Yangshan	3.010061
		Singapore - Hong Kong	3.010061
92	Maersk Kowloon	Algericas - Sines	3.593755
		Valencia - Algericas	3.593755
		Genoa - Valencia	3.593755
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	2.923507
		Sines - Gioia Tauro Harbour	2.923507
		Freeport - Sines	2.923507
		Charleston - Freeport	2.923507
		Savannah - Charleston	2.923507
94	Maersk Savannah	Qingdao - Busan	3.088462
		Yangshan - Qingdao	3.088462
		Ningbo Zhoushan - Yangshan	3.088462
		Shenzhen - Ningbo Zhoushan	3.088462
		Hong Kong - Shenzhen	3.088462
95	Maersk Sarnia	Busan - Vancouver	3.168239
		Yangshan - Busan	3.168239
		Ningbo Zhousan - Yangshan	3.168239
		Yantian - Ningbo Zhousan	3.168239
		Vancouver - Seattle	3.168239
96	Clementine Maersk	Busan - Newark	3.233588
		Yangshan - Busan	3.233588
		Norfolk - Newark	3.233588
		Port of Baltimore - Norfolk	3.233588
		Newark - Port of Baltimore	3.233588
97	Axel Maersk	Port of Miami - Freeport	3.233588
		Savannah - Port of Miami	3.233588
		Charleston - Savannah	3.233588
		Newark - Charleston	3.233588
		Singapore - Newark	3.233588
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3.311641
		Busan - Yokohama Ko	3.311641
		Yangshan - Busan	3.311641

No	Ship	Trip	***k***
		Los Angeles - Oakland	3.311641
		Prince Rupert - Loa Angeles	3.311641
99	Emma Maersk	Tanger Mediterranean - Salalah	3.677723
		Le Havre - Tanger Mediterranean	3.677723
		London Gateway Port - Le Havre	3.677723
		Antwerp - London Gateway Port	3.677723
		Hamburg - Antwerp	3.677723
100	Munich Maersk	Yantian - Tanjung Pelepas	7.5054
		Yangshan - Yantian	7.5054
		Ningbo Zhoushan - Yangshan	7.5054
		Busan - Ningbo Zhoushan	7.5054
		Tianjin - Busan	7.5054

From the ***k*** resulted value, then the power transient or the estimated instantaneous power is to be calculated.

Power transient for each trip calculated using Eq. (7), resulted

Table 4.6 Power Transient

No	Ship	Trip	P Trans (kW)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	43.32288
		Port Moresby - Tanjung Bara Coal	202.0864
		Benete - Port Moresby	163.0699
2	Territory Trader	Surabaya - Sorong	756.5254
		Sorong - Surabaya	572.3907
3	Multi Express	Tangguh LNG - Gresik	64.10233
		Tangguh LNG - Ciwadan	129.1587
4	Tanto Abadi	Gorontalo - Surabaya	321.7981
		Port of Makassar - Surabaya	279.37
		Surabaya - Gorontalo	341.9573
5	Meratus Sabang	Surabaya - Benoa (Bali)	305.5597
		Benoa (Bali) - Surabaya	245.4442
6	Meratus Sibolga	Surabaya - Benoa (Bali)	168.8689
		Benoa (Bali) - Surabaya	425.076
7	Tanto Ceria	Banjarmasin - Gresik	111.9043
		Surabaya - Banjarmasin	120.4773
		Gresik - Surabaya	46.70741

No	Ship	Trip	P Trans (kW)
8	Meratus Project 1	Gresik - Tangguh LNG	594.1035
		Ciwandan - Surabaya	1073.322
		Tangguh LNG - Ciwandan	569.8575
9	Meratus Padang	Surabaya - Dili	275.4397
		Dili - Surabaya	45.5635
10	Tanto Sentosa	Surabaya - Gresik	216.4389
		Surabaya - Port of Makassar	426.9878
		Gresik - Surabaya	134.2586
11	Vitoria S	Istanbul - Galati	119.1001
		Galati - Haifa	113.9119
12	Merartus Benoa	Semarang - Surabaya	917.6558
		Kumai - Semarang	917.6558
		Surabaya - Kumai	921.4218
13	Meratus Bontang	Lembar - Ende	1313.737
		Surabaya - Lembar	1252.607
		Ende - Surabaya	236.7578
14	Meratus Barito	Ende - Surabaya	214.8684
		Lembar - Ende	763.119
		Surabaya - Lembar	659.5813
15	Tanto Alam	Jakarta - Balikpapan	661.3838
		Balikpapan - Jakarta	589.2065
16	Tanto Aman	Jakarta - Balikpapan	707.9565
		Balikpapan - Jakarta	534.0061
17	Meratus Ultima 2	Banjarmasin - Surabaya	939.2236
		Surabaya - Banjarmasin	870.7369
18	Meratus Ultima 1	Lembar - Surabaya	189.4741
		Surabaya - Lembar	748.0257
19	Tanto Subur I	Singapore -Batu Ampar	5.286516
		Jakarta - Singapore	321.7909
		Batu Ampar - Jakarta	96.75847
20	Tanto Subur II	Surabaya - Balikpapan	995.7321
		Balikpapan - Surabaya	629.0749
21	Meratus Palembang	Banjarmasin - Surabaya	244.7204
		Surabaya - Dili	249.6475
22	Goteborg	Matadi - Pointe Noire	14.27451
		Pointe Noire - Douala	759.1823
		Pointe Noire - Cabinda	148.0606
		Pointe Noire - Matadi	675.4832

No	Ship	Trip	P Trans (kW)
23	Meratus Dili	Surabaya - Dili	1508.38
		Dili - Maumere	464.4607
		Surabaya - Banjarmasin	474.7817
24	Meratus Kendari 1	Surabaya - Banjarmasin	119.3666
		Surabaya - Ambon	912.09
		Ambon - Port of Makassar	699.1707
		Banjarmasin - Surabaya	105.2076
25	Viola	Boma - Matadi	574.5173
		Pointe Noire - Boma	777.3578
		Matadi - Pointe Noire	26.45563
26	Meratus Kalabahi	Palu - Surabaya	1215.851
		Tolitoli - Palu	1658.231
		Ambon - Surabaya	1347.249
27	Meratus Kupang	Surabaya - Port of Makassar	1021.738
		Port of Makassar - Surabaya	483.1353
28	Meratus Kelimutu	Palu - Tolitoli	1403.793
		Palu - Surabaya	1158.707
		Tolitoli - Palu	1151.547
		Surabaya - Tolitoli	1258.288
29	Ruth	Santa Cruz de Tenerife - Ferrol	2197.574
		Las Palmas - Santa Cruz de Tenerife	1783.493
		Tilbury - Las Palmas	3215
		Rotterdam - Tilbury	976.8345
		Hamburg - Rotterdam	1735.724
30	Meratus Batam	Surabaya - Kupang	2583.202
		Kupang - Surabaya	264.8306
31	Tanto Express	Jayapura - Ambon	1181.329
		Surabaya - Port of Makassar	797.5455
		Gresik - Surabaya	284.64
		Ambon - Surabaya	805.356
32	New York Trader	Evyap - Istanbul	829.7271
		San Juan - Evyap	928.1325
		Kingston - San Juan	412.4855
		Port of Spain - Kingston	1476.972
		Point Lisas - Port of Spain	9.105373
33	Maersk Regensburg	Cotonou - Lagos	1196.034
		Cotonou - Takoradi	860.8387
34	Maersk Roubaix	Port Owendo - Pointe Noire	36.78001

No	Ship	Trip	P Trans (kW)
		Tema - Port Owendo	442.0945
		Pointe Noire - Tema	2669.883
		Porto de Luanda - Pointe Noire	3037.19
		Pointe Noire - Porto de Luanda	127.0418
35	Meratus Mamiri	Kupang - Surabaya	260.0485
		Surabaya - Port of Makassar	1680.389
36	Meratus Makassar	Surabaya - Port of Makassar	146.2403
		Port of Makassar - Surabaya	1499.895
37	Meratus Malino	Palu - Surabaya	2201.781
		Surabaya - Port of Makassar	3581.206
38	X-Press Elbe	Rotterdam - Antwerp	684.5286
		Sankt Pettersburg - Riga	1042.609
		Riga - Kiel	3700.536
		Kiel - Brunsbuttel	271.6157
		Brunsbuttel - Rotterdam	3046.806
39	Juliana	Panama City (Balboa) - Corinto	4073.239
		Corinto - Panama City (Balboa)	2336.707
		Puerto Caldera - Corinto	171.7885
		Panama City (Balboa) - Puerto Caldera	893.2532
40	Wybelsum	Goteborg - Cuxhaven	2471.582
		Felixstowe - Goteborg	5198.803
		Bremerhaven - Felixstowe	2307.271
		Sankt Pettersburg - Bremerhaven	1406.667
		Kiel - Sankt Pettersburg	5458.523
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	2627.394
		Port of Makassar - Semarang	10628.18
		Jakarta (Tanjjung Priok) - Surabaya	959.7108
		Jakarta (Tanjung Priok) - Port of Makassar	3617.951
		Surabaya - Bitung	11904.41
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	1473.389
		Puerto Cortes - Puerto Colon	1965.893
		Santo Tomas De Castilla - Puerto Cortes	1155.102
		Fort Lauderdale - Santo Tomas De Castilla	4918.242
		Savannah - Fort Lauderdale	6164.789
43	AS Samanta	Cartagena - Santa Marta	1247.57
		Barranquilla - Cartagena	1060.211
		Kingston - Barranquilla	3502.954
		Port of Miami - Kingston	6039.523

No	Ship	Trip	P Trans (kW)
		Puerto De Haina - Port of Miami	7886.305
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	1647.638
		Fort Lauderdale - Santo Tomas de Castilla	5641.445
		Savannah - Fort Lauderdale	1830.004
		Wilmington (NC) - Savannah	889.4595
		Gloucester City - Wilmington (NC)	1840.227
45	RHL Agilitas	Halifax - Kingston	4866.771
		Newark - Halifark	2406.861
		Kingston - Newark	3890.023
46	Viona	Bremerhaven - Rotterdam	6452.984
		Arhus - Bremerhaven	8127.84
		Reykjavik - Arhus	7482.063
		Grundartangi - Reykjavik	2116.127
47	Maersk Vallvik	Charleston - Freeport	4259.688
		Norfolk - Charleston	2833.853
		Freeport - Port Elizabeth	5320.248
		Port Elizabeth - Durban	4649.798
48	Maersk Vilnius	Durban - Cape Town	323.3866
		Salalah - Durban	4794.692
		Al Duqm - Salalah	948.9596
		Cape Town - Newark	3578.182
		Newark - Port of Baltimore	2416.364
49	Maersk Visby	Port Elizabeth - Durban	1263.466
		Freeport - Port Elizabeth	4824.027
		Charleston - Freeport	4461.189
		Norfolk - Charleston	3110.429
		Durban - Cape Town	8644.414
50	Bernard A	Samsun - Istanbul	2089.318
		Poti - Samsun	4376.911
		Istanbul - Poti	976.3678
		Constanta - Istanbul	1467.395
		Samsun - Constanta	2150.71
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	638.846
		Port of Makassar - Semarang	2577.61
		Surabaya - Port of Makassar	592.0634
52	Nexo Maersk	Tanger Mediterranean - Algeciras	921.6431
		Vado Ligure - Tanger Mediterranean	2716.697
		For sur mer - Vado Ligure	1443.08

No	Ship	Trip	P Trans (kW)
		Algericas - Montreal	6195.504
		Tanger Mediterranean - For sur mer	5393.83
53	Nele Maersk	Novorossiysk - Port Said	4101.289
		Port Said - Novorossiysk	1305.965
		Istanbul - Novorossiysk	827.223
		Damietta - Istanbul	8371.791
		Port Said - Damietta	85.94438
54	Tanto Nusantara	Jakarta - Belawan	1818.699
		Belawan - Jakarta	1112.828
55	EMS Trader	Puerto Colon - Cartagena	7494.836
		Puerto Cortes - Puerto Colon	3554.037
		Santo Tomas de Castilla - Puerto Cortes	447.1859
		Mariel - Santo Tomas De Castilla	1094.011
		New Orleans - Mariel	5466.853
56	Miami Trader	Jawaharlal Nehru Port - Colombo	3592.025
		Mundra - Jawaharlal Nehru Port	1768.814
		Dubai (Jebel Ali) - Mundra	2855.365
		Colombo - Durban	3391.327
		Port Louis - Dubai (Jebel Ali)	2435.466
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	4729.181
		Djibouti - Salalah	3755.794
		Toamasina - Victoria	9074.523
		Port Louis - Toamasina	10152.59
		Le Port (Pointe des Galets) - Port Louis	4.498775
58	X-Press Machu Picchu	Puerto Colon - Cartagena	119.7023
		Mariel - Puerto Colon	4638.108
		Cartagena - Mariel	3861.585
59	JPO Aries	Valencia - Lisbon	2013.545
		Lisbon - Halifax	2762.813
		Barcelona - Valencia	2147.49
60	Nordatlantic	Toamasina - Salalah	2279.888
		Port Louis - Toamasina	1424.319
		Le Port (Pointe des Galets) - Port Louis	797.8524
		Salalah - Port Louis	2139.426
61	Ballenita	Tacoma - Vancouver	5987.054
		Everett - Tacoma	4168.151
		Tokyo Ko - Everett	5227.418
62	Maersk Norfolk	Fos sur mer - Genoa	362.1978

No	Ship	Trip	P Trans (kW)
		Tanger Mediterranean - Fos sur mer	4792.902
		Montreal - Tanger Mediterranean	2391.483
		Tanger Mediterranean - Algericas	84.88016
		Genoa - Tanger Mediterranean	2236.911
63	Maersk Newport	Istanbul - Evyap	1389.088
		Piraeus (Athens) - Istanbul	2926.414
		For sur mer - Piraeus (Athens)	5823.671
		Barcelona - For sur mer	735.1331
		Castellon de la Plana - Barcelona	2060.397
64	City of Hongkong	Conarky - San Pedro	2208.126
		Dakar - Conarky	772.3694
		Durban - Cape Town	4040.304
		Ngqura - Durban	6006.583
		San Pedro - Ngqura	1078.299
65	Maersk Brani	Hamburg - Bremerhaven	4719.414
		Antwerp - Hamburg	5563.01
		Bremerhaven - Altamira	9558.289
66	Porto	Nagoya Ko - Yokkaichi	591.8792
		Yokkaichi - Taipei	7527.712
		Taipei - Taichung	2160.004
		Taichung - Kaohsiung	3240.1
		Kaohsiung - Hong Kong	5688.919
67	Burgundy	Constanta - Istanbul	152.0383
		Odessa - Constanta	4086.652
		Diliskelesi - Odessa	2730.718
		Piraeus (Athens) - Diliskelesi	674.9324
		Malta Freeport - Piraeus (Athens)	3307.169
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	2369.391
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	1739.019
		Shuaiba - Khalifa Bin Salman Port	1092.883
		Khalifa Bin Salman Port - Shuaiba	3379.845
69	Maersk Izmir	Sydney - Melbourne	2508.776
		Tauranga - Sydney	5754.086
		Panama City - Tauranga	5297.987
		Cartagena - Panama City	722.1225
		Charleston - Cartagena	2895.173
70	Nordautumn	Algericas - Tanger Mediterranean	332.5626
		Dakar Abidjan	10081.62

No	Ship	Trip	P Trans (kW)
		Tanger Mediterranean - Dakar	9353.729
		Abidjan - Lome	10168.63
71	Maersk Cabinda	Lagos - Onne	2925.708
		Onne - Pointe Noire	2113.379
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	3992.936
		Yangshan - Ningbo Zhousan	1353.824
		Qingdao - Yangshan	3347.766
		Busan - Qingdao	8137.185
		Hong Kong - Sydney	5393.08
73	Wide Alpha	Yangshan - Ningbo Zhousan	1752.145
		Qingdao - Yangshan	7970.507
		Busan - Qingdao	8399.324
		Osaka - Busan	5130.7
74	Maersk Indus	Colombo - Pointe Noire	7614.779
		Jawaharlal Nehru Port - Colombo	9153.227
		Mundra - Jawaharlal Nehru Port	2565.653
		Pointe Noire - Cotonou	4769.315
75	Kyparissia	Walvis Bay - Durban	1651.179
		Onne - Walvis Bay	2894.721
		Cotonou - Onne	1209.309
		Durban - Tanjung Pelepas	8110.706
		Tanjung Pelepas - Nansha	2887.008
76	Leonidio	Lagos - Cotonou	939.0476
		Cotonou - Lagos	892.4623
77	ALS Ceres	Surabaya - Singapore	528.718
		Jakarta (Tanjung Priok) - Surabaya	6421.175
		Shenzhen - Jakarta (Tanjung Priok)	7994.339
		Shantou - Shenzhen	2589.758
		Ningbo Zhousan - Shantou	9362.962
78	Rosa	Ningbo Zhousan - Shanghai	1641.344
		Qingdao - Ningbo Zhousan	2734.674
		Busan - Qingdao	3428.063
		Portland - Busan	6645.303
79	Lana	Douala - Cotonou	1170.37
		Porto de Luanda - Douala	1100.578
		Pointe Noire - Porto de Luanda	14142.59
		Algericas - Pointe Noire	3912.41
		Tanger Mediterranean - Algericas	30.7036

No	Ship	Trip	P Trans (kW)
80	Schubert	Shanghai - Busan	6376.265
		Ningbo Zhoushan - Shanghai	608.302
		Qingdao - Ningbo Zhoushan	4592.219
		Busan - Qingdao	3877.815
		Portland - Busan	6676.943
81	Northern Guard	Shanghai - Hong Kong	5171.544
		Qingdao - Shanghai	2878.559
		Busan - Qingdao	3149.28
		Hong Kong - Johor	5148.055
		Johor - Singapore	97.45569
82	Kea	Rotterdam - Hamburg	1529.341
		Le Havre - Rotterdam	6946.577
		Hamburg - Newark	7867.037
83	YM Wealth	Busan - Yangshan	4777.445
		Singapore - Busan	13400.12
		Jeddah - Singapore	5678.564
		Sokhna - Jeddah	5233.074
		Al Aqabah - Sokhna	590.1274
84	E R France	Hong Kong - Shenzhen	2118.887
		Kaohsing - Hong Kong	4825.633
		Busan - Kaohsiung	5949.96
		Manzanillo - Busan	11551.69
		Guayaquil - Manzanillo	5667.318
85	SC Mara	Sydney - Brisbane	11813.71
		Melbourne - Sydney	6494.321
		Yantian - Melbourne	7374.843
		Brisbane - Busan	11166.53
		Shanghai - Yantian	5065.481
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	48.51812
		Qinzhou - Rizhao	2955.205
		Lianyungang - Qinzhou	2064.047
87	Miami	Manzanillo - Los Angeles	3127.752
		Coronel - San Antonio	799.0141
		Valparaiso - Coronel	21.2441
		Los Angeles - Ningbo Zhoushan	4599.455
		San Antonio - Manzanillo	3965.303
88	Maersk Columbus	Algeciras - Port Said	14268.78
		Tanger Mediterranean - Algericas	23.1549

No	Ship	Trip	P Trans (kW)
		Port Said - Salalah	18456.16
		Salalah - Dubai (Jebel Ali)	13197.9
		Dubai (Jebel Ali) - Muhammad Bin Qasim	6781.09
89	Maersk Denver	Newark - Algericas	5013.607
		Norfolk - Newark	2720.913
		Djilbouti - Salalah	5739.103
		Port Said - Djibouti	11963.54
		Algericas - Port Said	11963.54
90	Maersk Chicago	Salalah - Algericas	11640.8
		Algericas - Newark	20219.87
		Savannah - Houston	16312.8
		Newark - Charleston	4166.586
		Charleston - Savannah	1171.942
91	Maersk Lirquen	Hong Kong - Yangshan	2283.284
		Singapore - Hong Kong	15531.25
92	Maersk Kowloon	Algericas - Sines	6557.859
		Valencia - Algericas	856.4924
		Genoa - Valencia	15194.22
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	14876.11
		Sines - Gioia Tauro Harbour	3672.556
		Freeport - Sines	6693.455
		Charleston - Freeport	12824.79
		Savannah - Charleston	2475.013
94	Maersk Savannah	Qingdao - Busan	6943.143
		Yangshan - Qingdao	6104.828
		Ningbo Zhoushan - Yangshan	30.69429
		Shenzhen - Ningbo Zhoushan	8731.533
		Hong Kong - Shenzhen	1073.021
95	Maersk Sarnia	Busan - Vancouver	14077.43
		Yangshan - Busan	2371.786
		Ningbo Zhousan - Yangshan	3730.867
		Yantian - Ningbo Zhousan	14154.64
		Vancouver - Seattle	9342.551
96	Clementine Maersk	Busan - Newark	20874.87
		Yangshan - Busan	3895.019
		Norfolk - Newark	8242.08
		Port of Baltimore - Norfolk	8535.105
		Newark - Port of Baltimore	3233.588

No	Ship	Trip	P Trans (kW)
97	Axel Maersk	Port of Miami - Freeport	1090.216
		Savannah - Port of Miami	2677.204
		Charleston - Savannah	2078.342
		Newark - Charleston	7556.097
		Singapore - Newark	22354.74
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	17748.33
		Busan - Yokohama Ko	27053.39
		Yangshan - Busan	2241.438
		Los Angeles - Oakland	3639.84
		Prince Rupert - Loa Angeles	6831.695
99	Emma Maersk	Tanger Mediterranean - Salalah	17190.47
		Le Havre - Tanger Mediterranean	8809.421
		London Gateway Port - Le Havre	18486.35
		Antwerp - London Gateway Port	2118.112
		Hamburg - Antwerp	6927.554
100	Munich Maersk	Yantian - Tanjung Pelepas	61954.49
		Yangshan - Yantian	39402.44
		Ningbo Zhoushan - Yangshan	364.966
		Busan - Ningbo Zhoushan	13695.8
		Tianjin - Busan	11385.02

Then come to the fuel oil consumption estimation. The Specific Fuel Oil Consumption (SFOC) using default value as J.-P. Jalkanen, which is **200 g/kWh**. So the value of fuel oil consumption estimation based on the STEAM method's resulted

Table 4.7 FOC Estimation STEAM Method's

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	8664.5751	216	1.872
		Port Moresby - Tanjung Bara Coal	40417.2813	360	14.550
		Benete - Port Moresby	32613.9837	456	14.872
2	Territory Trader	Surabaya - Sorong	151305.083	120	18.157
		Sorong - Surabaya	114478.137	192	21.980
3	Multi Express	Tangguh LNG - Gresik	12820.4664	384	4.923
		Tangguh LNG - Ciwadan	25831.7389	384	9.919
4	Tanto Abadi	Gorontalo - Surabaya	64359.622	120	7.723

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Port of Makassar - Surabaya	55873.9928	72	4.023
		Surabaya - Gorontalo	68391.4638	120	8.207
5	Meratus Sabang	Surabaya - Benoa (Bali)	61111.9347	48	2.933
		Benoa (Bali) - Surabaya	49088.8427	48	2.356
6	Meratus Sibolga	Surabaya - Benoa (Bali)	33773.7811	48	1.621
		Benoa (Bali) - Surabaya	85015.1906	29	2.465
7	Tanto Ceria	Banjarmasin - Gresik	22380.8631	48	1.074
		Surabaya - Banjarmasin	24095.4663	48	1.157
		Gresik - Surabaya	9341.48145	2	0.019
8	Meratus Project 1	Gresik - Tangguh LNG	118820.706	264	31.369
		Ciwandan - Surabaya	214664.496	72	15.456
		Tangguh LNG - Ciwandan	113971.492	480	54.706
9	Meratus Padang	Surabaya - Dili	55087.9374	120	6.611
		Dili - Surabaya	9112.70028	216	1.968
10	Tanto Sentosa	Surabaya - Gresik	43287.7708	2	0.087
		Surabaya - Port of Makassar	85397.5594	72	6.149
		Gresik - Surabaya	26851.7254	2	0.054
11	Vitoria S	Istanbul - Galati	23820.0239	120	2.858
		Galati - Haifa	22782.3712	336	7.655
12	Merartus Benoa	Semarang - Surabaya	183531.163	26	4.772
		Kumai - Semarang	183531.163	96	17.619
		Surabaya - Kumai	184284.368	96	17.691
13	Meratus Bontang	Lembar - Ende	262747.395	72	18.918
		Surabaya - Lembar	250521.302	35	8.768
		Ende - Surabaya	47351.5635	264	12.501
14	Meratus Barito	Ende - Surabaya	42973.6884	216	9.282
		Lembar - Ende	152623.802	48	7.326
		Surabaya - Lembar	131916.261	48	6.332
15	Tanto Alam	Jakarta - Balikpapan	132276.77	288	38.096
		Balikpapan - Jakarta	117841.306	312	36.766
16	Tanto Aman	Jakarta - Balikpapan	141591.302	288	40.778
		Balikpapan - Jakarta	106801.224	288	30.759
17	Meratus Ultima 2	Banjarmasin - Surabaya	187844.728	29	5.447
		Surabaya - Banjarmasin	174147.372	30	5.224
18	Meratus Ultima 1	Lembar - Surabaya	37894.8271	72	2.728
		Surabaya - Lembar	149605.132	34	5.087
19	Tanto Subur I	Singapore -Batu Ampar	1057.30323	1	0.001
		Jakarta - Singapore	64358.1891	72	4.634

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Batu Ampar - Jakarta	19351.6933	144	2.787
20	Tanto Subur II	Surabaya - Balikpapan	199146.421	144	28.677
		Balikpapan - Surabaya	125814.975	192	24.156
21	Meratus Palembang	Banjarmasin - Surabaya	48944.0848	72	3.524
		Surabaya - Dili	49929.5069	168	8.388
22	Goteborg	Matadi - Pointe Noire	2854.903	120	0.343
		Pointe Noire - Douala	151836.453	96	14.576
		Pointe Noire - Cabinda	29612.1117	48	1.421
		Pointe Noire - Matadi	135096.64	48	6.485
23	Meratus Dili	Surabaya - Dili	301675.926	96	28.961
		Dili - Maumere	92892.1427	48	4.459
		Surabaya - Banjarmasin	94956.3379	48	4.558
24	Meratus Kendari 1	Surabaya - Banjarmasin	23873.3252	72	1.719
		Surabaya - Ambon	182417.997	120	21.890
		Ambon - Port of Makassar	139834.138	72	10.068
		Banjarmasin - Surabaya	21041.5121	48	1.010
25	Viola	Boma - Matadi	114903.462	4	0.460
		Pointe Noire - Boma	155471.562	21	3.265
		Matadi - Pointe Noire	5291.12642	96	0.508
26	Meratus Kalabahi	Palu - Surabaya	243170.289	48	11.672
		Tolitoli - Palu	331646.199	14	4.643
		Ambon - Surabaya	269449.837	168	45.268
27	Meratus Kupang	Surabaya - Port of Makassar	204347.66	48	9.809
		Port of Makassar - Surabaya	96627.0505	72	6.957
28	Meratus Kelimutu	Palu - Tolitoli	280758.604	22	6.177
		Palu - Surabaya	231741.301	72	16.685
		Tolitoli - Palu	230309.33	17	3.915
		Surabaya - Tolitoli	251657.643	72	18.119
29	Ruth	Santa Cruz de Tenerife - Ferrol	439514.754	144	63.290
		Las Palmas - Santa Cruz de Tenerife	356698.687	5	1.783
		Tilbury - Las Palmas	642999.962	120	77.160
		Rotterdam - Tilbury	195366.899	20	3.907
		Hamburg - Rotterdam	347144.773	28	9.720
30	Meratus Batam	Surabaya - Kupang	516640.389	72	37.198
		Kupang - Surabaya	52966.1194	192	10.169
31	Tanto Express	Jayapura - Ambon	236265.791	96	22.682
		Surabaya - Port of Makassar	159509.098	48	7.656

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Gresik - Surabaya	56928.0019	2	0.114
		Ambon - Surabaya	161071.2	144	23.194
32	New York Trader	Evyap - Istanbul	165945.426	5	0.830
		San Juan - Evyap	185626.506	552	102.466
		Kingston - San Juan	82497.097	96	7.920
		Port of Spain - Kingston	295394.471	96	28.358
		Point Lisas - Port of Spain	1821.07463	16	0.029
33	Maersk Regensburg	Cotonou - Lagos	239206.794	7	1.674
		Cotonou - Takoradi	172167.743	48	8.264
34	Maersk Roubaix	Port Owendo - Pointe Noire	7356.00166	168	1.236
		Tema - Port Owendo	88418.9072	312	27.587
		Pointe Noire - Tema	533976.561	72	38.446
		Porto de Luanda - Pointe Noire	607437.963	23	13.971
		Pointe Noire - Porto de Luanda	25408.3534	192	4.878
35	Meratus Mamiri	Kupang - Surabaya	52009.6917	144	7.489
		Surabaya - Port of Makassar	336077.835	48	16.132
36	Meratus Makassar	Surabaya - Port of Makassar	29248.0622	96	2.808
		Port of Makassar - Surabaya	299978.999	48	14.399
37	Meratus Malino	Palu - Surabaya	440356.262	72	31.706
		Surabaya - Port of Makassar	716241.262	35	25.068
38	X-Press Elbe	Rotterdam - Antwerp	136905.722	15	2.054
		Sankt Pettersburg - Riga	208521.792	48	10.009
		Riga - Kiel	740107.265	48	35.525
		Kiel - Brunsbuttel	54323.1348	8	0.435
		Brunsbuttel - Rotterdam	609361.216	21	12.797
39	Juliana	Panama City (Balboa) - Corinto	814647.765	48	39.103
		Corinto - Panama City (Balboa)	467341.307	72	33.649
		Puerto Caldera - Corinto	34357.7006	72	2.474
		Panama City (Balboa) - Puerto Caldera	178650.641	48	8.575
40	Wybelsum	Goteborg - Cuxhaven	494316.377	31	15.324
		Felixstowe - Goteborg	1039760.5	48	49.909
		Bremerhaven - Felixstowe	461454.255	31	14.305
		Sankt Pettersburg - Bremerhaven	281333.321	192	54.016
		Kiel - Sankt Pettersburg	1091704.52	48	52.402
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	525478.822	34	17.866
		Port of Makassar - Semarang	2125636.92	48	102.031
		Jakarta (Tanjjung Priok) - Surabaya	191942.162	96	18.426

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Jakarta (Tanjung Priok) - Port of Makassar	723590.267	96	69.465
		Surabaya - Bitung	2380881.54	72	171.423
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	294677.746	24	7.072
		Puerto Cortes - Puerto Colon	393178.617	72	28.309
		Santo Tomas De Castilla - Puerto Cortes	231020.335	8	1.848
		Fort Lauderdale - Santo Tomas De Castilla	983648.395	72	70.823
		Savannah - Fort Lauderdale	1232957.79	25	30.824
43	AS Samanta	Cartagena - Santa Marta	249514.072	15	3.743
		Barranquilla - Cartagena	212042.266	12	2.545
		Kingston - Barranquilla	700590.883	35	24.521
		Port of Miami - Kingston	1207904.62	72	86.969
		Puerto De Haina - Port of Miami	1577260.93	72	113.563
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	329527.565	8	2.636
		Fort Lauderdale - Santo Tomas de Castilla	1128289.07	48	54.158
		Savannah - Fort Lauderdale	366000.704	48	17.568
		Wilmington (NC) - Savannah	177891.909	33	5.870
		Gloucester City - Wilmington (NC)	368045.396	48	17.666
45	RHL Agilitas	Halifax - Kingston	973354.244	120	116.803
		Newark - Halifark	481372.202	48	23.106
		Kingston - Newark	778004.662	120	93.361
46	Viona	Bremerhaven - Rotterdam	1290596.9	17	21.940
		Arhus - Bremerhaven	1625568.01	28	45.516
		Reykjavik - Arhus	1496412.52	72	107.742
		Grundartangi - Reykjavik	423225.388	3	1.270
47	Maersk Vallvik	Charleston - Freeport	851937.627	30	25.558
		Norfolk - Charleston	566770.645	48	27.205
		Freeport - Port Elizabeth	1064049.54	456	485.207
		Port Elizabeth - Durban	929959.692	29	26.969
48	Maersk Vilnius	Durban - Cape Town	64677.3177	192	12.418
		Salalah - Durban	958938.378	288	276.174
		Al Duqm - Salalah	189791.929	72	13.665
		Cape Town - Newark	715636.48	528	377.856
		Newark - Port of Baltimore	483272.726	48	23.197
49	Maersk Visby	Port Elizabeth - Durban	252693.27	48	12.129
		Freeport - Port Elizabeth	964805.422	504	486.262
		Charleston - Freeport	892237.826	28	24.983

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Norfolk - Charleston	622085.778	48	29.860
		Durban - Cape Town	1728882.85	48	82.986
50	Bernard A	Samsun - Istanbul	417863.659	35	14.625
		Poti - Samsun	875382.129	22	19.258
		Istanbul - Poti	195273.565	72	14.060
		Constanta - Istanbul	293479.003	32	9.391
		Samsun - Constanta	430142.048	35	15.055
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	127769.193	27	3.450
		Port of Makassar - Semarang	515521.935	48	24.745
		Surabaya - Port of Makassar	118412.674	72	8.526
52	Nexo Maersk	Tanger Mediterranean - Algeciras	184328.627	4	0.737
		Vado Ligure - Tanger Mediterranean	543339.328	72	39.120
		For sur mer - Vado Ligure	288615.959	48	13.854
		Algericas - Montreal	1239100.84	240	297.384
		Tanger Mediterranean - For sur mer	1078766.05	48	51.781
53	Nele Maersk	Novorossiysk - Port Said	820257.77	120	98.431
		Port Said - Novorossiysk	261193.065	192	50.149
		Istanbul - Novorossiysk	165444.608	72	11.912
		Damietta - Istanbul	1674358.17	96	160.738
		Port Said - Damietta	17188.8757	33	0.567
54	Tanto Nusantara	Jakarta - Belawan	363739.9	96	34.919
		Belawan - Jakarta	222565.559	144	32.049
55	EMS Trader	Puerto Colon - Cartagena	1498967.23	17	25.482
		Puerto Cortes - Puerto Colon	710807.392	48	34.119
		Santo Tomas de Castilla - Puerto Cortes	89437.1818	15	1.342
		Mariel - Santo Tomas De Castilla	218802.104	72	15.754
		New Orleans - Mariel	1093370.59	48	52.482
56	Miami Trader	Jawaharlal Nehru Port - Colombo	718405.093	72	51.725
		Mundra - Jawaharlal Nehru Port	353762.746	48	16.981
		Dubai (Jebel Ali) - Mundra	571072.924	72	41.117
		Colombo - Durban	678265.331	360	244.176
		Port Louis - Dubai (Jebel Ali)	487093.299	264	128.593
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	945836.253	168	158.900
		Djibouti - Salalah	751158.763	72	54.083
		Toamasina - Victoria	1814904.64	48	87.115
		Port Louis - Toamasina	2030517.97	27	54.824
		Le Port (Pointe des Galets) - Port Louis	899.755082	216	0.194

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
58	X-Press Machu Picchu	Puerto Colon - Cartagena	23940.4622	120	2.873
		Mariel - Puerto Colon	927621.652	72	66.789
		Cartagena - Mariel	772316.938	96	74.142
59	JPO Aries	Valencia - Lisbon	402708.953	72	28.995
		Lisbon - Halifax	552562.684	216	119.354
		Barcelona - Valencia	429498.087	17	7.301
60	Nordatlantic	Toamasina - Salalah	455977.544	264	120.378
		Port Louis - Toamasina	284863.785	48	13.673
		Le Port (Pointe des Galets) - Port Louis	159570.478	17	2.713
		Salalah - Port Louis	427885.192	216	92.423
61	Ballenita	Tacoma - Vancouver	1197410.75	13	15.566
		Everett - Tacoma	833630.166	4	3.335
		Tokyo Ko - Everett	1045483.52	312	326.191
62	Maersk Norfolk	Fos sur mer - Genoa	72439.5612	48	3.477
		Tanger Mediterranean - Fos sur mer	958580.496	48	46.012
		Montreal - Tanger Mediterranean	478296.576	288	137.749
		Tanger Mediterranean - Algericas	16976.0319	48	0.815
		Genoa - Tanger Mediterranean	447382.12	72	32.212
63	Maersk Newport	Istanbul - Evyap	277817.516	7	1.945
		Piraeus (Athens) - Istanbul	585282.781	31	18.144
		For sur mer - Piraeus (Athens)	1164734.12	72	83.861
		Barcelona - For sur mer	147026.628	27	3.970
		Castellon de la Plana - Barcelona	412079.446	13	5.357
64	City of Hongkong	Conarky - San Pedro	441625.224	48	21.198
		Dakar - Conarky	154473.876	72	11.122
		Durban - Cape Town	808060.894	72	58.180
		Ngqura - Durban	1201316.53	27	32.436
		San Pedro - Ngqura	215659.743	360	77.638
65	Maersk Brani	Hamburg - Bremerhaven	943882.74	10	9.439
		Antwerp - Hamburg	1112602.01	30	33.378
		Bremerhaven - Altamira	1911657.74	336	642.317
66	Porto	Nagoya Ko - Yokkaichi	118375.831	5	0.592
		Yokkaichi - Taipei	1505542.32	72	108.399
		Taipei - Taichung	432000.724	9	3.888
		Taichung - Kaohsiung	648019.985	12	7.776
		Kaohsiung - Hong Kong	1137783.82	23	26.169
67	Burgundy	Constanta - Istanbul	30407.653	72	2.189

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Odessa - Constanta	817330.487	16	13.077
		Diliskelesi - Odessa	546143.605	36	19.661
		Piraeus (Athens) - Diliskelesi	134986.472	72	9.719
		Malta Freeport - Piraeus (Athens)	661433.792	48	31.749
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	473878.174	48	22.746
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	347803.844	31	10.782
		Shuaiba - Khalifa Bin Salman Port	218576.646	72	15.738
		Khalifa Bin Salman Port - Shuaiba	675969.015	24	16.223
69	Maersk Izmir	Sydney - Melbourne	501755.256	48	24.084
		Tauranga - Sydney	1150817.12	96	110.478
		Panama City - Tauranga	1059597.34	432	457.746
		Cartagena - Panama City	144424.495	48	6.932
		Charleston - Cartagena	579034.569	120	69.484
70	Nordautumn	Algericas - Tanger Mediterranean	66512.5255	6	0.399
		Dakar Abidjan	2016323.34	72	145.175
		Tanger Mediterranean - Dakar	1870745.8	96	179.592
		Abidjan - Lome	2033725.34	23	46.776
71	Maersk Cabinda	Lagos - Onne	585141.556	48	28.087
		Onne - Pointe Noire	422675.867	96	40.577
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	798587.152	72	57.498
		Yangshan - Ningbo Zhousan	270764.841	16	4.332
		Qingdao - Yangshan	669553.274	48	32.139
		Busan - Qingdao	1627437.06	34	55.333
		Hong Kong - Sydney	1078616.05	312	336.528
73	Wide Alpha	Yangshan - Ningbo Zhousan	350429.029	15	5.256
		Qingdao - Yangshan	1594101.41	28	44.635
		Busan - Qingdao	1679864.74	32	53.756
		Osaka - Busan	1026139.93	48	49.255
74	Maersk Indus	Colombo - Pointe Noire	1522955.73	408	621.366
		Jawaharlal Nehru Port - Colombo	1830645.36	48	87.871
		Mundra - Jawaharlal Nehru Port	513130.575	48	24.630
		Pointe Noire - Cotonou	953862.96	120	114.464
75	Kyparissia	Walvis Bay - Durban	330235.72	168	55.480
		Onne - Walvis Bay	578944.168	168	97.263
		Cotonou - Onne	241861.701	96	23.219
		Durban - Tanjung Pelepas	1622141.24	312	506.108
		Tanjung Pelepas - Nansha	577401.689	144	83.146

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
76	Leonidio	Lagos - Cotonou	187809.518	8	1.502
		Cotonou - Lagos	178492.467	8	1.428
77	ALS Ceres	Surabaya - Singapore	105743.605	144	15.227
		Jakarta (Tanjung Priok) - Surabaya	1284234.98	36	46.232
		Shenzhen - Jakarta (Tanjung Priok)	1598867.83	120	191.864
		Shantou - Shenzhen	517951.514	20	10.359
		Ningbo Zhousan - Shantou	1872592.31	36	67.413
78	Rosa	Ningbo Zhousan - Shanghai	328268.875	26	8.535
		Qingdao - Ningbo Zhousan	546934.795	48	26.253
		Busan - Qingdao	685612.522	72	49.364
		Portland - Busan	1329060.56	312	414.667
79	Lana	Douala - Cotonou	234074.038	72	16.853
		Porto de Luanda - Douala	220115.519	120	26.414
		Pointe Noire - Porto de Luanda	2828518.64	19	53.742
		Algericas - Pointe Noire	782482.088	312	244.134
		Tanger Mediterranean - Algericas	6140.71912	23	0.141
80	Schubert	Shanghai - Busan	1275253.06	34	43.359
		Ningbo Zhoushan - Shanghai	121660.408	35	4.258
		Qingdao - Ningbo Zhoushan	918443.869	48	44.085
		Busan - Qingdao	775563.095	72	55.841
		Portland - Busan	1335388.6	312	416.641
81	Northern Guard	Shanghai - Hong Kong	1034308.86	72	74.470
		Qingdao - Shanghai	575711.723	48	27.634
		Busan - Qingdao	629855.997	72	45.350
		Hong Kong - Johor	1029611.02	168	172.975
		Johor - Singapore	19491.1385	22	0.429
82	Kea	Rotterdam - Hamburg	305868.255	48	14.682
		Le Havre - Rotterdam	1389315.37	18	25.008
		Hamburg - Newark	1573407.48	264	415.380
83	YM Wealth	Busan - Yangshan	955489	48	45.863
		Singapore - Busan	2680023.89	144	385.923
		Jeddah - Singapore	1135712.77	336	381.599
		Sokhna - Jeddah	1046614.84	48	50.238
		Al Aqabah - Sokhna	118025.477	72	8.498
84	E R France	Hong Kong - Shenzhen	423777.315	3	1.271
		Kaohsing - Hong Kong	965126.503	29	27.989
		Busan - Kaohsiung	1189992	72	85.679
		Manzanillo - Busan	2310339	408	942.618

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Guayaquil - Manzanillo	1133463.6	144	163.219
85	SC Mara	Sydney - Brisbane	2362741.08	33	77.970
		Melbourne - Sydney	1298864.27	48	62.345
		Yantian - Melbourne	1474968.67	336	495.589
		Brisbane - Busan	2233305.41	240	535.993
		Shanghai - Yantian	1013096.28	72	72.943
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	9703.62434	34	0.330
		Qinzhou - Rizhao	591041.092	168	99.295
		Lianyungang - Qinzhou	412809.414	192	79.259
87	Miami	Manzanillo - Los Angeles	625550.362	120	75.066
		Coronel - San Antonio	159802.812	48	7.671
		Valparaiso - Coronel	4248.81938	168	0.714
		Los Angeles - Ningbo Zhoushan	919890.92	456	419.470
		San Antonio - Manzanillo	793060.502	312	247.435
88	Maersk Columbus	Algeciras - Port Said	2853756.7	120	342.451
		Tanger Mediterranean - Algericas	4630.97948	120	0.556
		Port Said - Salalah	3691231.62	120	442.948
		Salalah - Dubai (Jebel Ali)	2639579.79	48	126.700
		Dubai (Jebel Ali) - Muhammad Bin Qasim	1356217.95	72	97.648
89	Maersk Denver	Newark - Algericas	1002721.43	264	264.718
		Norfolk - Newark	544182.654	33	17.958
		Djilbouti - Salalah	1147820.63	72	82.643
		Port Said - Djibouti	2392708.3	96	229.700
		Algericas - Port Said	2392708.3	120	287.125
90	Maersk Chicago	Salalah - Algericas	2328160.35	240	558.758
		Algericas - Newark	4043973.9	168	679.388
		Savannah - Houston	3262560.63	72	234.904
		Newark - Charleston	833317.188	48	39.999
		Charleston - Savannah	234388.397	20	4.688
91	Maersk Lirquen	Hong Kong - Yangshan	456656.707	168	76.718
		Singapore - Hong Kong	3106250.96	96	298.200
92	Maersk Kowloon	Algericas - Sines	1311571.73	23	30.166
		Valencia - Algericas	171298.476	72	12.333
		Genoa - Valencia	3038844.58	32	97.243
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	2975222.37	96	285.621
		Sines - Gioia Tauro Harbour	734511.203	120	88.141
		Freeport - Sines	1338690.93	288	385.543

No	Ship	Trip	FOC (g/hour)	Travel Time (hour)	FOC Estimation (ton)
		Charleston - Freeport	2564957.24	27	69.254
		Savannah - Charleston	495002.622	15	7.425
94	Maersk Savannah	Qingdao - Busan	1388628.68	48	66.654
		Yangshan - Qingdao	1220965.58	48	58.606
		Ningbo Zhoushan - Yangshan	6138.85849	25	0.153
		Shenzhen - Ningbo Zhoushan	1746306.5	72	125.734
		Hong Kong - Shenzhen	214604.2	9	1.931
95	Maersk Sarnia	Busan - Vancouver	2815486.42	288	810.860
		Yangshan - Busan	474357.25	96	45.538
		Ningbo Zhousan - Yangshan	746173.381	20	14.923
		Yantian - Ningbo Zhousan	2830927.81	48	135.885
		Vancouver - Seattle	1868510.11	12	22.422
96	Clementine Maersk	Busan - Newark	4174973.8	552	2304.586
		Yangshan - Busan	779003.857	72	56.088
		Norfolk - Newark	1648416	25	41.210
		Port of Baltimore - Norfolk	1707020.96	13	22.191
		Newark - Port of Baltimore	646717.665	48	31.042
97	Axel Maersk	Port of Miami - Freeport	218043.148	14	3.053
		Savannah - Port of Miami	535440.849	48	25.701
		Charleston - Savannah	415668.497	15	6.235
		Newark - Charleston	1511219.3	48	72.539
		Singapore - Newark	4470948.47	552	2467.964
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3549665.01	216	766.728
		Busan - Yokohama Ko	5410677.16	48	259.713
		Yangshan - Busan	448287.646	72	32.277
		Los Angeles - Oakland	727968.043	48	34.942
		Prince Rupert - Loa Angeles	1366338.9	120	163.961
99	Emma Maersk	Tanger Mediterranean - Salalah	3438094.82	240	825.143
		Le Havre - Tanger Mediterranean	1761884.24	96	169.141
		London Gateway Port - Le Havre	3697269.59	16	59.156
		Antwerp - London Gateway Port	423622.49	24	10.167
		Hamburg - Antwerp	1385510.76	34	47.107
100	Munich Maersk	Yantian - Tanjung Pelepas	12390897.3	72	892.145
		Yangshan - Yantian	7880488.4	48	378.263
		Ningbo Zhoushan - Yangshan	72993.2013	48	3.504
		Busan - Ningbo Zhoushan	2739160.22	48	131.480
		Tianjin - Busan	2277004.58	72	163.944

4.3 Analysis of Error in Estimation Value

The absolute percentage error is used to determine the range of error from estimation value to the actual data. The actual data using the MV. Meratus Benoa noon report. This report contains essential voyage data, including the bunkering data, which is showing the amount of fuel oil consumption per day. Then calculate the data with the time of voyage to get the actual fuel oil consumption.

The formula to determine the error rate as follows:

$$\boldsymbol{Absolute\ Percentage\ Error} = \left(\frac{|\boldsymbol{A_t} - \boldsymbol{F_t}|}{\boldsymbol{A_t}}\right) \times \mathbf{100\%} \tag{11}$$

$$\boldsymbol{Mean\ APE} = \sum_{t=1}^{n}\left(\frac{|\boldsymbol{A_t} - \boldsymbol{F_t}|}{\boldsymbol{A_t}}\right) \times \frac{\mathbf{100\%}}{\boldsymbol{n}} \tag{12}$$

Where:
A_t : Actual value
F_t : Forecast value
n : Number of calculated values

For the error rate from STEAM's method using Eq. (11) and Eq. (12), resulted

Table 4.8 MAPE of STEAM Method's

Voyage Number	Trip Number	Route		Actual FOC MFO (ton)	Estimated FOC (ton)	Error Rate (%)
		Origin	Destination			
1901	MBN-2	Kumai	Semarang	7.234	6.3981952	12%
1901	MBN-3	Semarang	Surabaya	5.088	6.3639699	25%
1902	MBN-4	Surabaya	Samarinda	13.671	15.709107	15%
1903	MBN-6	Surabaya	Kumai	12.924	9.4875486	27%
1903	MBN-7	Kumai	Semarang	7.916	5.7295738	28%
1903	MBN-8	Semarang	Surabaya	4.202	5.7152996	36%
1904	MBN-10	Sampit	Surabaya	6.882	6.0422427	12%
1905	MBN-11	Surabaya	Semarang	5.104	6.6492293	30%
1905	MBN-12	Semarang	Kumai	7.727	7.5396415	2%
1905	MBN-13	Kumai	Surabaya	6.494	6.8961114	6%
1906	MBN-14	Surabaya	Kumai	7.472	5.1690953	31%
1906	MBN-15	Kumai	Surabaya	6.634	7.8214651	18%

Voyage Number	Trip Number	Route		Actual FOC MFO (ton)	Estimated FOC (ton)	Error Rate (%)
		Origin	Destination			
1907	MBN-16	Surabaya	Kumai	8.132	5.8977819	27%
1907	MBN-17	Kumai	Surabaya	6.802	6.9015008	1%
1908	MBN-18	Surabaya	Kumai	9.178	8.4712189	8%
1908	MBN-20	Semarang	Surabaya	4.513	4.2866739	5%
1909	MBN-21	Surabaya	Kumai	12.084	8.1529788	33%
1909	MBN-23	Semarang	Surabaya	4.493	4.6757078	4%
1910	MBN-25	Kumai	Semarang	8.066	5.0117549	38%
1910	MBN-26	Semarang	Surabaya	4.376	5.0063244	14%
					Avg. Error	=14%

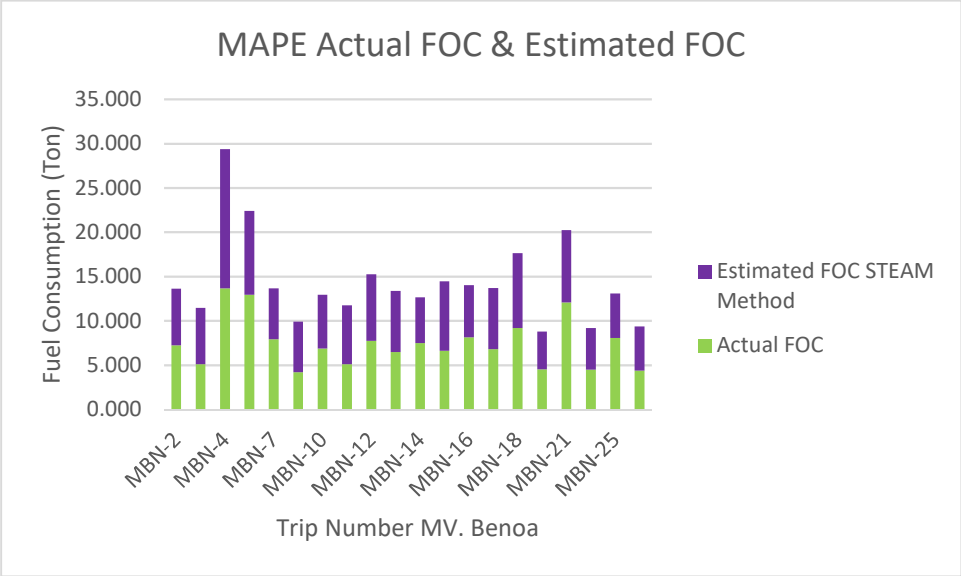

Figure 4.1 Graph of MAPE Between Estimated FOC STEAM Method & Actual FOC

This method, as stated by J.-P. Jalkanen, only have **7%** of differences between the actual value, so this error result with **14%** of error is quite close to those statements.

4.4 EEOI Calculation Result

The variables that use for the EEOI calculation are stated in guidelines for EEOI by IMO, which is fuel oil consumption, distance sailed, and cargo carried. The cargo

carried is assumed at the maximum capacity for each ship. The formula stated in Eq. 5 and resulted as follow

Table 4.9 EEOI Estimation Value from STEAM Method's

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	612.68	167	1.872	0.0000586
		Port Moresby - Tanjung Bara Coal	2149.63	167	14.550	0.0001299
		Benete - Port Moresby	2708.69	167	14.872	0.0001054
2	Territory Trader	Surabaya - Sorong	1217.44	256	18.157	0.0001868
		Sorong - Surabaya	1228.04	256	21.980	0.0002241
3	Multi Express	Tangguh LNG - Gresik	1321.35	256	4.923	0.0000467
		Tangguh LNG - Ciwadan	1702.42	256	9.919	0.0000730
4	Tanto Abadi	Gorontalo - Surabaya	999.99	270	7.723	0.0000917
		Port of Makassar - Surabaya	436.5	270	4.023	0.0001094
		Surabaya - Gorontalo	995.77	270	8.207	0.0000979
5	Meratus Sabang	Surabaya - Benoa (Bali)	282.67	136	2.933	0.0002446
		Benoa (Bali) - Surabaya	283.51	136	2.356	0.0001959
6	Meratus Sibolga	Surabaya - Benoa (Bali)	285.96	136	1.621	0.0001336
		Benoa (Bali) - Surabaya	289.24	136	2.465	0.0002009
7	Tanto Ceria	Banjarmasin - Gresik	256.49	361	1.074	0.0000372
		Surabaya - Banjarmasin	264.65	361	1.157	0.0000388
		Gresik - Surabaya	8.03	361	0.019	0.0000207
8	Meratus Project 1	Gresik - Tangguh LNG	1311.97	512	31.369	0.0001497
		Ciwandan - Surabaya	450.45	512	15.456	0.0002149
		Tangguh LNG - Ciwandan	1744.94	512	54.706	0.0001963
9	Meratus Padang	Surabaya - Dili	876.65	630	6.611	0.0000384
		Dili - Surabaya	880.55	630	1.968	0.0000114
10	Tanto Sentosa	Surabaya - Gresik	8.24	256	0.087	0.0001316
		Surabaya - Port of Makassar	429.49	256	6.149	0.0001793
		Gresik - Surabaya	7.16	256	0.054	0.0000939
11	Vitoria S	Istanbul - Galati	414.75	285	2.858	0.0000775
		Galati - Haifa	1163.32	285	7.655	0.0000740
12	Merartus Benoa	Semarang - Surabaya	190.78	368	4.772	0.0002179
		Kumai - Semarang	284.04	368	17.619	0.0005404
		Surabaya - Kumai	282.25	368	17.691	0.0005461

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
13	Meratus Bontang	Lembar - Ende	396.98	368	18.918	0.0004152
		Surabaya - Lembar	271.06	368	8.768	0.0002818
		Ende - Surabaya	606.15	368	12.501	0.0001797
14	Meratus Barito	Ende - Surabaya	617.03	368	9.282	0.0001311
		Lembar - Ende	402.1	368	7.326	0.0001587
		Surabaya - Lembar	270.79	368	6.332	0.0002037
15	Tanto Alam	Jakarta - Balikpapan	1579.44	338	38.096	0.0002288
		Balikpapan - Jakarta	1577.22	338	36.766	0.0002211
16	Tanto Aman	Jakarta - Balikpapan	1583.33	338	40.778	0.0002443
		Balikpapan - Jakarta	1585.9	338	30.759	0.0001840
17	Meratus Ultima 2	Banjarmasin - Surabaya	264.11	455	5.447	0.0001453
		Surabaya - Banjarmasin	264.13	455	5.224	0.0001394
18	Meratus Ultima 1	Lembar - Surabaya	279.34	455	2.728	0.0000688
		Surabaya - Lembar	280.96	455	5.087	0.0001276
19	Tanto Subur I	Singapore -Batu Ampar	1.8	385	0.001	0.0000049
		Jakarta - Singapore	510.81	385	4.634	0.0000755
		Batu Ampar - Jakarta	511.41	385	2.787	0.0000454
20	Tanto Subur II	Surabaya - Balikpapan	966.27	385	28.677	0.0002471
		Balikpapan - Surabaya	967.54	385	24.156	0.0002079
21	Meratus Palembang	Banjarmasin - Surabaya	264.91	630	3.524	0.0000677
		Surabaya - Dili	856.19	630	8.388	0.0000499
22	Goteborg	Matadi - Pointe Noire	184.26	618	0.343	0.0000096
		Pointe Noire - Douala	672.8	618	14.576	0.0001124
		Pointe Noire - Cabinda	170.08	618	1.421	0.0000434
		Pointe Noire - Matadi	201.57	618	6.485	0.0001669
23	Meratus Dili	Surabaya - Dili	875.76	600	28.961	0.0001767
		Dili - Maumere	244	600	4.459	0.0000976
		Surabaya - Banjarmasin	264.95	600	4.558	0.0000919
24	Meratus Kendari 1	Surabaya - Banjarmasin	264.83	599	1.719	0.0000347
		Surabaya - Ambon	978.26	599	21.890	0.0001198
		Ambon - Port of Makassar	600.91	599	10.068	0.0000897
		Banjarmasin - Surabaya	263.66	599	1.010	0.0000205
25	Viola	Boma - Matadi	27.7	713	0.460	0.0000746
		Pointe Noire - Boma	194.23	713	3.265	0.0000756

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Matadi - Pointe Noire	230.52	713	0.508	0.0000099
26	Meratus Kalabahi	Palu - Surabaya	625.72	831	11.672	0.0000720
		Tolitoli - Palu	162.98	831	4.643	0.0001099
		Ambon - Surabaya	984.4	831	45.268	0.0001774
27	Meratus Kupang	Surabaya - Port of Makassar	437.46	802	9.809	0.0000896
		Port of Makassar - Surabaya	439.06	802	6.957	0.0000633
28	Meratus Kelimutu	Palu - Tolitoli	158.08	831	6.177	0.0001507
		Palu - Surabaya	626.68	831	16.685	0.0001027
		Tolitoli - Palu	161.52	831	3.915	0.0000935
		Surabaya - Tolitoli	735.98	831	18.119	0.0000950
29	Ruth	Santa Cruz de Tenerife - Ferrol	1332.9	868	63.290	0.0001754
		Las Palmas - Santa Cruz de Tenerife	54.18	868	1.783	0.0001216
		Tilbury - Las Palmas	1711.49	868	77.160	0.0001665
		Rotterdam - Tilbury	177.64	868	3.907	0.0000812
		Hamburg - Rotterdam	317.68	868	9.720	0.0001130
30	Meratus Batam	Surabaya - Kupang	723.96	910	37.198	0.0001810
		Kupang - Surabaya	726.32	910	10.169	0.0000493
31	Tanto Express	Jayapura - Ambon	916.77	662	22.682	0.0001198
		Surabaya - Port of Makassar	433.79	662	7.656	0.0000855
		Gresik - Surabaya	8.46	662	0.114	0.0000652
		Ambon - Surabaya	975.62	662	23.194	0.0001151
32	New York Trader	Evyap - Istanbul	43.66	1102	0.830	0.0000553
		San Juan - Evyap	5412.36	1102	102.466	0.0000551
		Kingston - San Juan	664.05	1102	7.920	0.0000347
		Port of Spain - Kingston	1005.47	1102	28.358	0.0000821
		Point Lisas - Port of Spain	23.48	1102	0.029	0.0000036
33	Maersk Regensburg	Cotonou - Lagos	73.48	1118	1.674	0.0000653
		Cotonou - Takoradi	283.66	1118	8.264	0.0000835
34	Maersk Roubaix	Port Owendo - Pointe Noire	444.75	1118	1.236	0.0000080
		Tema - Port Owendo	1760.54	1118	27.587	0.0000449
		Pointe Noire - Tema	946.46	1118	38.446	0.0001165
		Porto de Luanda - Pointe Noire	236.75	1118	13.971	0.0001692

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Pointe Noire - Porto de Luanda	714.48	1118	4.878	0.0000196
35	Meratus Mamiri	Kupang - Surabaya	714.13	1104	7.489	0.0000305
		Surabaya - Port of Makassar	438.33	1104	16.132	0.0001069
36	Meratus Makassar	Surabaya - Port of Makassar	444.44	1104	2.808	0.0000183
		Port of Makassar - Surabaya	442.43	1104	14.399	0.0000945
37	Meratus Malino	Palu - Surabaya	604.39	1104	31.706	0.0001523
		Surabaya - Port of Makassar	437.59	1104	25.068	0.0001664
38	X-Press Elbe	Rotterdam - Antwerp	122.36	1036	2.054	0.0000519
		Sankt Pettersburg - Riga	462.73	1036	10.009	0.0000669
		Riga - Kiel	555.13	1036	35.525	0.0001980
		Kiel - Brunsbuttel	50.53	1036	0.435	0.0000266
		Brunsbuttel - Rotterdam	288.69	1036	12.797	0.0001372
39	Juliana	Panama City (Balboa) - Corinto	713.72	1338	39.103	0.0001313
		Corinto - Panama City (Balboa)	720.72	1338	33.649	0.0001119
		Puerto Caldera - Corinto	277.5	1338	2.474	0.0000214
		Panama City (Balboa) - Puerto Caldera	503.11	1338	8.575	0.0000408
40	Wybelsum	Goteborg - Cuxhaven	363.89	1306	15.324	0.0001034
		Felixstowe - Goteborg	550.18	1306	49.909	0.0002227
		Bremerhaven - Felixstowe	318.18	1306	14.305	0.0001104
		Sankt Pettersburg - Bremerhaven	1001.09	1306	54.016	0.0001325
		Kiel - Sankt Pettersburg	784.23	1306	52.402	0.0001640
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	263.78	1005	17.866	0.0002161
		Port of Makassar - Semarang	593.41	1005	102.031	0.0005485
		Jakarta (Tanjjung Priok) - Surabaya	408.51	1005	18.426	0.0001439
		Jakarta (Tanjung Priok) - Port of Makassar	793.79	1005	69.465	0.0002792
		Surabaya - Bitung	1055.01	1005	171.423	0.0005183
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	231.37	1713	7.072	0.0000572
		Puerto Cortes - Puerto Colon	786.44	1713	28.309	0.0000674
		Santo Tomas De Castilla - Puerto Cortes	64.17	1713	1.848	0.0000539
		Fort Lauderdale - Santo Tomas De Castilla	893.65	1713	70.823	0.0001483
		Savannah - Fort Lauderdale	391.1	1713	30.824	0.0001475

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
43	AS Samanta	Cartagena - Santa Marta	129.22	1713	3.743	0.0000542
		Barranquilla - Cartagena	101.55	1713	2.545	0.0000469
		Kingston - Barranquilla	443.18	1713	24.521	0.0001036
		Port of Miami - Kingston	927.94	1713	86.969	0.0001754
		Puerto De Haina - Port of Miami	1087.71	1713	113.563	0.0001954
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	57.17	1713	2.636	0.0000863
		Fort Lauderdale - Santo Tomas de Castilla	897	1713	54.158	0.0001130
		Savannah - Fort Lauderdale	411.68	1713	17.568	0.0000799
		Wilmington (NC) - Savannah	247.95	1713	5.870	0.0000443
		Gloucester City - Wilmington (NC)	540.28	1713	17.666	0.0000612
45	RHL Agilitas	Halifax - Kingston	1841.17	1732	116.803	0.0001174
		Newark - Halifark	647.08	1732	23.106	0.0000661
		Kingston - Newark	1527.21	1732	93.361	0.0001132
46	Viona	Bremerhaven - Rotterdam	273.68	1719	21.940	0.0001495
		Arhus - Bremerhaven	496.75	1719	45.516	0.0001709
		Reykjavik - Arhus	1376.91	1719	107.742	0.0001459
		Grundartangi - Reykjavik	15.55	1719	1.270	0.0001523
47	Maersk Vallvik	Charleston - Freeport	408.49	1800	25.558	0.0001114
		Norfolk - Charleston	456.95	1800	27.205	0.0001060
		Freeport - Port Elizabeth	7013.3	1800	485.207	0.0001232
		Port Elizabeth - Durban	395.61	1800	26.969	0.0001214
48	Maersk Vilnius	Durban - Cape Town	819.94	1810	12.418	0.0000268
		Salalah - Durban	3628.87	1810	276.174	0.0001348
		Al Duqm - Salalah	352.12	1810	13.665	0.0000687
		Cape Town - Newark	6951.03	1810	377.856	0.0000963
		Newark - Port of Baltimore	429.55	1810	23.197	0.0000957
49	Maersk Visby	Port Elizabeth - Durban	412.78	1810	12.129	0.0000520
		Freeport - Port Elizabeth	7030.25	1810	486.262	0.0001225
		Charleston - Freeport	408.37	1810	24.983	0.0001084
		Norfolk - Charleston	442.14	1810	29.860	0.0001196
		Durban - Cape Town	817.51	1810	82.986	0.0001798
50	Bernard A	Samsun - Istanbul	395.39	1604	14.625	0.0000739
		Poti - Samsun	242.18	1604	19.258	0.0001589
		Istanbul - Poti	630.81	1604	14.060	0.0000445

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Constanta - Istanbul	215.29	1604	9.391	0.0000872
		Samsun - Constanta	387.73	1604	15.055	0.0000776
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	253.09	1380	3.450	0.0000317
		Port of Makassar - Semarang	582.99	1380	24.745	0.0000986
		Surabaya - Port of Makassar	443.11	1380	8.526	0.0000447
52	Nexo Maersk	Tanger Mediterranean - Algeciras	24.19	2230	0.737	0.0000438
		Vado Ligure - Tanger Mediterranean	883.92	2230	39.120	0.0000636
		For sur mer - Vado Ligure	235.7	2230	13.854	0.0000845
		Algericas - Montreal	3327.24	2230	297.384	0.0001285
		Tanger Mediterranean - For sur mer	713.53	2230	51.781	0.0001043
53	Nele Maersk	Novorossiysk - Port Said	1307.73	2230	98.431	0.0001082
		Port Said - Novorossiysk	1372.17	2230	50.149	0.0000525
		Istanbul - Novorossiysk	496.12	2230	11.912	0.0000345
		Damietta - Istanbul	770.36	2230	160.738	0.0003000
		Port Said - Damietta	70.86	2230	0.567	0.0000115
54	Tanto Nusantara	Jakarta - Belawan	869.18	2312	34.919	0.0000557
		Belawan - Jakarta	902.82	2312	32.049	0.0000492
55	EMS Trader	Puerto Colon - Cartagena	278.18	2452	25.482	0.0001198
		Puerto Cortes - Puerto Colon	768.94	2452	34.119	0.0000580
		Santo Tomas de Castilla - Puerto Cortes	64.3	2452	1.342	0.0000273
		Mariel - Santo Tomas De Castilla	603.32	2452	15.754	0.0000341
		New Orleans - Mariel	614.14	2452	52.482	0.0001117
56	Miami Trader	Jawaharlal Nehru Port - Colombo	926.1	2462	51.725	0.0000727
		Mundra - Jawaharlal Nehru Port	423.06	2462	16.981	0.0000523
		Dubai (Jebel Ali) - Mundra	952.39	2462	41.117	0.0000562
		Colombo - Durban	3659.54	2462	244.176	0.0000869
		Port Louis - Dubai (Jebel Ali)	3032.51	2462	128.593	0.0000552
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	2287.52	2529	158.900	0.0000881
		Djibouti - Salalah	784.31	2529	54.083	0.0000874
		Toamasina - Victoria	909.66	2529	87.115	0.0001214
		Port Louis - Toamasina	476.07	2529	54.824	0.0001460

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Le Port (Pointe des Galets) - Port Louis	142.29	2529	0.194	0.0000017
58	X-Press Machu Picchu	Puerto Colon - Cartagena	482.62	2529	2.873	0.0000075
		Mariel - Puerto Colon	1005.04	2529	66.789	0.0000842
		Cartagena - Mariel	1058.44	2529	74.142	0.0000888
59	JPO Aries	Valencia - Lisbon	720.55	2470	28.995	0.0000522
		Lisbon - Halifax	2561.35	2470	119.354	0.0000605
		Barcelona - Valencia	177.56	2470	7.301	0.0000534
60	Nordatlantic	Toamasina - Salalah	2223.83	2478	120.378	0.0000700
		Port Louis - Toamasina	476.55	2478	13.673	0.0000371
		Le Port (Pointe des Galets) - Port Louis	139.6	2478	2.713	0.0000251
		Salalah - Port Louis	2269.76	2478	92.423	0.0000527
61	Ballenita	Tacoma - Vancouver	178.69	2546	15.566	0.0001097
		Everett - Tacoma	47.97	2546	3.335	0.0000875
		Tokyo Ko - Everett	4561.24	2546	326.191	0.0000901
62	Maersk Norfolk	Fos sur mer - Genoa	241.65	2478	3.477	0.0000186
		Tanger Mediterranean - Fos sur mer	709.62	2478	46.012	0.0000839
		Montreal - Tanger Mediterranean	3316.55	2478	137.749	0.0000537
		Tanger Mediterranean - Algericas	169.32	2478	0.815	0.0000062
		Genoa - Tanger Mediterranean	1146.06	2478	32.212	0.0000364
63	Maersk Newport	Istanbul - Evyap	57.2	2478	1.945	0.0000440
		Piraeus (Athens) - Istanbul	352	2478	18.144	0.0000667
		For sur mer - Piraeus (Athens)	1105.23	2478	83.861	0.0000982
		Barcelona - For sur mer	203.82	2478	3.970	0.0000252
		Castellon de la Plana - Barcelona	132.16	2478	5.357	0.0000524
64	City of Hongkong	Conarky - San Pedro	620.77	2578	21.198	0.0000425
		Dakar - Conarky	504.3	2578	11.122	0.0000274
		Durban - Cape Town	894.88	2578	58.180	0.0000809
		Ngqura - Durban	403.62	2578	32.436	0.0000999
		San Pedro - Ngqura	3171.3	2578	77.638	0.0000304
65	Maersk Brani	Hamburg - Bremerhaven	122.21	3398	9.439	0.0000729
		Antwerp - Hamburg	393.82	3398	33.378	0.0000800
		Bremerhaven - Altamira	5506.03	3398	642.317	0.0001101

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
66	Porto	Nagoya Ko - Yokkaichi	12.69	2798	0.592	0.0000534
		Yokkaichi - Taipei	1064.21	2798	108.399	0.0001167
		Taipei - Taichung	95.25	2798	3.888	0.0000468
		Taichung - Kaohsiung	151.81	2798	7.776	0.0000587
		Kaohsiung - Hong Kong	355.56	2798	26.169	0.0000843
67	Burgundy	Constanta - Istanbul	329.81	3476	2.189	0.0000061
		Odessa - Constanta	204.68	3476	13.077	0.0000589
		Diliskelesi - Odessa	401.67	3476	19.661	0.0000451
		Piraeus (Athens) - Diliskelesi	387.11	3476	9.719	0.0000232
		Malta Freeport - Piraeus (Athens)	542.64	3476	31.749	0.0000540
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	89.15	3534	22.746	0.0002315
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	252.58	3534	10.782	0.0000387
		Shuaiba - Khalifa Bin Salman Port	443.24	3534	15.738	0.0000322
		Khalifa Bin Salman Port - Shuaiba	443.24	3534	16.223	0.0000332
69	Maersk Izmir	Sydney - Melbourne	583.6	3460	24.084	0.0000382
		Tauranga - Sydney	1596.45	3460	110.478	0.0000641
		Panama City - Tauranga	6513.73	3460	457.746	0.0000651
		Cartagena - Panama City	324.8	3460	6.932	0.0000198
		Charleston - Cartagena	1472.67	3460	69.484	0.0000437
70	Nordautumn	Algericas - Tanger Mediterranean	26.14	3586	0.399	0.0000136
		Dakar Abidjan	1188.65	3586	145.175	0.0001092
		Tanger Mediterranean - Dakar	1526.1	3586	179.592	0.0001052
		Abidjan - Lome	399.95	3586	46.776	0.0001046
71	Maersk Cabinda	Lagos - Onne	506.42	4496	28.087	0.0000395
		Onne - Pointe Noire	824.53	4496	40.577	0.0000351
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	741.33	5400	57.498	0.0000460
		Yangshan - Ningbo Zhousan	127.21	5400	4.332	0.0000202
		Qingdao - Yangshan	427.97	5400	32.139	0.0000446
		Busan - Qingdao	468.9	5400	55.333	0.0000701
		Hong Kong - Sydney	4491.55	5400	336.528	0.0000445
73	Wide Alpha	Yangshan - Ningbo Zhousan	138.21	5400	5.256	0.0000226
		Qingdao - Yangshan	432.08	5400	44.635	0.0000613

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Busan - Qingdao	493.93	5400	53.756	0.0000646
		Osaka - Busan	656.05	5400	49.255	0.0000446
74	Maersk Indus	Colombo - Pointe Noire	6202.31	5400	621.366	0.0000595
		Jawaharlal Nehru Port - Colombo	913.03	5400	87.871	0.0000571
		Mundra - Jawaharlal Nehru Port	410.53	5400	24.630	0.0000356
		Pointe Noire - Cotonou	1266.25	5400	114.464	0.0000537
75	Kyparissia	Walvis Bay - Durban	1558.73	4770	55.480	0.0000239
		Onne - Walvis Bay	1815.59	4770	97.263	0.0000360
		Cotonou - Onne	770.77	4770	23.219	0.0000202
		Durban - Tanjung Pelepas	4888.15	4770	506.108	0.0000696
		Tanjung Pelepas - Nansha	1499.4	4770	83.146	0.0000373
76	Leonidio	Lagos - Cotonou	57.99	4770	1.502	0.0000174
		Cotonou - Lagos	56.09	4770	1.428	0.0000171
77	ALS Ceres	Surabaya - Singapore	850.4	4300	15.227	0.0000134
		Jakarta (Tanjung Priok) - Surabaya	423.6	4300	46.232	0.0000814
		Shenzhen - Jakarta (Tanjung Priok)	1810	4300	191.864	0.0000790
		Shantou - Shenzhen	209.37	4300	10.359	0.0000369
		Ningbo Zhousan - Shantou	585.05	4300	67.413	0.0000859
78	Rosa	Ningbo Zhousan - Shanghai	184.83	4380	8.535	0.0000338
		Qingdao - Ningbo Zhousan	480.46	4380	26.253	0.0000400
		Busan - Qingdao	490.82	4380	49.364	0.0000736
		Portland - Busan	4744.9	4380	414.667	0.0000640
79	Lana	Douala - Cotonou	591.41	4387	16.853	0.0000208
		Porto de Luanda - Douala	896.42	4387	26.414	0.0000215
		Pointe Noire - Porto de Luanda	357.41	4387	53.742	0.0001099
		Algericas - Pointe Noire	3773.44	4387	244.134	0.0000473
		Tanger Mediterranean - Algericas	51.25	4387	0.141	0.0000020
80	Schubert	Shanghai - Busan	469.78	4255	43.359	0.0000695
		Ningbo Zhoushan - Shanghai	218.41	4255	4.258	0.0000147
		Qingdao - Ningbo Zhoushan	559.46	4255	44.085	0.0000594
		Busan - Qingdao	461.63	4255	55.841	0.0000911
		Portland - Busan	4788.62	4255	416.641	0.0000656
81	Northern Guard	Shanghai - Hong Kong	853.31	4294	74.470	0.0000652
		Qingdao - Shanghai	391.91	4294	27.634	0.0000526

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Busan - Qingdao	628.44	4294	45.350	0.0000539
		Hong Kong - Johor	1876.37	4294	172.975	0.0000688
		Johor - Singapore	33.36	4294	0.429	0.0000096
82	Kea	Rotterdam - Hamburg	322.11	6900	14.682	0.0000212
		Le Havre - Rotterdam	260.99	6900	25.008	0.0000445
		Hamburg - Newark	3697.55	6900	415.380	0.0000522
83	YM Wealth	Busan - Yangshan	466.83	5551	45.863	0.0000567
		Singapore - Busan	2519.04	5551	385.923	0.0000885
		Jeddah - Singapore	4395.61	5551	381.599	0.0000501
		Sokhna - Jeddah	621.91	5551	50.238	0.0000467
		Al Aqabah - Sokhna	328.29	5551	8.498	0.0000150
84	E R France	Hong Kong - Shenzhen	18.94	5762	1.271	0.0000373
		Kaohsing - Hong Kong	356.02	5762	27.989	0.0000437
		Busan - Kaohsiung	935.06	5762	85.679	0.0000510
		Manzanillo - Busan	6397.38	5762	942.618	0.0000820
		Guayaquil - Manzanillo	2011.96	5762	163.219	0.0000451
85	SC Mara	Sydney - Brisbane	554.46	5089	77.970	0.0000886
		Melbourne - Sydney	588.9	5089	62.345	0.0000667
		Yantian - Melbourne	5033.09	5089	495.589	0.0000620
		Brisbane - Busan	4189.36	5089	535.993	0.0000806
		Shanghai - Yantian	847.67	5089	72.943	0.0000542
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	68.28	5089	0.330	0.0000030
		Qinzhou - Rizhao	1539.98	5089	99.295	0.0000406
		Lianyungang - Qinzhou	1526.95	5089	79.259	0.0000327
87	Miami	Manzanillo - Los Angeles	1253.54	5085	75.066	0.0000378
		Coronel - San Antonio	233.16	5085	7.671	0.0000207
		Valparaiso - Coronel	276.67	5085	0.714	0.0000016
		Los Angeles - Ningbo Zhoushan	5805.59	5085	419.470	0.0000456
		San Antonio - Manzanillo	3750.36	5085	247.435	0.0000416
88	Maersk Columbus	Algeciras - Port Said	1935.87	6188	342.451	0.0000917
		Tanger Mediterranean - Algericas	114.03	6188	0.556	0.0000025
		Port Said - Salalah	2077.73	6188	442.948	0.0001105
		Salalah - Dubai (Jebel Ali)	957.34	6188	126.700	0.0000686
		Dubai (Jebel Ali) - Muhammad Bin Qasim	785.86	6188	97.648	0.0000644

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89	Maersk Denver	Newark - Algericas	3288.34	6188	264.718	0.0000417
		Norfolk - Newark	321.91	6188	17.958	0.0000289
		Djilbouti - Salalah	753.31	6188	82.643	0.0000568
		Port Said - Djibouti	1382.88	6188	229.700	0.0000861
		Algericas - Port Said	1933.79	6188	287.125	0.0000769
90	Maersk Chicago	Salalah - Algericas	3861.43	6188	558.758	0.0000750
		Algericas - Newark	3238.72	6188	679.388	0.0001087
		Savannah - Houston	1353.07	6188	234.904	0.0000899
		Newark - Charleston	655.63	6188	39.999	0.0000316
		Charleston - Savannah	134.63	6188	4.688	0.0000180
91	Maersk Lirquen	Hong Kong - Yangshan	826.78	8850	76.718	0.0000336
		Singapore - Hong Kong	1450.51	8850	298.200	0.0000745
92	Maersk Kowloon	Algericas - Sines	277.86	7455	30.166	0.0000467
		Valencia - Algericas	464.01	7455	12.333	0.0000114
		Genoa - Valencia	522.24	7455	97.243	0.0000801
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	1654.37	8814	285.621	0.0000628
		Sines - Gioia Tauro Harbour	1333.46	8814	88.141	0.0000240
		Freeport - Sines	3663.55	8814	385.543	0.0000383
		Charleston - Freeport	405.43	8814	69.254	0.0000621
		Savannah - Charleston	130.41	8814	7.425	0.0000207
94	Maersk Savannah	Qingdao - Busan	505.32	9662	66.654	0.0000438
		Yangshan - Qingdao	442.77	9662	58.606	0.0000439
		Ningbo Zhoushan - Yangshan	106.25	9662	0.153	0.0000005
		Shenzhen - Ningbo Zhoushan	808.45	9662	125.734	0.0000516
		Hong Kong - Shenzhen	41.71	9662	1.931	0.0000154
95	Maersk Sarnia	Busan - Vancouver	4639.29	8478	810.860	0.0000661
		Yangshan - Busan	515.15	8478	45.538	0.0000334
		Ningbo Zhousan - Yangshan	122.09	8478	14.923	0.0000462
		Yantian - Ningbo Zhousan	737.77	8478	135.885	0.0000696
		Vancouver - Seattle	165.01	8478	22.422	0.0000514
96	Clementine Maersk	Busan - Newark	10290.87	7226	2304.586	0.0000994
		Yangshan - Busan	465.68	7226	56.088	0.0000534
		Norfolk - Newark	328.83	7226	41.210	0.0000556

Numb.	Ship	Trip	Distance Traveled (nm)	Container Capacity (TEU)	FOC Estimation (ton)	EEOI (ton CO2/TEU mile)
		Port of Baltimore - Norfolk	171.76	7226	22.191	0.0000573
		Newark - Port of Baltimore	484.37	7226	31.042	0.0000284
97	Axel Maersk	Port of Miami - Freeport	93.08	7226	3.053	0.0000146
		Savannah - Port of Miami	463.46	7226	25.701	0.0000246
		Charleston - Savannah	125.89	7226	6.235	0.0000220
		Newark - Charleston	659.71	7226	72.539	0.0000488
		Singapore - Newark	10193.28	7226	2467.964	0.0001074
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3829.42	9930	766.728	0.0000646
		Busan - Yokohama Ko	860.19	9930	259.713	0.0000975
		Yangshan - Busan	478.44	9930	32.277	0.0000218
		Los Angeles - Oakland	388.55	9930	34.942	0.0000290
		Prince Rupert - Loa Angeles	1470.98	9930	163.961	0.0000360
99	Emma Maersk	Tanger Mediterranean - Salalah	3958.94	13460	825.143	0.0000496
		Le Havre - Tanger Mediterranean	1238.14	13460	169.141	0.0000325
		London Gateway Port - Le Havre	253.73	13460	59.156	0.0000555
		Antwerp - London Gateway Port	186.03	13460	10.167	0.0000130
		Hamburg - Antwerp	401.8	13460	47.107	0.0000279
100	Munich Maersk	Yantian - Tanjung Pelepas	1513.2	20568	892.145	0.0000919
		Yangshan - Yantian	822.23	20568	378.263	0.0000717
		Ningbo Zhoushan - Yangshan	121.62	20568	3.504	0.0000045
		Busan - Ningbo Zhoushan	534.28	20568	131.480	0.0000384
		Tianjin - Busan	750.76	20568	163.944	0.0000340

4.5 Generating EEOI Measurement Tool

4.5.1 Multiple Linear Regression (MLR)

Using GNU Octave to determining the function to be used for android based apps. This function will generate the estimation value based on the variables that have been chosen. Then using the term of Multiple Linear Regression (MLR) to determine the estimation value. Data preparation also must be held to match the MLR requirements. The fundamental function of MLR is,

$$\boldsymbol{y} = (\boldsymbol{x_0} * \boldsymbol{\theta_0}) + (\boldsymbol{x_1} * \boldsymbol{\theta_1}) + (\boldsymbol{x_2} * \boldsymbol{\theta_2}) + \cdots + (\boldsymbol{x_n} * \boldsymbol{\theta_n}) \quad (13)$$

From the fundamental equation of multiple linear regression, then came to choosing the variables for the function. All of the variables must be easy to acquire, and the trendline of each variable must showing a linear line regarding the output value, which is the EEOI value. So by that meaning, the variables that have been chosen are,

EEOI	**: y/ output**
LOA	**:** $\boldsymbol{x_1}$
B	**:** $\boldsymbol{x_2}$
H	**:** $\boldsymbol{x_3}$
T	**:** $\boldsymbol{x_4}$
Vs	**:** $\boldsymbol{x_5}$
Container Capacity	**:** $\boldsymbol{x_6}$
Avg Speed	**:** $\boldsymbol{x_7}$
Avg Draught	**:** $\boldsymbol{x_8}$
Power Installed	**:** $\boldsymbol{x_9}$
Travel Time	**:** $\boldsymbol{x_{10}}$

The linear trendline for each variable to the EEOI value proven as this graph,

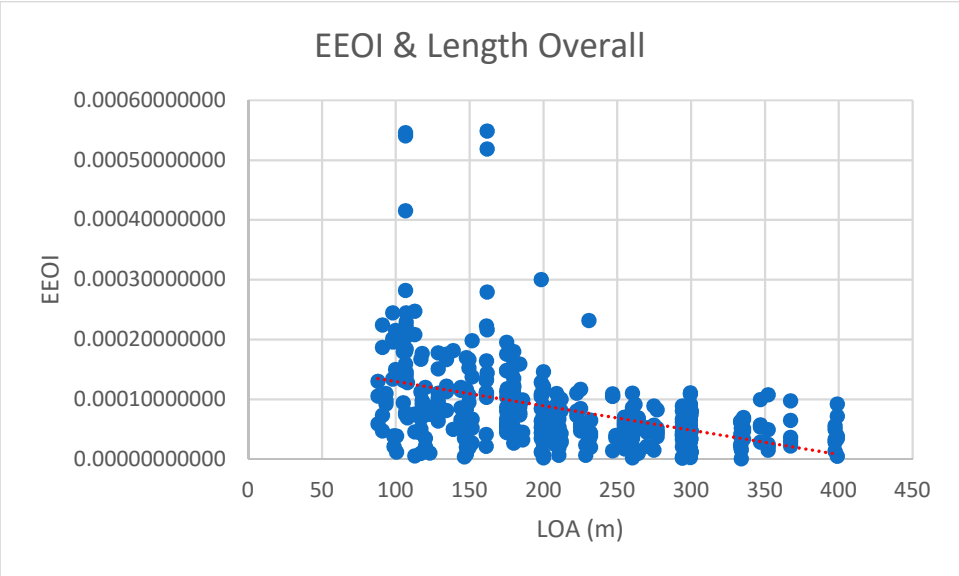


Figure 4.2Graph of EEOI & Length Overall

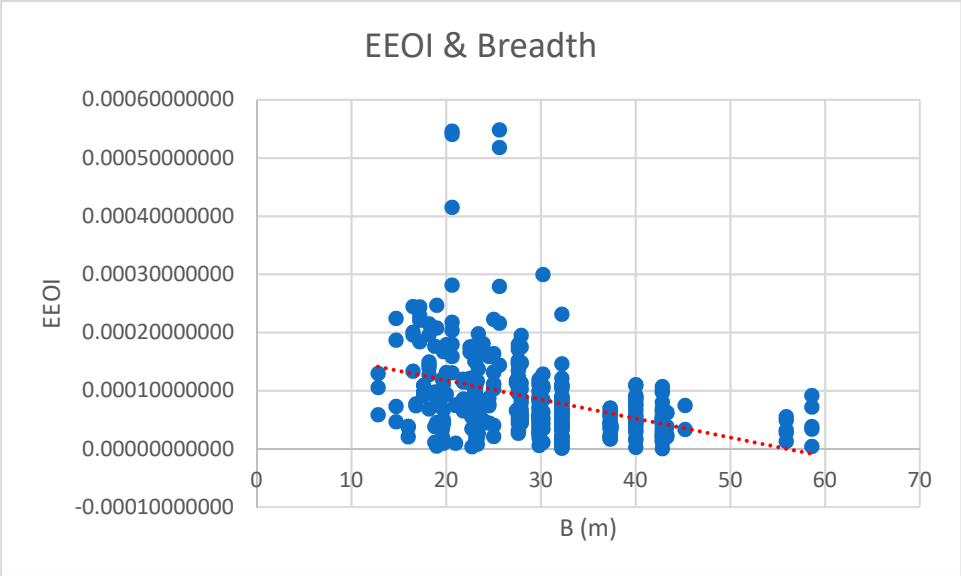


Figure 4.3 Graph of EEOI & Breadth

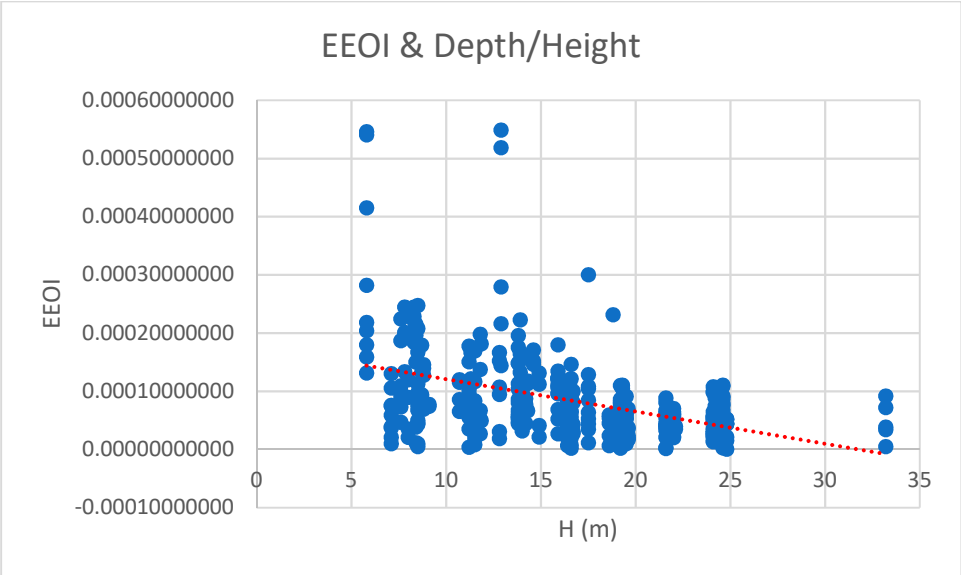


Figure 4.4 Graph of EEOI & Depth/Height

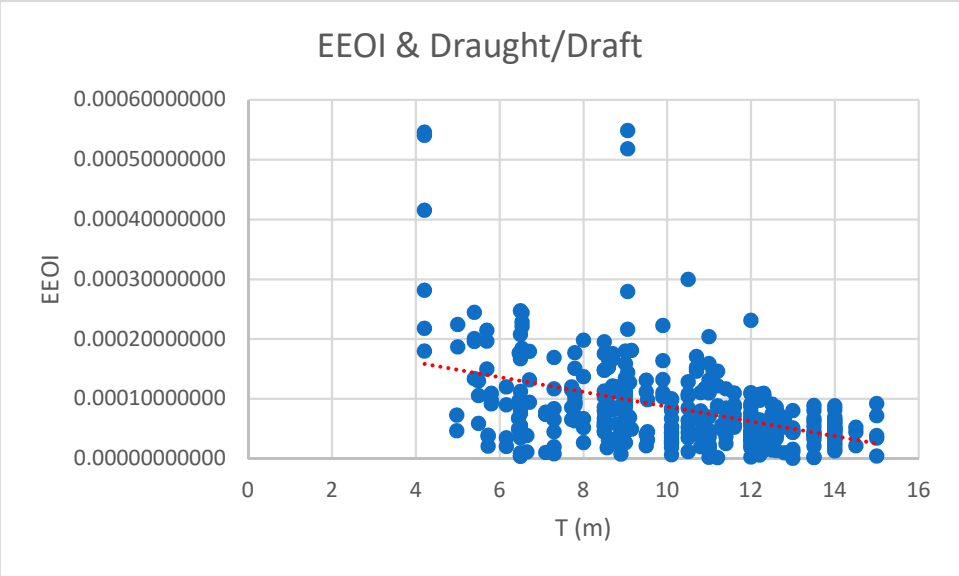


Figure 4.5 Graph of EEOI & Draught/Draft

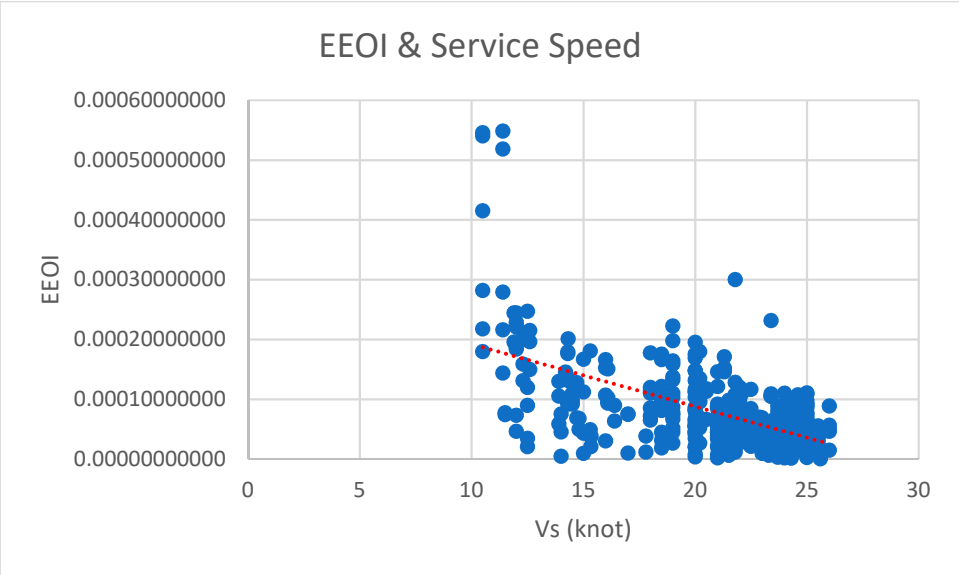


Figure 4.6 Graph of EEOI & Service Speed

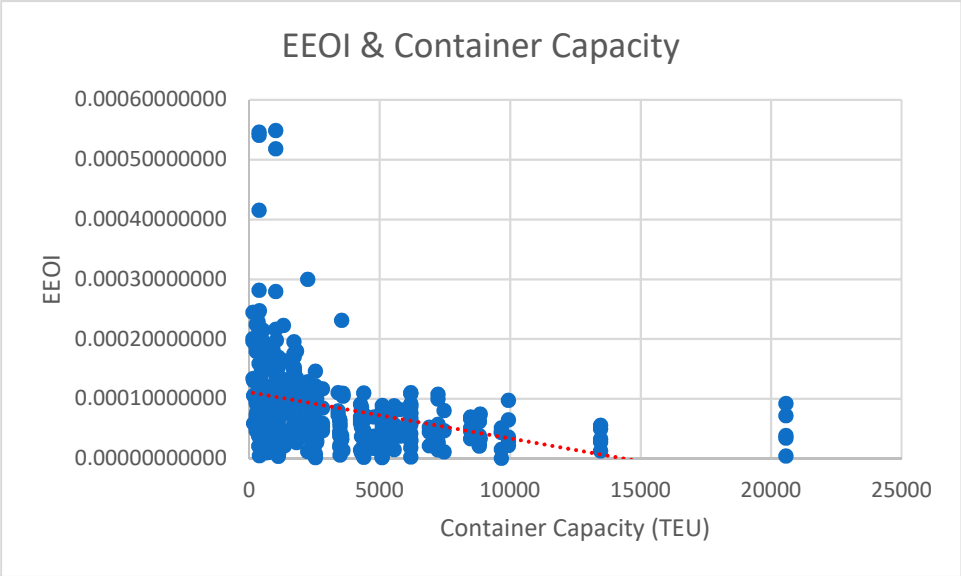


Figure 4.7 Graph of EEOI & Container Capacity

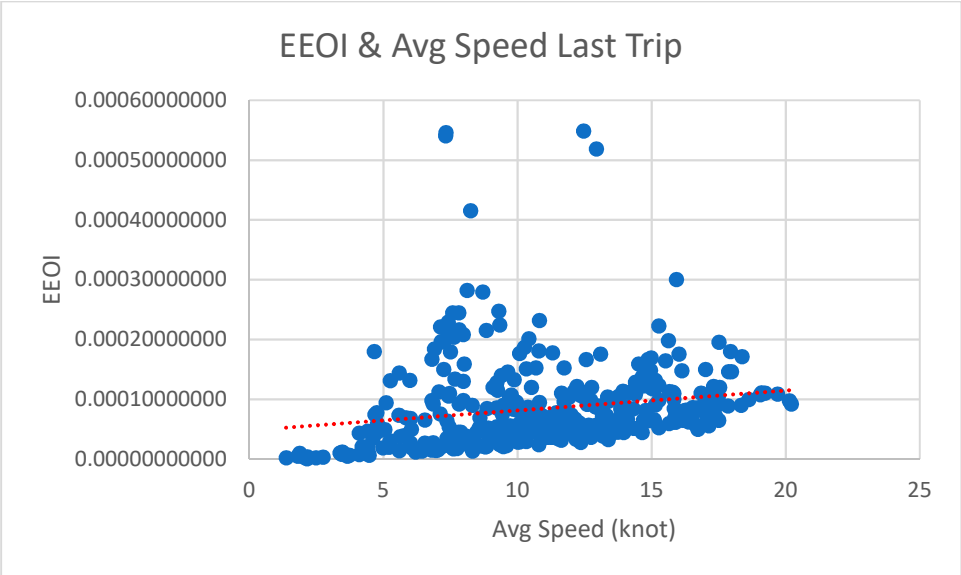


Figure 4.8 Graph of EEOI & Average Speed Last Trip

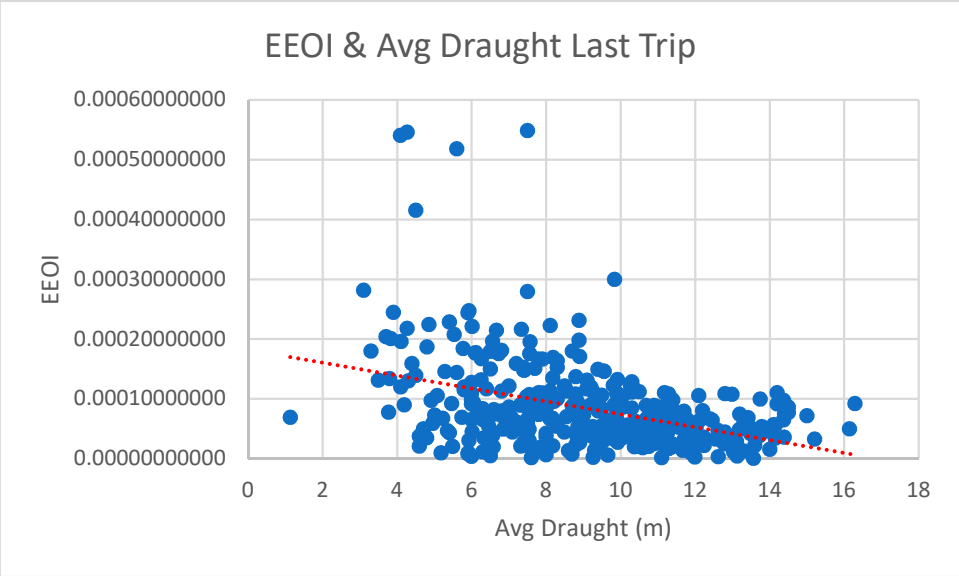


Figure 4.9 Graph of EEOI & Average Draught Last Trip

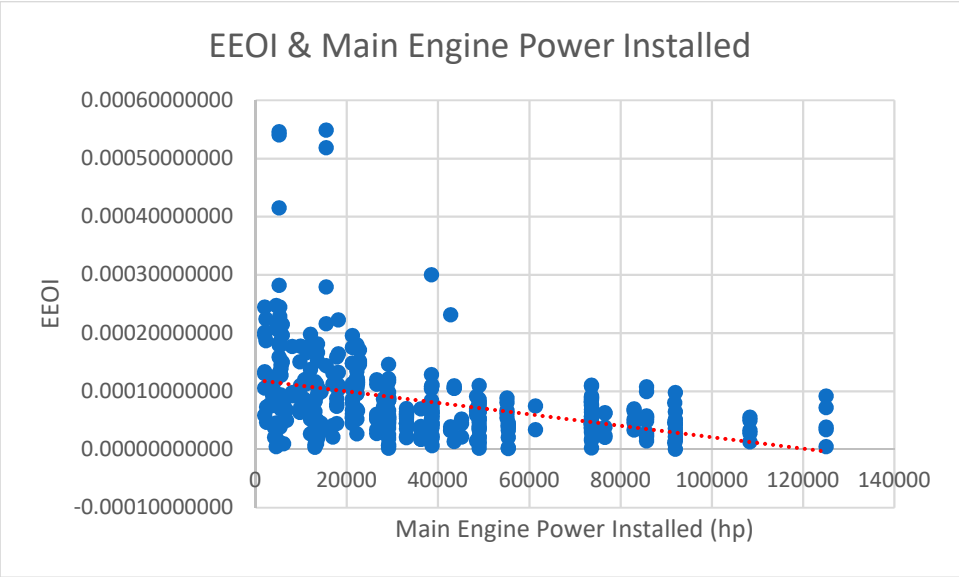


Figure 4.10 Graph of EEOI & Main Engine Power Installed

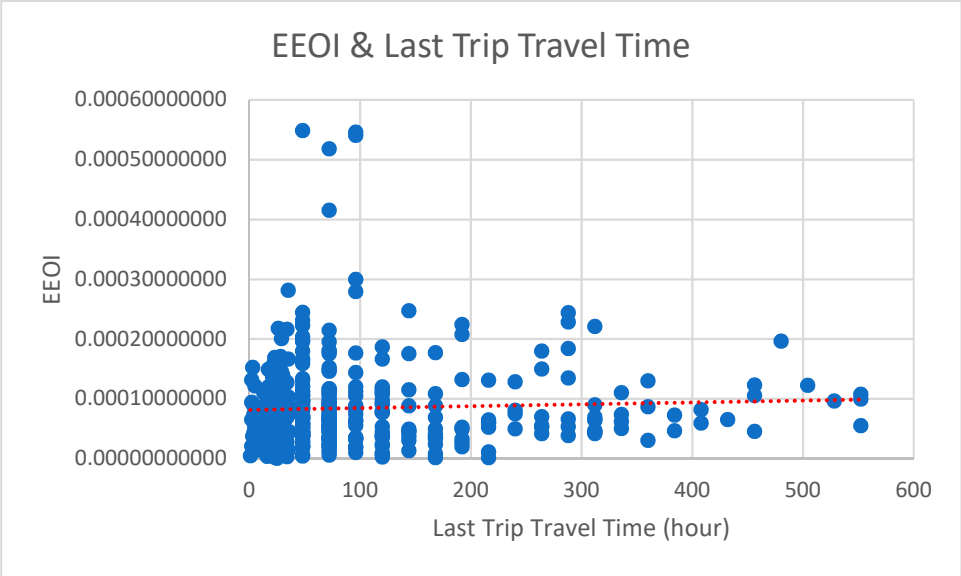


Figure 4.11 Graph of EEOI & Last Trip Travel Time

For $\boldsymbol{x_0}$ is equal to 1. Then using the GNU Octave, and based on the data that has been prepared, the value of $\boldsymbol{\theta}$ as a result,

Table 4.10 θ Result from GNU Octave

θ	Value
0	0.0003963798
1	0.0000005049
2	0.0000036758
3	-0.0000011131
4	-0.0000038011
5	-0.0000283217
6	-0.0000000284
7	0.0000124749
8	-0.0000033527
9	0.0000000028
10	-0.0000000290

Then the EEOI result of the prediction using the MLR and the error from the first prediction is

Table 4.11 MAPE of EEOI Estimation Value Multiple Linear Regression (MLR)

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Meratus Sangatta	Port Moresby - Tanjung Bara Coal	0.0120483	0.000140757	8%
Meratus Sangatta	Benete - Port Moresby	0.0121113	0.000128496	22%
Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	0.0253633	0.000102800	75%
Territory Trader	Sorong - Surabaya	0.0130289	0.000222895	1%
Territory Trader	Surabaya - Sorong	0.0082140	0.000236503	27%
Tanto Abadi	Port of Makassar - Surabaya	0.0113758	0.000140975	29%
Tanto Abadi	Surabaya - Gorontalo	0.0083110	0.000146070	49%
Tanto Abadi	Gorontalo - Surabaya	0.0082759	0.000144074	57%
Meratus Sibolga	Benoa (Bali) - Surabaya	0.0070016	0.000189928	5%
Meratus Sabang	Surabaya - Benoa (Bali)	0.0142697	0.000225121	8%
Meratus Sabang	Benoa (Bali) - Surabaya	0.0142274	0.000217556	11%
Meratus Sibolga	Surabaya - Benoa (Bali)	0.0117218	0.000155047	16%
Meratus Project 1	Ciwandan - Surabaya	0.0126857	0.000213501	1%
Meratus Project 1	Tangguh LNG - Ciwandan	0.0218318	0.000181081	8%
Meratus Project 1	Gresik - Tangguh LNG	0.0159702	0.000188793	26%
Meratus Padang	Surabaya - Dili	0.0076902	0.000049902	30%
Tanto Sentosa	Surabaya - Gresik	0.0169733	0.000144463	10%
Tanto Sentosa	Surabaya - Port of Makassar	0.0117231	0.000160556	10%
Tanto Sentosa	Gresik - Surabaya	0.0195335	0.000134155	43%
Meratus Barito	Surabaya - Lembar	0.0144113	0.000214908	5%
Meratus Bontang	Surabaya - Lembar	0.0122974	0.000300198	7%
Meratus Bontang	Lembar - Ende	0.0172733	0.000296053	29%
Merartus Benoa	Semarang - Surabaya	0.0129793	0.000286556	32%
Meratus Barito	Lembar - Ende	0.0097051	0.000217301	37%
Meratus Barito	Ende - Surabaya	0.0284605	0.000181016	38%
Meratus Bontang	Ende - Surabaya	0.0414796	0.000249723	39%
Merartus Benoa	Kumai - Semarang	0.0321886	0.000285130	47%
Merartus Benoa	Surabaya - Kumai	0.0323928	0.000284651	48%
Tanto Alam	Balikpapan - Jakarta	0.0164847	0.000204740	7%
Tanto Alam	Jakarta - Balikpapan	0.0151953	0.000210974	8%
Tanto Aman	Balikpapan - Jakarta	0.0151334	0.000203372	11%
Tanto Aman	Jakarta - Balikpapan	0.0151579	0.000211419	13%
Meratus Ultima 2	Banjarmasin - Surabaya	0.0077326	0.000167512	15%
Meratus Ultima 2	Surabaya - Banjarmasin	0.0079986	0.000167104	20%
Meratus Ultima 1	Surabaya - Lembar	0.0082322	0.000153909	21%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Meratus Ultima 1	Lembar - Surabaya	0.0175340	0.000111389	62%
Tanto Subur II	Balikpapan - Surabaya	0.0158753	0.000212369	2%
Tanto Subur II	Surabaya - Balikpapan	0.0119221	0.000228887	7%
Goteborg	Pointe Noire - Matadi	0.0158754	0.000151378	9%
Goteborg	Pointe Noire - Douala	0.0095125	0.000154360	37%
Meratus Dili	Surabaya - Dili	0.0076657	0.000193856	10%
Meratus Dili	Dili - Maumere	0.0137567	0.000158444	62%
Meratus Dili	Surabaya - Banjarmasin	0.0126690	0.000157224	71%
Viola	Boma - Matadi	0.0084944	0.000113093	52%
Viola	Pointe Noire - Boma	0.0063600	0.000125041	65%
Meratus Kelimutu	Palu - Tolitoli	0.0086441	0.000154059	2%
Meratus Kalabahi	Tolitoli - Palu	0.0047722	0.000128925	17%
Meratus Kalabahi	Ambon - Surabaya	0.0094812	0.000113818	36%
Meratus Kelimutu	Palu - Surabaya	0.0071361	0.000143317	40%
Meratus Kupang	Surabaya - Port of Makassar	0.0066905	0.000136121	52%
Meratus Kalabahi	Palu - Surabaya	0.0042618	0.000110244	53%
Meratus Kelimutu	Surabaya - Tolitoli	0.0060763	0.000146652	54%
Meratus Kelimutu	Tolitoli - Palu	0.0065373	0.000144629	55%
Meratus Kupang	Port of Makassar - Surabaya	0.0099992	0.000108682	72%
Ruth	Rotterdam - Tilbury	0.0060858	0.000082162	1%
Ruth	Hamburg - Rotterdam	0.0047643	0.000107213	5%
Ruth	Las Palmas - Santa Cruz de Tenerife	0.0049884	0.000112974	7%
Ruth	Tilbury - Las Palmas	0.0037900	0.000139680	16%
Ruth	Santa Cruz de Tenerife - Ferrol	0.0058397	0.000120826	31%
Meratus Batam	Surabaya - Kupang	0.0065002	0.000195044	8%
Tanto Express	Jayapura - Ambon	0.0058175	0.000118544	1%
Tanto Express	Gresik - Surabaya	0.0131337	0.000071074	9%
Tanto Express	Ambon - Surabaya	0.0081999	0.000101434	12%
Tanto Express	Surabaya - Port of Makassar	0.0061474	0.000102737	20%
New York Trader	Evyap - Istanbul	0.0057261	0.000054938	1%
New York Trader	Port of Spain - Kingston	0.0047739	0.000077495	6%
New York Trader	Kingston - San Juan	0.0072284	0.000027502	21%
New York Trader	San Juan - Evyap	0.0050994	0.000041479	25%
Maersk Regensburg	Cotonou - Lagos	0.0047632	0.000070133	7%
Maersk Regensburg	Cotonou - Takoradi	0.0084608	0.000054723	34%
Maersk Roubaix	Pointe Noire - Tema	0.0038036	0.000110004	6%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Maersk Roubaix	Porto de Luanda - Pointe Noire	0.0048574	0.000113283	33%
Maersk Roubaix	Tema - Port Owendo	0.0088609	0.000023639	47%
Meratus Mamiri	Surabaya - Port of Makassar	0.0068442	0.000158572	48%
Meratus Makassar	Port of Makassar - Surabaya	0.0058644	0.000096801	2%
Meratus Malino	Palu - Surabaya	0.0074455	0.000169865	12%
Meratus Malino	Surabaya - Port of Makassar	0.0049990	0.000193050	16%
Meratus Makassar	Surabaya - Port of Makassar	0.0116758	0.000026043	42%
X-Press Elbe	Brunsbuttel - Rotterdam	0.0038285	0.000134252	2%
X-Press Elbe	Sankt Pettersburg - Riga	0.0054596	0.000080927	21%
X-Press Elbe	Kiel - Brunsbuttel	0.0083327	0.000033248	25%
X-Press Elbe	Riga - Kiel	0.0045509	0.000145427	27%
X-Press Elbe	Rotterdam - Antwerp	0.0064521	0.000067213	29%
Juliana	Panama City (Balboa) - Puerto Caldera	0.0047703	0.000041754	2%
Juliana	Panama City (Balboa) - Corinto	0.0033627	0.000117063	11%
Juliana	Corinto - Panama City (Balboa)	0.0049950	0.000083895	25%
Wybelsum	Bremerhaven - Felixstowe	0.0051278	0.000110591	0%
Wybelsum	Kiel - Sankt Pettersburg	0.0032214	0.000156699	4%
Wybelsum	Goteborg - Cuxhaven	0.0044837	0.000110606	7%
Wybelsum	Felixstowe - Goteborg	0.0045918	0.000154217	31%
Wybelsum	Sankt Pettersburg - Bremerhaven	0.0100943	0.000076767	42%
Meratus Gorontalo	Jakarta (Tanjung Priok) - Port of Makassar	0.0106087	0.000296105	6%
Meratus Gorontalo	Surabaya - Bitung	0.0059865	0.000356065	31%
Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	0.0113066	0.000287462	33%
Meratus Gorontalo	Port of Makassar - Semarang	0.0070955	0.000344403	37%
Maersk Wolfsburg	Fort Lauderdale - Santo Tomas De Castilla	0.0040284	0.000143773	3%
Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	0.0069967	0.000089960	4%
Maersk Wolfsburg	Savannah - Fort Lauderdale	0.0031961	0.000159698	8%
AS Samanta	Puerto De Haina - Port of Miami	0.0033097	0.000175014	10%
AS Samanta	Port of Miami - Kingston	0.0038796	0.000156460	11%
Maersk Winnipeg	Savannah - Fort Lauderdale	0.0058298	0.000094086	18%
AS Samanta	Kingston - Barranquilla	0.0039487	0.000124652	20%
Maersk Wolfsburg	Puerto Cortes - Puerto Colon	0.0045776	0.000092041	37%
Maersk Wolfsburg	Santo Tomas De Castilla - Puerto Cortes	0.0062334	0.000073880	37%
Maersk Winnipeg	Fort Lauderdale - Santo Tomas de Castilla	0.0026756	0.000155213	37%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
AS Samanta	Cartagena - Santa Marta	0.0058041	0.000076637	41%
Maersk Wolfsburg	Wilmington (NC) - Savannah	0.0051865	0.000083079	45%
Maersk Winnipeg	Wilmington (NC) - Savannah	0.0066546	0.000064823	46%
AS Samanta	Barranquilla - Cartagena	0.0059084	0.000070789	51%
Maersk Winnipeg	Gloucester City - Wilmington (NC)	0.0044421	0.000092995	52%
RHL Agilitas	Halifax - Kingston	0.0031793	0.000114117	3%
RHL Agilitas	Kingston - Newark	0.0038329	0.000102789	9%
RHL Agilitas	Newark - Halifark	0.0036185	0.000082733	25%
Viona	Reykjavik - Arhus	0.0024550	0.000131656	10%
Viona	Arhus - Bremerhaven	0.0026463	0.000141349	17%
Viona	Bremerhaven - Rotterdam	0.0029163	0.000123059	18%
Viona	Grundartangi - Reykjavik	0.0090576	0.000061252	60%
Maersk Vallvik	Port Elizabeth - Durban	0.0036289	0.000122560	1%
Maersk Vallvik	Freeport - Port Elizabeth	0.0032188	0.000118435	4%
Maersk Vallvik	Charleston - Freeport	0.0036357	0.000117191	5%
Maersk Vallvik	Norfolk - Charleston	0.0052002	0.000096930	9%
Maersk Vilnius	Newark - Port of Baltimore	0.0055319	0.000093054	3%
Maersk Vilnius	Cape Town - Newark	0.0037604	0.000101304	5%
Maersk Visby	Durban - Cape Town	0.0029067	0.000168880	6%
Maersk Vilnius	Salalah - Durban	0.0039289	0.000123745	8%
Maersk Visby	Freeport - Port Elizabeth	0.0035490	0.000112424	8%
Maersk Visby	Norfolk - Charleston	0.0053744	0.000104931	12%
Maersk Visby	Port Elizabeth - Durban	0.0057567	0.000058946	13%
Maersk Visby	Charleston - Freeport	0.0033943	0.000124873	15%
Maersk Vilnius	Al Duqm - Salalah	0.0101226	0.000057009	17%
Maersk Vilnius	Durban - Cape Town	0.0115923	0.000020113	25%
Bernard A	Poti - Samsun	0.0047811	0.000151794	4%
Bernard A	Constanta - Istanbul	0.0078230	0.000094564	8%
Bernard A	Samsun - Constanta	0.0047510	0.000111903	44%
Bernard A	Samsun - Istanbul	0.0046590	0.000109860	49%
Bernard A	Istanbul - Poti	0.0060073	0.000074788	68%
Meratus Medan - 2	Port of Makassar - Semarang	0.0044505	0.000149301	51%
Nele Maersk	Istanbul - Novorossiysk	0.0066572	0.000031970	7%
Nele Maersk	Port Said - Novorossiysk	0.0064185	0.000047340	10%
Nexo Maersk	Algericas - Montreal	0.0033088	0.000113815	11%
Nexo Maersk	Tanger Mediterranean - For sur mer	0.0030858	0.000118985	14%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Nele Maersk	Novorossiysk - Port Said	0.0042093	0.000090897	16%
Nexo Maersk	Tanger Mediterranean - Algeciras	0.0075852	0.000035869	18%
Nexo Maersk	Vado Ligure - Tanger Mediterranean	0.0037365	0.000080217	26%
Nexo Maersk	For sur mer - Vado Ligure	0.0093417	0.000057983	31%
Nele Maersk	Damietta - Istanbul	0.0057164	0.000138495	54%
Tanto Nusantara	Belawan - Jakarta	0.0075952	0.000053043	8%
Tanto Nusantara	Jakarta - Belawan	0.0052595	0.000075332	35%
EMS Trader	Puerto Colon - Cartagena	0.0027778	0.000124105	4%
Miami Trader	Jawaharlal Nehru Port - Colombo	0.0036161	0.000069601	4%
Miami Trader	Dubai (Jebel Ali) - Mundra	0.0035162	0.000060182	7%
Miami Trader	Port Louis - Dubai (Jebel Ali)	0.0040491	0.000049035	11%
EMS Trader	New Orleans - Mariel	0.0035526	0.000097017	13%
EMS Trader	Puerto Cortes - Puerto Colon	0.0028374	0.000073779	27%
Miami Trader	Mundra - Jawaharlal Nehru Port	0.0052772	0.000037518	28%
Miami Trader	Colombo - Durban	0.0045755	0.000058063	33%
EMS Trader	Mariel - Santo Tomas De Castilla	0.0054245	0.000017460	49%
Happy Helena	Port Louis - Toamasina	0.0027007	0.000161147	10%
X-Press Machu Picchu	Cartagena - Mariel	0.0043190	0.000102316	15%
Happy Helena	Djibouti - Salalah	0.0043714	0.000102126	17%
Happy Helena	Toamasina - Victoria	0.0025127	0.000155825	28%
Happy Helena	Salalah - Le Port (Pointe des Galets)	0.0034972	0.000113734	29%
X-Press Machu Picchu	Mariel - Puerto Colon	0.0034114	0.000117264	39%
JPO Aries	Barcelona - Valencia	0.0044531	0.000052442	2%
JPO Aries	Lisbon - Halifax	0.0039224	0.000058920	3%
JPO Aries	Valencia - Lisbon	0.0046476	0.000048456	7%
Nordatlantic	Toamasina - Salalah	0.0051840	0.000023511	66%
Nordatlantic	Salalah - Port Louis	0.0041556	0.000013436	74%
Ballenita	Tacoma - Vancouver	0.0033069	0.000105000	4%
Ballenita	Tokyo Ko - Everett	0.0031092	0.000083272	8%
Ballenita	Everett - Tacoma	0.0037902	0.000080158	8%
Maersk Newport	Istanbul - Evyap	0.0056920	0.000044499	1%
Maersk Newport	Piraeus (Athens) - Istanbul	0.0040962	0.000072752	9%
Maersk Newport	For sur mer - Piraeus (Athens)	0.0030300	0.000108263	10%
Maersk Norfolk	Montreal - Tanger Mediterranean	0.0040389	0.000060306	12%
Maersk Newport	Castellon de la Plana - Barcelona	0.0045751	0.000060112	15%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Maersk Norfolk	Tanger Mediterranean - Fos sur mer	0.0031461	0.000109421	30%
Maersk Newport	Barcelona - For sur mer	0.0061614	0.000014969	41%
Maersk Norfolk	Fos sur mer - Genoa	0.0092388	0.000006681	64%
City of Hongkong	Durban - Cape Town	0.0036572	0.000080079	1%
City of Hongkong	Ngqura - Durban	0.0030407	0.000109523	10%
City of Hongkong	Conarky - San Pedro	0.0035147	0.000053908	27%
City of Hongkong	San Pedro - Ngqura	0.0051599	0.000016338	46%
Maersk Brani	Bremerhaven - Altamira	0.0027613	0.000113515	3%
Maersk Brani	Antwerp - Hamburg	0.0034469	0.000093676	17%
Maersk Brani	Hamburg - Bremerhaven	0.0037026	0.000086241	18%
Porto	Kaohsiung - Hong Kong	0.0028750	0.000085589	1%
Porto	Taichung - Kaohsiung	0.0035132	0.000054548	7%
Porto	Yokkaichi - Taipei	0.0030069	0.000107561	8%
Porto	Taipei - Taichung	0.0041995	0.000035503	24%
Burgundy	Odessa - Constanta	0.0033550	0.000049358	16%
Burgundy	Malta Freeport - Piraeus (Athens)	0.0037964	0.000039123	28%
Burgundy	Diliskelesi - Odessa	0.0038466	0.000025843	43%
Northern Discovery	Khalifa Bin Salman Port - Shuaiba	0.0023140	0.000035689	7%
Maersk Izmir	Tauranga - Sydney	0.0025589	0.000069783	9%
Maersk Izmir	Panama City - Tauranga	0.0028222	0.000051605	21%
Maersk Izmir	Sydney - Melbourne	0.0034999	0.000028659	25%
Maersk Izmir	Charleston - Cartagena	0.0034674	0.000030875	29%
Nordautumn	Dakar Abidjan	0.0025886	0.000110810	1%
Nordautumn	Tanger Mediterranean - Dakar	0.0026883	0.000097373	7%
Nordautumn	Abidjan - Lome	0.0024576	0.000112351	7%
Maersk Cabinda	Onne - Pointe Noire	0.0054153	0.000042365	21%
Maersk Cabinda	Lagos - Onne	0.0044085	0.000055110	39%
Maersk Euphrates	Qingdao - Yangshan	0.0053408	0.000047834	7%
Maersk Indus	Pointe Noire - Cotonou	0.0045128	0.000059875	12%
Maersk Euphrates	Ningbo Zhousan - Hong Kong	0.0046249	0.000051930	13%
Maersk Indus	Mundra - Jawaharlal Nehru Port	0.0055677	0.000030105	15%
Wide Alpha	Yangshan - Ningbo Zhousan	0.0051681	0.000018466	18%
Maersk Indus	Colombo - Pointe Noire	0.0031325	0.000075425	27%
Maersk Euphrates	Hong Kong - Sydney	0.0033078	0.000058712	32%
Maersk Euphrates	Busan - Qingdao	0.0034529	0.000097376	39%
Wide Alpha	Osaka - Busan	0.0034841	0.000066482	49%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Wide Alpha	Busan - Qingdao	0.0030851	0.000097878	51%
Maersk Euphrates	Yangshan - Ningbo Zhousan	0.0059893	0.000007743	62%
Wide Alpha	Qingdao - Yangshan	0.0030858	0.000099228	62%
Maersk Indus	Jawaharlal Nehru Port - Colombo	0.0025034	0.000097947	71%
Kyparissia	Cotonou - Onne	0.0057931	0.000021947	8%
Leonidio	Lagos - Cotonou	0.0064165	0.000014205	18%
Kyparissia	Walvis Bay - Durban	0.0050130	0.000029190	22%
Leonidio	Cotonou - Lagos	0.0066339	0.000012584	26%
Kyparissia	Durban - Tanjung Pelepas	0.0029687	0.000105838	52%
Kyparissia	Onne - Walvis Bay	0.0043038	0.000058204	62%
Kyparissia	Tanjung Pelepas - Nansha	0.0044669	0.000060988	64%
ALS Ceres	Ningbo Zhousan - Shantou	0.0025639	0.000086726	1%
Lana	Pointe Noire - Porto de Luanda	0.0022150	0.000122209	11%
Rosa	Portland - Busan	0.0027398	0.000055309	14%
ALS Ceres	Shenzhen - Jakarta (Tanjung Priok)	0.0027624	0.000068097	14%
ALS Ceres	Jakarta (Tanjung Priok) - Surabaya	0.0035411	0.000065948	19%
Lana	Algericas - Pointe Noire	0.0034451	0.000021045	55%
Rosa	Qingdao - Ningbo Zhousan	0.0041627	0.000015051	62%
Rosa	Busan - Qingdao	0.0061122	0.000024538	67%
ALS Ceres	Shantou - Shenzhen	0.0039802	0.000010515	71%
Schubert	Portland - Busan	0.0027035	0.000056308	14%
Schubert	Shanghai - Busan	0.0030031	0.000058214	16%
Schubert	Qingdao - Ningbo Zhoushan	0.0035600	0.000042888	28%
Schubert	Busan - Qingdao	0.0064717	0.000032147	65%
Northern Guard	Shanghai - Hong Kong	0.0036686	0.000066927	3%
Northern Guard	Busan - Qingdao	0.0049813	0.000043830	19%
Northern Guard	Qingdao - Shanghai	0.0053251	0.000037023	30%
Northern Guard	Hong Kong - Johor	0.0038928	0.000097454	42%
Kea	Le Havre - Rotterdam	0.0030653	0.000046436	4%
Kea	Hamburg - Newark	0.0031733	0.000043785	16%
YM Wealth	Singapore - Busan	0.0021986	0.000095178	8%
YM Wealth	Sokhna - Jeddah	0.0029685	0.000041670	11%
YM Wealth	Jeddah - Singapore	0.0029400	0.000036904	26%
YM Wealth	Busan - Yangshan	0.0039547	0.000032547	43%
E R France	Manzanillo - Busan	0.0025613	0.000093315	14%
E R France	Busan - Kaohsiung	0.0030924	0.000063770	25%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
E R France	Kaohsing - Hong Kong	0.0032713	0.000058733	34%
E R France	Hong Kong - Shenzhen	0.0063612	0.000023060	38%
E R France	Guayaquil - Manzanillo	0.0028744	0.000063421	41%
SC Mara	Yantian - Melbourne	0.0028168	0.000062766	1%
SC Mara	Melbourne - Sydney	0.0034392	0.000062569	6%
SC Mara	Shanghai - Yantian	0.0035839	0.000050214	7%
SC Mara	Brisbane - Busan	0.0024172	0.000093751	16%
SC Mara	Sydney - Brisbane	0.0025113	0.000103745	17%
Miami	San Antonio - Manzanillo	0.0034235	0.000021886	47%
Miami	Los Angeles - Ningbo Zhoushan	0.0032323	0.000023768	48%
Fan Ya Guang Zhou	Qinzhou - Rizhao	0.0046031	0.000019820	51%
Miami	Manzanillo - Los Angeles	0.0039395	0.000015517	59%
Maersk Denver	Djilbouti - Salalah	0.0038231	0.000056212	1%
Maersk Denver	Newark - Algericas	0.0032113	0.000045612	9%
Maersk Columbus	Dubai (Jebel Ali) - Muhammad Bin Qasim	0.0036648	0.000070975	10%
Maersk Denver	Norfolk - Newark	0.0041005	0.000032786	13%
Maersk Denver	Port Said - Djibouti	0.0027768	0.000098993	15%
Maersk Columbus	Port Said - Salalah	0.0023102	0.000131363	19%
Maersk Columbus	Algeciras - Port Said	0.0024795	0.000111778	22%
Maersk Chicago	Salalah - Algericas	0.0024861	0.000093281	24%
Maersk Denver	Algericas - Port Said	0.0024822	0.000098297	28%
Maersk Chicago	Algericas - Newark	0.0020749	0.000142025	31%
Maersk Chicago	Savannah - Houston	0.0021285	0.000137801	53%
Maersk Chicago	Newark - Charleston	0.0029285	0.000048646	54%
Maersk Columbus	Salalah - Dubai (Jebel Ali)	0.0020056	0.000110867	62%
Maersk Lirquen	Singapore - Hong Kong	0.0029415	0.000091318	23%
Maersk Kowloon	Valencia - Algericas	0.0063856	0.000017586	54%
Northern Jubilee	Freeport - Sines	0.0032087	0.000034974	9%
Northern Jubilee	Charleston - Freeport	0.0027182	0.000082337	33%
Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	0.0023685	0.000084991	35%
Northern Jubilee	Sines - Gioia Tauro Harbour	0.0036731	0.000010031	58%
Maersk Savannah	Shenzhen - Ningbo Zhoushan	0.0034789	0.000032855	36%
Maersk Savannah	Qingdao - Busan	0.0037105	0.000019538	55%
Maersk Savannah	Yangshan - Qingdao	0.0042347	0.000013045	70%
Maersk Sarnia	Ningbo Zhousan - Yangshan	0.0066863	0.000033925	27%
Maersk Sarnia	Vancouver - Seattle	0.0029683	0.000072696	41%

Ship	Trip	EEOI (STEAM) ton CO2/TEU nm	EEOI (MLR) ton CO2/TEU nm	Error
Maersk Sarnia	Busan - Vancouver	0.0025338	0.000095717	45%
Maersk Sarnia	Yantian - Ningbo Zhousan	0.0026555	0.000106069	52%
Maersk Sarnia	Yangshan - Busan	0.0076063	0.000011549	65%
Clementine Maersk	Yangshan - Busan	0.0062851	0.000078401	47%
Clementine Maersk	Busan - Newark	0.0021805	0.000164165	65%
Axel Maersk	Singapore - Newark	0.0022014	0.000174703	63%
Gunvor Maersk	Prince Rupert - Loa Angeles	0.0032631	0.000040842	13%
Gunvor Maersk	Busan - Yokohama Ko	0.0022321	0.000135435	39%
Gunvor Maersk	Los Angeles - Oakland	0.0049414	0.000017157	41%
Gunvor Maersk	Yokohama Ko - Prince Rupert	0.0022562	0.000097630	51%
Emma Maersk	Le Havre - Tanger Mediterranean	0.0030406	0.000034691	7%
Emma Maersk	Tanger Mediterranean - Salalah	0.0023773	0.000069063	39%
Emma Maersk	Hamburg - Antwerp	0.0033184	0.000039163	40%
Emma Maersk	London Gateway Port - Le Havre	0.0024729	0.000087346	57%
Munich Maersk	Yantian - Tanjung Pelepas	0.0022658	0.000085730	7%
Munich Maersk	Yangshan - Yantian	0.0027799	0.000055447	23%
			MAPE = 26%	

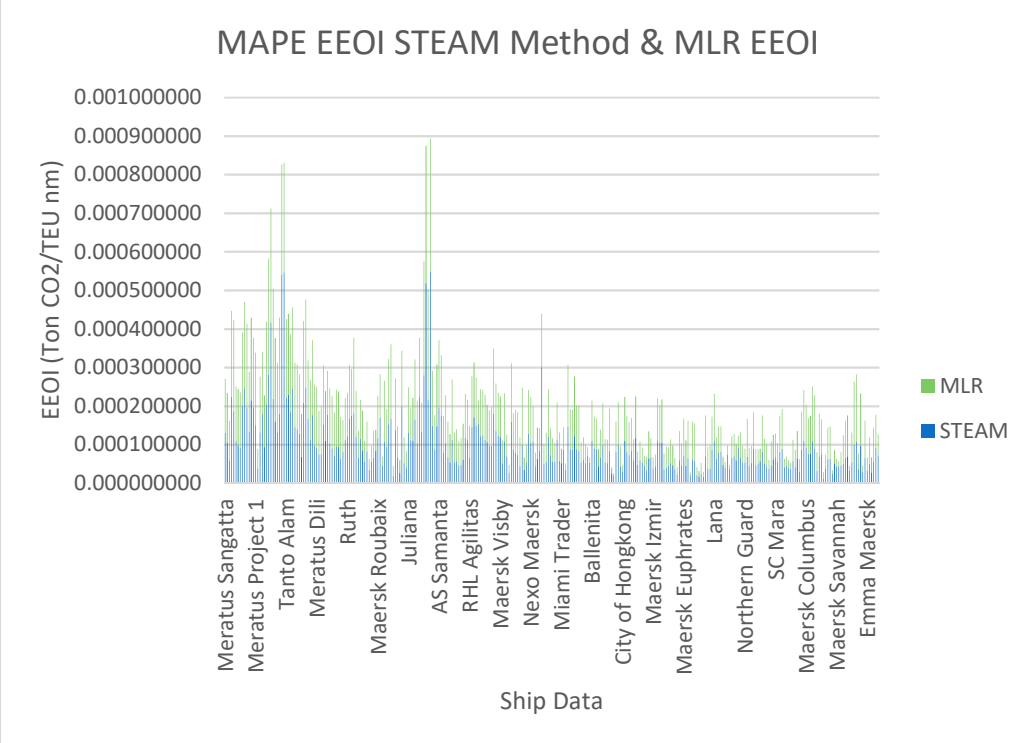


Figure 4.12 Graph of MAPE Between EEOI STEAM Method & MLR

The result of the MAPE is **26%** from the MLR equation to the STEAM estimation method.

4.5.2 Generate the Android Application

The function that has been acquired from the GNU Octave is used to generate the EEOI estimation value using a specific variable that has been chosen. Then those functions applied to the Android Studio for generating EEOI measurement tools in the form of an android application. This apps will represent the EEOI measurement tools and could be used for determining the EEOI value from the ship based on the last trip/voyage of the ship.

4.5.3 User Interface

Figure 4.13 EEOI Generator Cover

The user interface is the part of the user would interact with the EEOI Generator application and how the information is displayed on the android phone screen, or the communication mechanism between the user and the application.

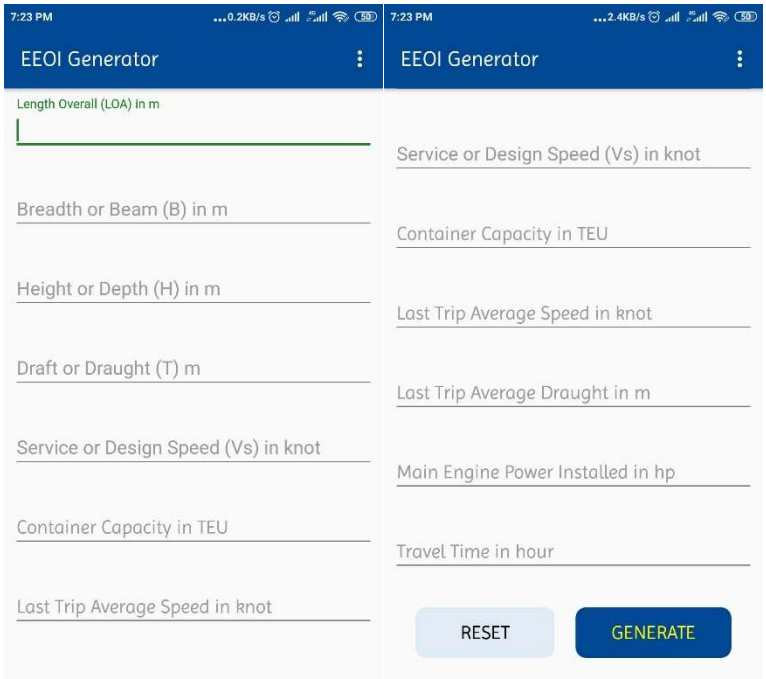


Figure 4.14 Input Design of the EEOI Generator

The design of this application must be simplified and comfortable for usage because it will determine how the user will interact with the application. The input consists of the variables that have been chosen, such as LOA (Length Overall) in meter, B (Breadth or Beam) in meter, H (Height or Depth) in meter, T (Draught) in meter, Vs (Design Speed or Service Speed) in knot, Container Capacity in TEU, Last Trip Average Speed in knot, Last Trip Average Draught in meter, Main Engine Power Installed in horsepower, and Travel Time in hours.

Figure 4.15 Number Command for the EEOI Generator

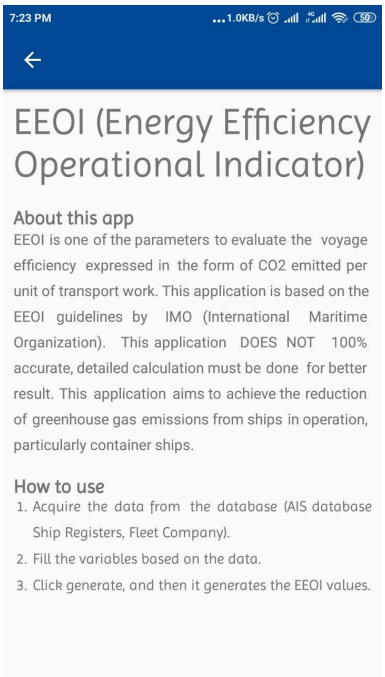


Figure 4.16 About the EEOI Generator Application

This application also provided information about the usage of the EEOI and the guide for using the application. The context is based on IMO Guidelines about EEOI. So here is the info about the application and how to use it

About this application:

1. EEOI (Energy Efficiency Operational Indicator) is one of the parameters to evaluate the voyage efficiency expressed in the form of CO2 emitted per unit of transport work.
2. This application is based on the EEOI guidelines by IMO (International Maritime Organization).
3. This application **DOES NOT 100%** accurate, detailed calculation must be done for better result.
4. This application aims to achieve the reduction of greenhouse gas emissions from ships in operation, particularly container ships.

How to use:

1. Acquire the data from the database (AIS database, Ship Registers, Fleet Company).
2. Fill the variables based on the data.
3. Click generate, and then it generates the EEOI values.

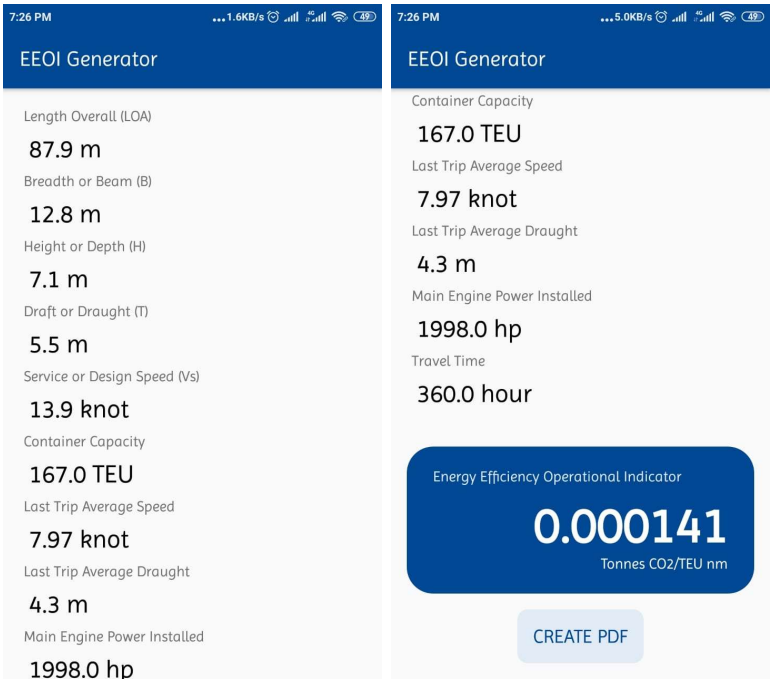


Figure 4.17 Output Design of EEOI Generator

The output design is the same as the input design but added the EEOI resulted value based on the MLR equation. The output could be resulted in negative terms due to the non-limitation to the input. The output also provided in the PDF form so that the EEOI resulted in value is easier to be saved and shared to the other device than android phones.

Figure 4.18 Output of EEOI Generator in PDF form

4.6 Analysis of EEOI Calculation

4.6.1 Analysis of the Fuel Oil Consumption, Average Speed, Container Capacity, and Voyage Distance to the EEOI Value

Analysis EEOI of the 100 ships data is done with different voyage and different container capacity. Therefore, factors that influence the result of EEOI could be determined.

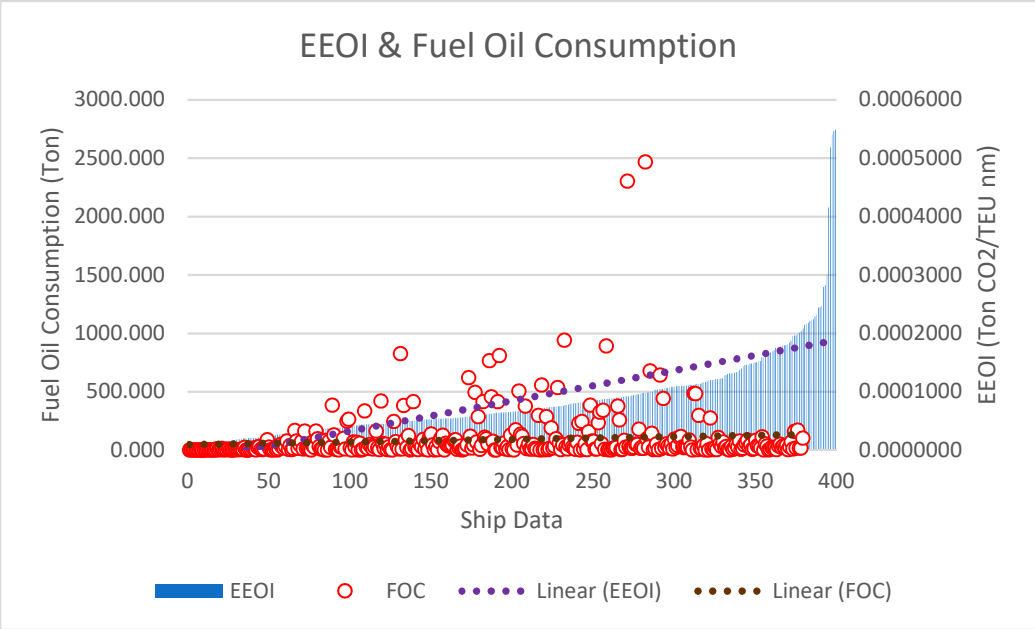


Figure 4.19 Graph of EEOI & Fuel Oil Consumption

Figure 4.19 shows the relation between EEOI and fuel oil consumption of the 100 ships that have been acquired before. The value of EEOI is sorted from the lowest to the highest. As shown in the graph, the trend line of fuel oil consumption has a positive gradient and increases insignificantly. The highest fuel oil consumption of a ship is done by Axel Maersk, with **2467.9 Tons** of fuel, and it has **0.0001074 Ton CO_2/TEU nm** EEOI value. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and consumed **102.03 Tons** of fuel oil.

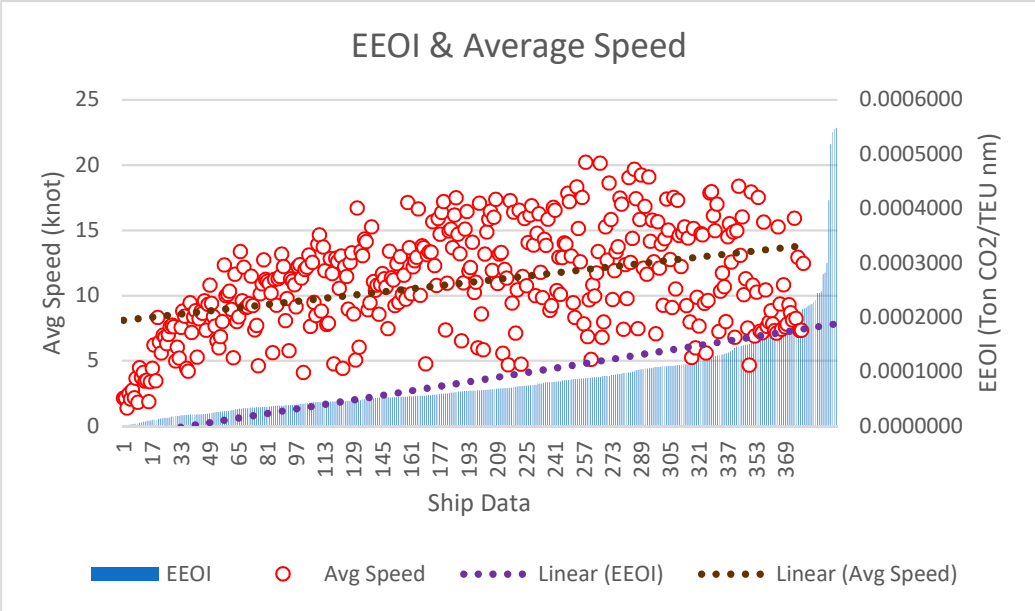


Figure 4.20 Graph of EEOI & Average Speed

Figure 4.20 represents the relation between EEOI and the average speed of the 100 ships. The trend line of average speed shows a slight increase with a positive gradient. The graph shows that the average speed of the ship does have a slight increase correlated with the value of EEOI that increases dramatically. The highest average speed of a ship is done by Munich Maersk, with **20.21 knots**, and the EEOI value is **0.0000919 Ton CO_2/TEU nm**. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and sailed with an average speed of **12.46 knots**.

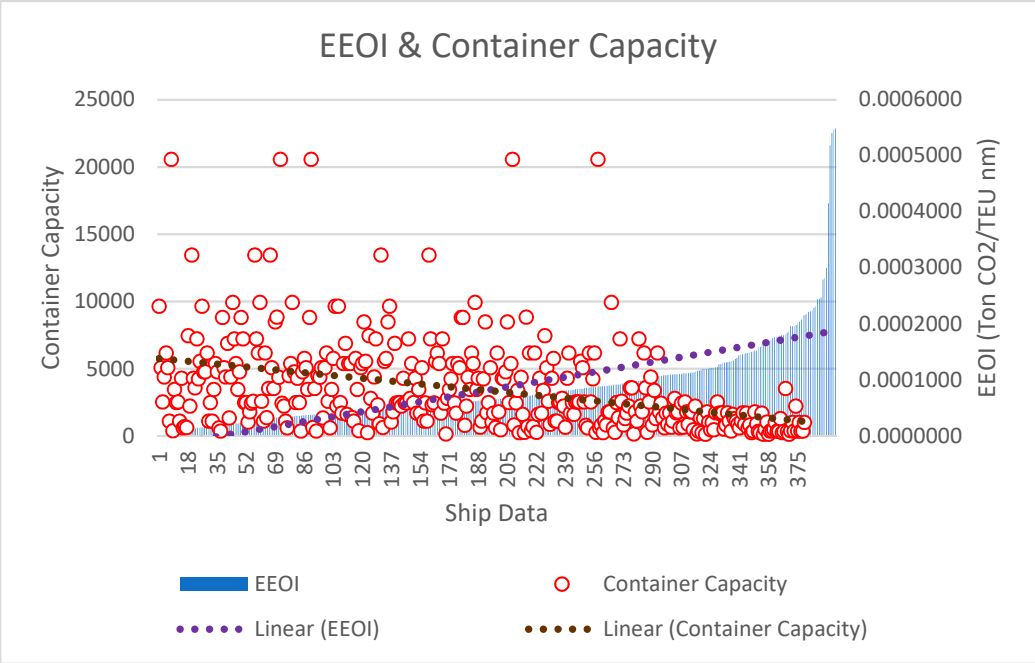


Figure 4.21 Graph of EEOI & Container Capacity

Figure 4.21 shows the correlation between EEOI and the amount of container capacity by the 100 ships. Analyzed from the graph, it shows the different relationships between these variables. The value of EEOI increases as the amount of cargo carried decreased significantly. These relationships are shown by a negative gradient of the trend line. There is one ship that has the maximum value of container capacity with different EEOI value due to its sailing trip. Munich Maersk is the one that has the biggest container capacity, with **20,568 TEU** capacity. The trip from Ningbo Zhoushan to Yangshan generate **0.0000045 Ton CO_2/TEU nm** of EEOI, from Tianjin to Busan generate **0.0000340 Ton CO_2/TEU nm** of EEOI, from Busan to Ningbo Zhoushan generate **0.0000384 Ton CO_2/TEU nm** of EEOI, from Yangshan to Yantian generate **0.0000717 Ton CO_2/TEU nm** of EEOI, and from Yantian to Tanjung Pelepas generate **0.0000919 Ton CO_2/TEU nm** of EEOI. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and the container capacity is **1005 TEU**.

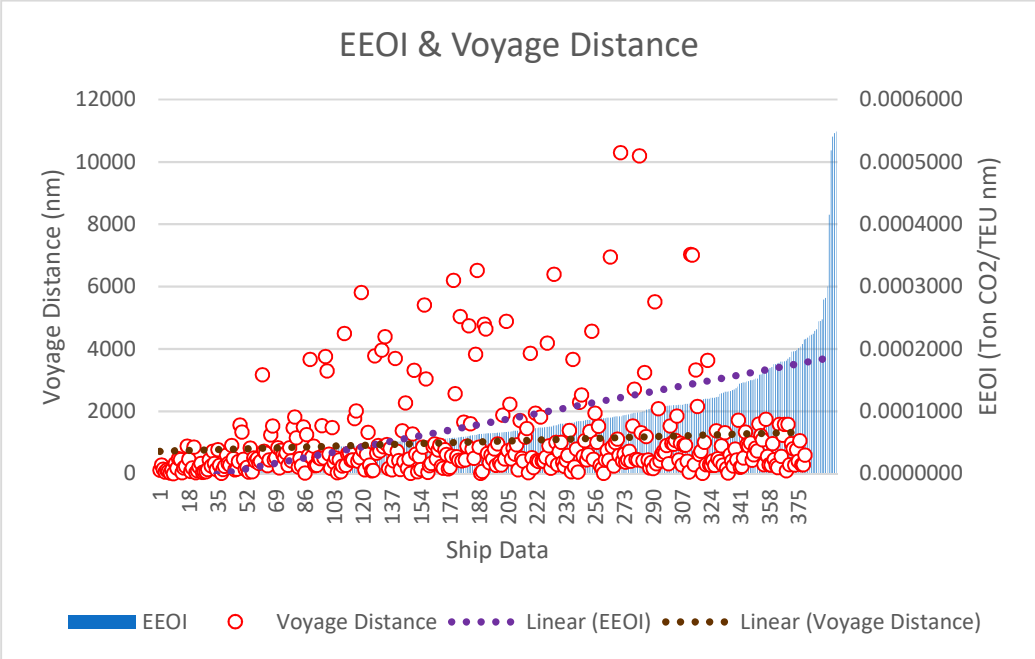


Figure 4.22 Graph of EEOI & Voyage Distance

Figure 4.22 shows the correlation between EEOI and voyage distance by the 100 ships. Analyzed from the graph, it shows the different relationships between these variables. The graph shows that the voyage distance of the ship does have a slight increase correlated with the value of EEOI that increases dramatically. The longest trip done by a ship is from Busan to Newark, with **10,290.87 nm** of distance, the ship is Clementine Maersk, and the EEOI value is **0.0000994 Ton CO_2/TEU nm**. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and the trip is from Port of Makassar to Semarang with **593.41 nm** of distance.

4.6.2 Analysis of the Actual EEOI Value, STEAM Method EEOI Value, and MLR EEOI Value

The EEOI value of the two methods has differences; the STEAM method and the MLR has each factor that affects the value to the actual EEOI.

Table 4.12 Actual EEOI Value, STEAM Method EEOI Value, and MLR EEOI Value

Trip Number	Route		Noon Report Date	EEOI (Ton CO2/TEU nm)		
	Origin	Destination		Actual	STEAM	MLR
MBN-2	Kumai	Semarang	13/01/2019	0.00043076	0.000380975	0.000291043
MBN-3	Semarang	Surabaya	14/01/2019	0.000574487	0.000718586	0.000315156
MBN-4	Surabaya	Samarinda	17/01/2019	0.000448816	0.000515732	0.000298359
MBN-6	Surabaya	Kumai	28/01/2019	0.000637328	0.000467878	0.000290003
MBN-7	Kumai	Semarang	01/02/2019	0.000344715	0.0002495	0.000282592
MBN-8	Semarang	Surabaya	03/02/2019	0.000433876	0.000590154	0.0003032
MBN-10	Sampit	Surabaya	08/02/2019	0.000688578	0.000604599	0.000295882
MBN-11	Surabaya	Semarang	11/02/2019	0.00047969	0.000624958	0.000305802
MBN-12	Semarang	Kumai	12/02/2019	0.000405013	0.000395202	0.00029814
MBN-13	Kumai	Surabaya	14/02/2019	0.000408547	0.000433843	0.000297037
MBN-14	Surabaya	Kumai	17/02/2019	0.000397723	0.000275138	0.000278374
MBN-15	Kumai	Surabaya	20/02/2019	0.000302977	0.000357223	0.000300218
MBN-16	Surabaya	Kumai	23/02/2019	0.000419273	0.000304075	0.000283715
MBN-17	Kumai	Surabaya	27/02/2019	0.000295713	0.000300029	0.00029272
MBN-18	Surabaya	Kumai	03/03/2019	0.000463282	0.000427621	0.00029913
MBN-20	Semarang	Surabaya	08/03/2019	0.000358175	0.000340211	0.000294101
MBN-21	Surabaya	Kumai	11/03/2019	0.000616871	0.000416189	0.000302807
MBN-23	Semarang	Surabaya	17/03/2019	0.00063578	0.000661605	0.000300063
MBN-25	Kumai	Semarang	23/03/2019	0.000445915	0.000277075	0.000281838
MBN-26	Semarang	Surabaya	26/03/2019	0.000779606	0.00089185	0.000307454

Table 4.12 showed the value of the EEOI that has been calculated from the noon report of the MV Meratus Benoa. From the noon report, it determined the actual value of the EEOI. The actual value will be used for determining the reliability of the two methods. From the calculated EEOI value, the MAPE of each method determined as,

Table 4.13 MAPE of STEAM Method & MLR EEOI Value to the Actual Value

MAPE	
STEAM	MLR/EEOI Generator
12%	32%

MAPE	
STEAM	MLR/EEOI Generator
25%	45%
15%	34%
27%	54%
28%	18%
36%	30%
12%	57%
30%	36%
2%	26%
6%	27%
31%	30%
18%	1%
27%	32%
1%	1%
8%	35%
5%	18%
33%	51%
4%	53%
38%	37%
14%	61%
Avg. MAPE = 19%	Avg. MAPE = 34%

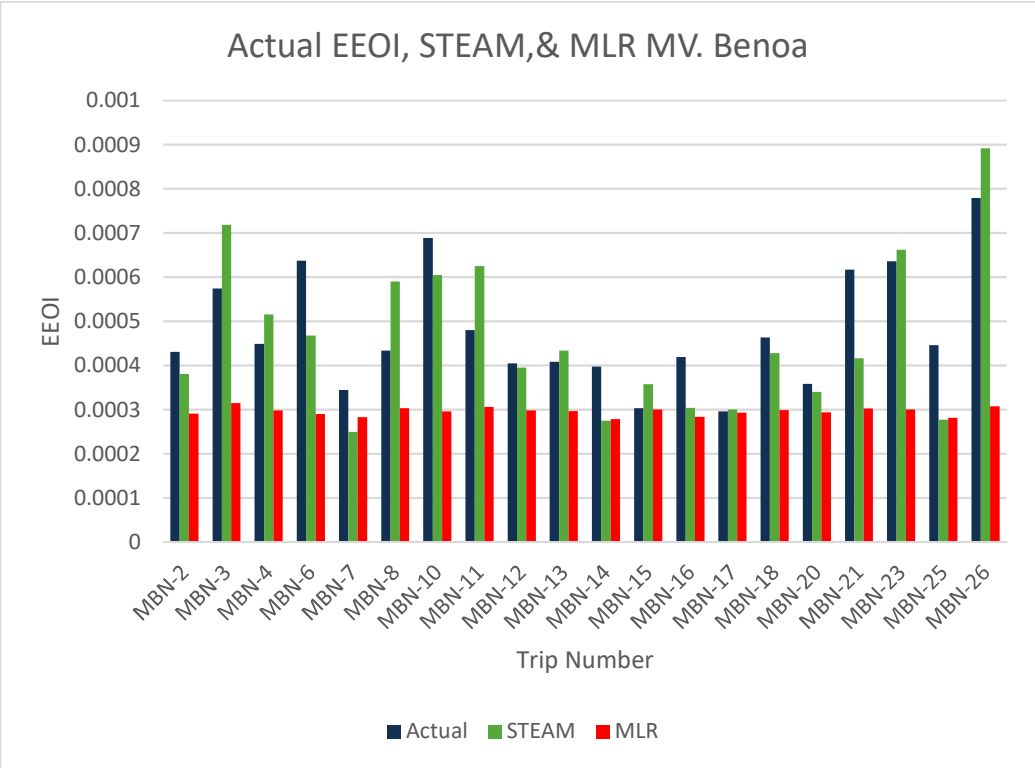


Figure 4.23 Graph of Actual, STEAM Method, and MLR EEOI

The MAPE shows that the STEAM method is more reliable or relevant than the MLR EEOI value because the variables used for calculation are too scrambled, so the error is massive. The equation for calculating EEOI from the MLR is also using the value from the STEAM Method. It is not directly using the actual value of EEOI due to the minimum data available.

CHAPTER 5

CONCLUSION

5.1 Conclusion

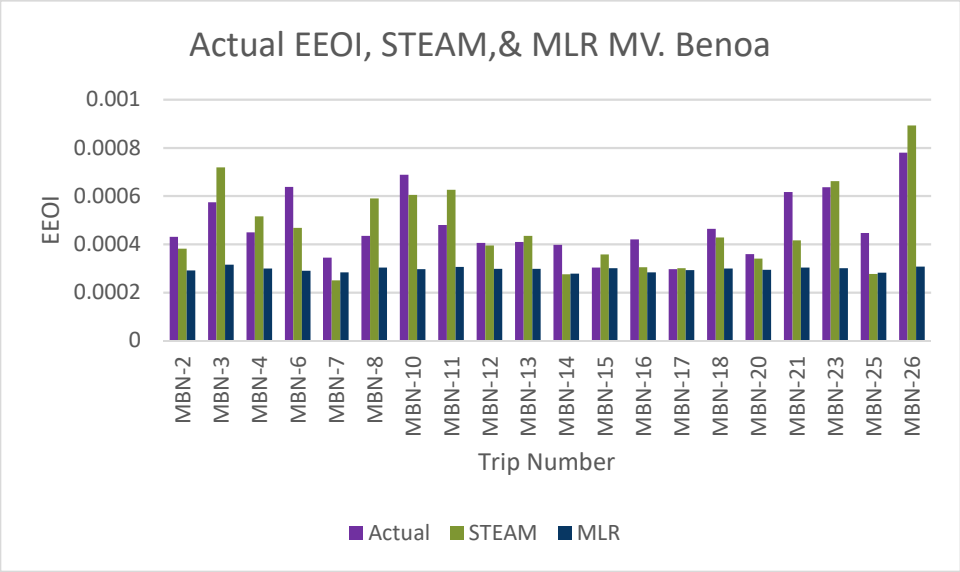
The conclusion of this research are:

1. Estimation of the fuel oil consumption using the STEAM method resulted in fuel estimation per voyage/trip. The resulted value is compared with the actual fuel oil consumption based on noon report of MV Meratus Benoa, and the calculation of Mean Absolute Percentage Error (MAPE) resulted as,

    - STEAM method fuel oil consumption estimation MAPE to the actual fuel oil consumption: **14%** (without any correction)

2. Energy Efficiency Operational Indicator (EEOI) calculated using two methods, the STEAM method and the Multiple Linear Regression (MLR) equation. The STEAM method based on the fuel oil consumption estimation and the MLR equation is generated from the STEAM EEOI resulted in a value that has been changed some chosen variables. The calculation of EEOI resulted as,

    - The MLR EEOI value MAPE to the STEAM method EEOI value: **26%**
    - The MLR EEOI value MAPE to the actual EEOI value: **34%**
    - The STEAM method EEOI value MAPE to the actual EEOI value: **19%**
    - EEOI of each method and the actual value



- The maximum fuel oil consumption is done by Axel Maersk, with **2467.9 Tons** of fuel, and it has **0.0001074 Ton CO_2/TEU nm** EEOI value. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and consumed **102.03 Tons** of fuel oil.
- The maximum average speed is done by Munich Maersk, with **20.21 knots**, and the EEOI value is **0.0000919 Ton CO_2/TEU nm**. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and sailed with an average speed of **12.46 knots**.
- The maximum container capacity is carried by Munich Maersk, with **20,568 TEU** capacity. The EEOI value is different each trip resulted as, the trip from Ningbo Zhoushan to Yangshan generate **0.0000045 Ton CO_2/TEU nm** of EEOI, from Tianjin to Busan generate **0.0000340 Ton CO_2/TEU nm** of EEOI, from Busan to Ningbo Zhoushan generate **0.0000384 Ton CO_2/TEU nm** of EEOI, from Yangshan to Yantian generate **0.0000717 Ton CO_2/TEU nm** of EEOI, and from Yantian to Tanjung Pelepas generate **0.0000919 Ton CO_2/TEU nm** of EEOI. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and the container capacity is **1005 TEU**
- The longest distance sailed is done by Clementine Maersk, with **10,290.87 nm** of distance, and the EEOI value is **0.0000994 Ton CO_2/TEU nm**. The highest EEOI value of a ship is done by Meratus Gorontalo, with **0.0005485 Ton CO_2/TEU nm**, and the trip is from Port of Makassar to Semarang with **593.41 nm** of distance.
- Improvement of cargo management and the sailing speed could be made based on the resulted EEOI value. It shows that the cargo is significantly affected the EEOI value. Ships that have less average container carried are higher at the EEOI value compared to the ships that carried more container. In terms of ship operational conditions, ship operators of the ships should monitor and evaluate which operational mode suits the best against the sea condition at that specific time.

3. The development of the EEOI measurement tool resulted in generating android based application for estimating the EEOI value using MLR equation. The equation, as stated before based on the chosen variables, such as length overall, breadth, draught, depth, service speed, container capacity, last trip average speed, last trip average draught, main engine power installed, and travel time.

5.2 Suggestion

Based on the result of this research, some suggestion is given by the author to support further research, as follow:

1. For the STEAM method of fuel oil consumption estimation, the author suggests the correction of the variables should be proposed, minimize the error between the actual value and the estimation value. These variables are the Specific Fuel Oil Consumption (SFOC), the fuel type of the ships, and the safety speed margin. If the data more comprehended, the author suggests that instead of using the STEAM method, it could be using the STEAM 2 Method. However, it needed more than AIS data to use for the calculation for better accuracy.
2. For the MLR EEOI calculation, the author suggests that the statistical approach uses a better formula than MLR. This equation is not quite matched for the variables that have been chosen. The error is massive than the STEAM method.
3. For generating the EEOI measurement tool, the author suggests exploring more platforms or media, and for better sharing and saving the data, it could be connected to a database or even using the internal AIS database such as AIS ITS that has been recently launched.

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APPENDIX

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ATTACHMENT 1:

FUEL OIL CONSUMPTION ESTIMATION (STEAM)

Step 1: Collecting database

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	612.68	9	4.77	4.96	13.9	0.5	1998	200
		Port Moresby - Tanjung Bara Coal	2149.63	15	7.97	4.3	13.9	0.5	1998	200
		Benete - Port Moresby	2708.69	19	7.42	5.08	13.9	0.5	1998	200
2	Territory Trader	Surabaya - Sorong	1217.44	5	10.25	4.8	12	0.5	2300	200
		Sorong - Surabaya	1228.04	8	9.34	4.85	12	0.5	2300	200
3	Multi Express	Tangguh LNG - Gresik	1321.35	16	4.41	5.35	12	0.5	2447	200
		Tangguh LNG - Ciwadan	1702.42	16	5.57	5.01	12	0.5	2447	200
4	Tanto Abadi	Gorontalo - Surabaya	999.99	5	7.82	6	14.5	0.5	3807	200
		Port of Makassar - Surabaya	436.5	3	7.46	6	14.5	0.5	3807	200
		Surabaya - Gorontalo	995.77	5	7.98	6	14.5	0.5	3807	200
5	Meratus Sabang	Surabaya - Benoa (Bali)	282.67	2	7.81	3.9	11.9	0.5	2050	200
		Benoa (Bali) - Surabaya	283.51	2	7.26	4.11	11.9	0.5	2050	200
6	Meratus Sibolga	Surabaya - Benoa (Bali)	285.96	2	7.66	3.8	14.32	0.5	2050	200
		Benoa (Bali) - Surabaya	289.24	29 hrs	10.42	3.83	14.32	0.5	2050	200
7	Tanto Ceria	Banjarmasin - Gresik	256.49	2	5.62	4.6	15.34	0.5	4200	200
		Surabaya - Banjarmasin	264.65	2	5.76	4.66	15.34	0.5	4200	200
		Gresik - Surabaya	8.03	2 hrs	4.2	4.6	15.34	0.5	4200	200
8	Meratus Project 1	Gresik - Tangguh LNG	1311.97	11	7.25	6.5	12.6	0.5	5875	200
		Ciwandan - Surabaya	450.45	3	8.83	6.67	12.6	0.5	5875	200
		Tangguh LNG - Ciwandan	1744.94	20	7.15	6.56	12.6	0.5	5875	200
9	Meratus Padang	Surabaya - Dili	876.65	5	8.07	6.56	17.8	0.5	5384	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Dili - Surabaya	880.55	9	4.43	6.3	17.8	0.5	5384	200
10	Tanto Sentosa	Surabaya - Gresik	8.24	2 hrs	5.98	6.25	14.3	0.5	5500	200
		Surabaya - Port of Makassar	429.49	3	7.5	6.5	14.3	0.5	5500	200
		Gresik - Surabaya	7.16	2hrs	5.1	6.05	14.3	0.5	5500	200
11	Vitoria S	Istanbul - Galati	414.75	5	4.75	3.77	11.5	0.5	3219	200
		Galati - Haifa	1163.32	14	4.68	6.57	11.5	0.5	3219	200
12	Merartus Benoa	Semarang - Surabaya	190.78	26 hrs	7.32	4.27	10.5	0.5	5220	200
		Kumai - Semarang	284.04	4	7.32	4.09	10.5	0.5	5220	200
		Surabaya - Kumai	282.25	4	7.33	4.27	10.5	0.5	5220	200
13	Meratus Bontang	Lembar - Ende	396.98	3	8.25	4.5	10.5	0.5	5220	200
		Surabaya - Lembar	271.06	35 hrs	8.12	3.1	10.5	0.5	5220	200
		Ende - Surabaya	606.15	11	4.66	3.3	10.5	0.5	5220	200
14	Meratus Barito	Ende - Surabaya	617.03	9	5.25	3.5	12.3	0.5	5220	200
		Lembar - Ende	402.1	2	8.01	4.4	12.3	0.5	5220	200
		Surabaya - Lembar	270.79	2	7.63	3.7	12.3	0.5	5220	200
15	Tanto Alam	Jakarta - Balikpapan	1579.44	12	7.41	5.4	12	0.5	5322	200
		Balikpapan - Jakarta	1577.22	13	7.13	6.01	12	0.5	5322	200
16	Tanto Aman	Jakarta - Balikpapan	1583.33	12	7.58	5.9	12	0.5	5322	200
		Balikpapan - Jakarta	1585.9	12	6.9	5.77	12	0.5	5322	200
17	Meratus Ultima 2	Banjarmasin - Surabaya	264.11	29 hrs	9.63	5.28	14.2	0.5	5600	200
		Surabaya - Banjarmasin	264.13	30 hrs	9.39	4.5	14.2	0.5	5600	200
18	Meratus Ultima 1	Lembar - Surabaya	279.34	3	5.84	5.74	14.7	0.5	5600	200
		Surabaya - Lembar	280.96	34 hrs	9.23	6	14.7	0.5	5600	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
19	Tanto Subur I	Singapore -Batu Ampar	1.8	1 hrs	1.81	6.5	14	0.5	4556	200
		Jakarta - Singapore	510.81	3	7.12	6.5	14	0.5	4556	200
		Batu Ampar - Jakarta	511.41	6	4.77	6.5	14	0.5	4556	200
20	Tanto Subur II	Surabaya - Balikpapan	966.27	6	9.3	5.93	12.5	0.5	4559	200
		Balikpapan - Surabaya	967.54	8	7.98	5.53	12.5	0.5	4559	200
21	Meratus Palembang	Banjarmasin - Surabaya	264.91	3	6	5.22	14.8	0.5	6802	200
		Surabaya - Dili	856.19	7	6.04	4.71	14.8	0.5	6802	200
22	Goteborg	Matadi - Pointe Noire	184.26	5	1.88	5.18	15	0.5	13410	200
		Pointe Noire - Douala	672.8	4	7.07	5.96	15	0.5	13410	200
		Pointe Noire - Cabinda	170.08	2	4.1	5.4	15	0.5	13410	200
		Pointe Noire - Matadi	201.57	2	6.8	6.26	15	0.5	13410	200
23	Meratus Dili	Surabaya - Dili	875.76	4	10.07	6.1	14.3	0.5	8027	200
		Dili - Maumere	244	2	6.8	4.91	14.3	0.5	8027	200
		Surabaya - Banjarmasin	264.95	2	6.85	5.46	14.3	0.5	8027	200
24	Meratus Kendari 1	Surabaya - Banjarmasin	264.83	3	4.61	4.79	12.5	0.5	4487	200
		Surabaya - Ambon	978.26	5	9.08	4.1	12.5	0.5	4487	200
		Ambon - Port of Makassar	600.91	3	8.31	4.19	12.5	0.5	4487	200
		Banjarmasin - Surabaya	263.66	2	4.42	5.49	12.5	0.5	4487	200
25	Viola	Boma - Matadi	27.7	4 hrs	9.43	6.2	17	0.5	6155	200
		Pointe Noire - Boma	194.23	21 hrs	10.43	6.21	17	0.5	6155	200
		Matadi - Pointe Noire	230.52	4	3.38	5.91	17	0.5	6155	200
26	Meratus Kalabahi	Palu - Surabaya	625.72	2	10.92	6.81	18	0.5	9910	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Tolitoli - Palu	162.98	14 hrs	12.11	5.96	18	0.5	9910	200
		Ambon - Surabaya	984.4	7	11.3	6.12	18	0.5	9910	200
27	Meratus Kupang	Surabaya - Port of Makassar	437.46	2	9.46	7.3	16.4	0.5	9765	200
		Port of Makassar - Surabaya	439.06	3	7.37	7.5	16.4	0.5	9765	200
28	Meratus Kelimutu	Palu - Tolitoli	158.08	22 hrs	10.33	7.7	16.1	0.5	9765	200
		Palu - Surabaya	626.68	3	9.69	8.09	16.1	0.5	9765	200
		Tolitoli - Palu	161.52	17 hrs	9.67	8.1	16.1	0.5	9765	200
		Surabaya - Tolitoli	735.98	3	9.96	8.1	16.1	0.5	9765	200
29	Ruth	Santa Cruz de Tenerife - Ferrol	1332.9	6	13.09	6.73	18.5	0.5	11265	200
		Las Palmas - Santa Cruz de Tenerife	54.18	5 hrs	12.21	7	18.5	0.5	11265	200
		Tilbury - Las Palmas	1711.49	5	14.86	7.9	18.5	0.5	11265	200
		Rotterdam - Tilbury	177.64	20 hrs	9.99	7.8	18.5	0.5	11265	200
		Hamburg - Rotterdam	317.68	28 hrs	12.1	8.11	18.5	0.5	11265	200
30	Meratus Batam	Surabaya - Kupang	723.96	3	10.79	6.8	15.3	0.5	13596	200
		Kupang - Surabaya	726.32	8	5.05	6.85	15.3	0.5	13596	200
31	Tanto Express	Jayapura - Ambon	916.77	4	10.51	5.8	18	0.5	10800	200
		Surabaya - Port of Makassar	433.79	2	9.22	6.13	18	0.5	10800	200
		Gresik - Surabaya	8.46	2 hrs	6.54	6	18	0.5	10800	200
		Ambon - Surabaya	975.62	6	9.25	5.8	18	0.5	10800	200
32	New York Trader	Evyap - Istanbul	43.66	5 hrs	9.72	6.45	20	0.5	13048	200
		San Juan - Evyap	5412.36	23	10.09	7.11	20	0.5	13048	200
		Kingston - San Juan	664.05	4	7.7	6.33	20	0.5	13048	200
		Port of Spain - Kingston	1005.47	4	11.78	6.6	20	0.5	13048	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Point Lisas - Port of Spain	23.48	16 hrs	2.16	6	20	0.5	13048	200
33	Maersk Regensburg	Cotonou - Lagos	73.48	7 hrs	10.98	6.3	20	0.5	13048	200
		Cotonou - Takoradi	283.66	2	9.84	6.3	20	0.5	13048	200
34	Maersk Roubaix	Port Owendo - Pointe Noire	444.75	7	3.44	5.9	20	0.5	13048	200
		Tema - Port Owendo	1760.54	13	7.88	6.01	20	0.5	13048	200
		Pointe Noire - Tema	946.46	3	14.35	6.4	20	0.5	13048	200
		Porto de Luanda - Pointe Noire	236.75	23 hrs	14.98	8.19	20	0.5	13048	200
		Pointe Noire - Porto de Luanda	714.48	8	5.2	6.58	20	0.5	13048	200
35	Meratus Mamiri	Kupang - Surabaya	714.13	6	5.24	5.93	16	0.5	13610	200
		Surabaya - Port of Makassar	438.33	2	9.76	7.55	16	0.5	13610	200
36	Meratus Makassar	Surabaya - Port of Makassar	444.44	4	4.98	7.8	18.5	0.5	13614	200
		Port of Makassar - Surabaya	442.43	2	10.82	8.84	18.5	0.5	13614	200
37	Meratus Malino	Palu - Surabaya	604.39	3	10.68	7.4	16	0.5	13610	200
		Surabaya - Port of Makassar	437.59	35 hrs	12.56	7.8	16	0.5	13610	200
38	X-Press Elbe	Rotterdam - Antwerp	122.36	15 hrs	8.9	7.49	19	0.5	12069	200
		Sankt Pettersburg - Riga	462.73	2	10.24	8.1	19	0.5	12069	200
		Riga - Kiel	555.13	2	15.62	8.88	19	0.5	12069	200
		Kiel - Brunsbuttel	50.53	8 hrs	6.54	8.9	19	0.5	12069	200
		Brunsbuttel - Rotterdam	288.69	21 hrs	14.64	8.8	19	0.5	12069	200
39	Juliana	Panama City (Balboa) - Corinto	713.72	2	15.14	9.1	20	0.5	16950	200
		Corinto - Panama City (Balboa)	720.72	3	12.58	9.26	20	0.5	16950	200
		Puerto Caldera - Corinto	277.5	3	5.27	8.18	20	0.5	16950	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Panama City (Balboa) - Puerto Caldera	503.11	2	9.13	9.2	20	0.5	16950	200
40	Wybelsum	Goteborg - Cuxhaven	363.89	31 hrs	11.91	8.8	19	0.5	18184	200
		Felixstowe - Goteborg	550.18	2	15.26	8.11	19	0.5	18184	200
		Bremerhaven - Felixstowe	318.18	31 hrs	11.64	7.8	19	0.5	18184	200
		Sankt Pettersburg - Bremerhaven	1001.09	8	9.87	9.91	19	0.5	18184	200
		Kiel - Sankt Pettersburg	784.23	2	15.51	8.3	19	0.5	18184	200
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	263.78	34 hrs	7.82	7.34	11.4	0.5	15520	200
		Port of Makassar - Semarang	593.41	2	12.46	7.5	11.4	0.5	15520	200
		Jakarta (Tanjjung Priok) - Surabaya	408.51	4	5.59	5.6	11.4	0.5	15520	200
		Jakarta (Tanjung Priok) - Port of Makassar	793.79	4	8.7	7.5	11.4	0.5	15520	200
		Surabaya - Bitung	1055.01	3	12.94	5.6	11.4	0.5	15520	200
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	231.37	1	10.01	7.5	20	0.5	21214	200
		Puerto Cortes - Puerto Colon	786.44	3	11.02	8.17	20	0.5	21214	200
		Santo Tomas De Castilla - Puerto Cortes	64.17	8 hrs	9.23	7.48	20	0.5	21214	200
		Fort Lauderdale - Santo Tomas De Castilla	893.65	3	14.96	7.4	20	0.5	21214	200
		Savannah - Fort Lauderdale	391.1	25 hrs	16.13	7.41	20	0.5	21214	200
43	AS Samanta	Cartagena - Santa Marta	129.22	15 hrs	9.47	7.49	20	0.5	21214	200
		Barranquilla - Cartagena	101.55	12 hrs	8.97	7.4	20	0.5	21214	200
		Kingston - Barranquilla	443.18	35 hrs	13.36	7.47	20	0.5	21214	200
		Port of Miami - Kingston	927.94	3	16.02	7.56	20	0.5	21214	200
		Puerto De Haina - Port of Miami	1087.71	3	17.51	7.57	20	0.5	21214	200
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	57.17	8 hrs	10.39	7	20	0.5	21214	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Fort Lauderdale - Santo Tomas de Castilla	897	2	15.66	6.8	20	0.5	21214	200
		Savannah - Fort Lauderdale	411.68	2	10.76	6.8	20	0.5	21214	200
		Wilmington (NC) - Savannah	247.95	33 hrs	8.46	7.1	20	0.5	21214	200
		Gloucester City - Wilmington (NC)	540.28	2	10.78	7.2	20	0.5	21214	200
45	RHL Agilitas	Halifax - Kingston	1841.17	5	15.01	9.2	20.5	0.5	22341	200
		Newark - Halifark	647.08	2	11.87	7.5	20.5	0.5	22341	200
		Kingston - Newark	1527.21	5	13.93	8.56	20.5	0.5	22341	200
46	Viona	Bremerhaven - Rotterdam	273.68	17 hrs	17.01	9.39	21.3	0.5	22770	200
		Arhus - Bremerhaven	496.75	28 hrs	18.37	8.9	21.3	0.5	22770	200
		Reykjavik - Arhus	1376.91	3	17.87	9.55	21.3	0.5	22770	200
		Grundartangi - Reykjavik	15.55	3 hrs	11.73	8.3	21.3	0.5	22770	200
47	Maersk Vallvik	Charleston - Freeport	408.49	30 hrs	14.17	10.3	20.2	0.5	22260	200
		Norfolk - Charleston	456.95	2	12.37	9.49	20.2	0.5	22260	200
		Freeport - Port Elizabeth	7013.3	19	15.26	10.3	20.2	0.5	22260	200
		Port Elizabeth - Durban	395.61	29 hrs	14.59	10.27	20.2	0.5	22260	200
48	Maersk Vilnius	Durban - Cape Town	819.94	8	6	7.4	20.2	0.5	22260	200
		Salalah - Durban	3628.87	12	14.74	8.18	20.2	0.5	22260	200
		Al Duqm - Salalah	352.12	3	8.59	7.07	20.2	0.5	22260	200
		Cape Town - Newark	6951.03	22	13.37	7.7	20.2	0.5	22260	200
		Newark - Port of Baltimore	429.55	2	11.73	8.21	20.2	0.5	22260	200
49	Maersk Visby	Port Elizabeth - Durban	412.78	2	9.45	9.9	20.2	0.5	22260	200
		Freeport - Port Elizabeth	7030.25	21	14.77	9.8	20.2	0.5	22260	200
		Charleston - Freeport	408.37	28 hrs	14.39	8.79	20.2	0.5	22260	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Norfolk - Charleston	442.14	2	12.76	8.5	20.2	0.5	22260	200
		Durban - Cape Town	817.51	2	17.94	8.7	20.2	0.5	22260	200
50	Bernard A	Samsun - Istanbul	395.39	35 hrs	11.34	7.8	19	0.5	17808	200
		Poti - Samsun	242.18	22 hrs	14.51	7.2	19	0.5	17808	200
		Istanbul - Poti	630.81	3	8.8	8.49	19	0.5	17808	200
		Constanta - Istanbul	215.29	32 hrs	10.08	7.7	19	0.5	17808	200
		Samsun - Constanta	387.73	35 hrs	11.45	7.6	19	0.5	17808	200
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	253.09	27 hrs	7.99	7.48	18.5	0.5	14400	200
		Port of Makassar - Semarang	582.99	2	12.72	7.5	18.5	0.5	14400	200
		Surabaya - Port of Makassar	443.11	3	7.79	7.5	18.5	0.5	14400	200
52	Nexo Maersk	Tanger Mediterranean - Algeciras	24.19	4 hrs	7.63	10.4	21.8	0.5	38570	200
		Vado Ligure - Tanger Mediterranean	883.92	3	10.94	8.9	21.8	0.5	38570	200
		For sur mer - Vado Ligure	235.7	2	8.86	8	21.8	0.5	38570	200
		Algericas - Montreal	3327.24	10	14.4	10.3	21.8	0.5	38570	200
		Tanger Mediterranean - For sur mer	713.53	2	13.75	8	21.8	0.5	38570	200
53	Nele Maersk	Novorossiysk - Port Said	1307.73	5	12.55	11.29	21.8	0.5	38570	200
		Port Said - Novorossiysk	1372.17	8	8.57	8.85	21.8	0.5	38570	200
		Istanbul - Novorossiysk	496.12	3	7.36	9.97	21.8	0.5	38570	200
		Damietta - Istanbul	770.36	4	15.92	9.84	21.8	0.5	38570	200
		Port Said - Damietta	70.86	33 hrs	3.46	9.3	21.8	0.5	38570	200
54	Tanto Nusantara	Jakarta - Belawan	869.18	4	10.13	7	21	0.5	29147	200
		Belawan - Jakarta	902.82	6	8.6	7.54	21	0.5	29147	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
55	EMS Trader	Puerto Colon - Cartagena	278.18	17 hrs	17.53	9.2	22	0.5	26565	200
		Puerto Cortes - Puerto Colon	768.94	2	13.67	9.58	22	0.5	26565	200
		Santo Tomas de Castilla - Puerto Cortes	64.3	15 hrs	6.85	9.5	22	0.5	26565	200
		Mariel - Santo Tomas De Castilla	603.32	3	9.23	9.65	22	0.5	26565	200
		New Orleans - Mariel	614.14	2	15.78	10.5	22	0.5	26565	200
56	Miami Trader	Jawaharlal Nehru Port - Colombo	926.1	3	13.17	10.98	21.5	0.5	28067	200
		Mundra - Jawaharlal Nehru Port	423.06	2	10.4	10.45	21.5	0.5	28067	200
		Dubai (Jebel Ali) - Mundra	952.39	3	12.2	10.18	21.5	0.5	28067	200
		Colombo - Durban	3659.54	15	12.92	11	21.5	0.5	28067	200
		Port Louis - Dubai (Jebel Ali)	3032.51	11	11.57	9.5	21.5	0.5	28067	200
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	2287.52	7	13.93	7.44	21	0.5	29147	200
		Djibouti - Salalah	784.31	3	12.9	7.9	21	0.5	29147	200
		Toamasina - Victoria	909.66	2	17.31	8.5	21	0.5	29147	200
		Port Louis - Toamasina	476.07	27 hrs	17.97	9.55	21	0.5	29147	200
		Le Port (Pointe des Galets) - Port Louis	142.29	9	1.37	11.1	21	0.5	29147	200
58	X-Press Machu Picchu	Puerto Colon - Cartagena	482.62	5	4.09	8.69	21	0.5	29147	200
		Mariel - Puerto Colon	1005.04	3	13.84	9.49	21	0.5	29147	200
		Cartagena - Mariel	1058.44	4	13.02	10.69	21	0.5	29147	200
59	JPO Aries	Valencia - Lisbon	720.55	3	11.06	9.5	21.5	0.5	26565	200
		Lisbon - Halifax	2561.35	9	12.29	9.71	21.5	0.5	26565	200
		Barcelona - Valencia	177.56	17 hrs	11.3	9.68	21.5	0.5	26565	200
60	Nordatlantic	Toamasina - Salalah	2223.83	11	11.92	8.55	22.9	0.5	28912	200

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		Port Louis - Toamasina	476.55	2	10.19	8.83	22.9	0.5	28912	200
		Le Port (Pointe des Galets) - Port Louis	139.6	17 hrs	8.4	10.9	22.9	0.5	28912	200
		Salalah - Port Louis	2269.76	9	11.67	11.04	22.9	0.5	28912	200
61	Ballenita	Tacoma - Vancouver	178.69	13 hrs	15.83	7.91	22	0.5	28818	200
		Everett - Tacoma	47.97	4 hrs	14.03	8.7	22	0.5	28818	200
		Tokyo Ko - Everett	4561.24	13	15.13	9.2	22	0.5	28818	200
62	Maersk Norfolk	Fos sur mer - Genoa	241.65	2	6.05	7.6	21.5	0.5	29194	200
		Tanger Mediterranean - Fos sur mer	709.62	2	14.31	7.69	21.5	0.5	29194	200
		Montreal - Tanger Mediterranean	3316.55	12	11.35	9.25	21.5	0.5	29194	200
		Tanger Mediterranean - Algericas	169.32	2	3.73	8	21.5	0.5	29194	200
		Genoa - Tanger Mediterranean	1146.06	3	11.1	8	21.5	0.5	29194	200
63	Maersk Newport	Istanbul - Evyap	57.2	7 hrs	9.47	9.4	21.5	0.5	29194	200
		Piraeus (Athens) - Istanbul	352	31 hrs	12.14	10.7	21.5	0.5	29194	200
		For sur mer - Piraeus (Athens)	1105.23	3	15.27	11.4	21.5	0.5	29194	200
		Barcelona - For sur mer	203.82	27 hrs	7.66	11.3	21.5	0.5	29194	200
		Castellon de la Plana - Barcelona	132.16	13 hrs	10.8	9.64	21.5	0.5	29194	200
64	City of Hongkong	Conarky - San Pedro	620.77	2	11.34	8	22	0.5	28912	200
		Dakar - Conarky	504.3	3	7.99	9.92	22	0.5	28912	200
		Durban - Cape Town	894.88	3	13.87	9.4	22	0.5	28912	200
		Ngqura - Durban	403.62	27 hrs	15.83	8.3	22	0.5	28912	200
		San Pedro - Ngqura	3171.3	15	8.93	7.54	22	0.5	28912	200
65	Maersk Brani	Hamburg - Bremerhaven	122.21	10 hrs	13.31	9	22.1	0.5	38728	200
		Antwerp - Hamburg	393.82	30 hrs	14.06	9.4	22.1	0.5	38728	200

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		Bremerhaven - Altamira	5506.03	14	16.84	11.18	22.1	0.5	38728	200
66	Porto	Nagoya Ko - Yokkaichi	12.69	5 hrs	7.45	9.77	22.5	0.5	29194	200
		Yokkaichi - Taipei	1064.21	3	17.39	9.09	22.5	0.5	29194	200
		Taipei - Taichung	95.25	9 hrs	11.47	9.1	22.5	0.5	29194	200
		Taichung - Kaohsiung	151.81	12 hrs	13.13	9.57	22.5	0.5	29194	200
		Kaohsiung - Hong Kong	355.56	23 hrs	15.84	10.3	22.5	0.5	29194	200
67	Burgundy	Constanta - Istanbul	329.81	3	4.46	9.66	23.3	0.5	38728	200
		Odessa - Constanta	204.68	16 hrs	13.36	8.9	23.3	0.5	38728	200
		Diliskelesi - Odessa	401.67	36 hrs	11.68	9.49	23.3	0.5	38728	200
		Piraeus (Athens) - Diliskelesi	387.11	3	7.33	8.8	23.3	0.5	38728	200
		Malta Freeport - Piraeus (Athens)	542.64	2	12.45	8.29	23.3	0.5	38728	200
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	89.15	2	10.82	8.88	23.4	0.5	42805	200
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	252.58	31 hrs	9.76	11.2	23.4	0.5	42805	200
		Shuaiba - Khalifa Bin Salman Port	443.24	3	8.36	9.84	23.4	0.5	42805	200
		Khalifa Bin Salman Port - Shuaiba	443.24	1	12.18	11.1	23.4	0.5	42805	200
69	Maersk Izmir	Sydney - Melbourne	583.6	2	11.45	8.9	23.5	0.5	38728	200
		Tauranga - Sydney	1596.45	4	15.1	9.8	23.5	0.5	38728	200
		Panama City - Tauranga	6513.73	18	14.69	10.79	23.5	0.5	38728	200
		Cartagena - Panama City	324.8	2	7.56	10.37	23.5	0.5	38728	200
		Charleston - Cartagena	1472.67	5	12.01	9.7	23.5	0.5	38728	200
70	Nordautumn	Algericas - Tanger Mediterranean	26.14	6 hrs	5.59	11.67	23.4	0.5	43569	200
		Dakar Abidjan	1188.65	3	17.43	9.9	23.4	0.5	43569	200

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		Tanger Mediterranean - Dakar	1526.1	4	17	12.1	23.4	0.5	43569	200
		Abidjan - Lome	399.95	23 hrs	17.48	10.05	23.4	0.5	43569	200
71	Maersk Cabinda	Lagos - Onne	506.42	2	11.29	11	21.5	0.5	36288	200
		Onne - Pointe Noire	824.53	4	10.13	10.07	21.5	0.5	36288	200
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	741.33	3	12.62	11.95	21	0.5	33096	200
		Yangshan - Ningbo Zhousan	127.21	16 hrs	8.8	11.4	21	0.5	33096	200
		Qingdao - Yangshan	427.97	2	11.9	10.7	21	0.5	33096	200
		Busan - Qingdao	468.9	34 hrs	16	11.3	21	0.5	33096	200
		Hong Kong - Sydney	4491.55	13	13.95	12.8	21	0.5	33096	200
73	Wide Alpha	Yangshan - Ningbo Zhousan	138.21	15 hrs	9.59	11.15	21	0.5	33096	200
		Qingdao - Yangshan	432.08	28 hrs	15.89	10.39	21	0.5	33096	200
		Busan - Qingdao	493.93	32 hrs	16.17	11.8	21	0.5	33096	200
		Osaka - Busan	656.05	2	13.72	11.91	21	0.5	33096	200
74	Maersk Indus	Colombo - Pointe Noire	6202.31	17	15.65	13.31	21	0.5	33096	200
		Jawaharlal Nehru Port - Colombo	913.03	2	16.64	13.39	21	0.5	33096	200
		Mundra - Jawaharlal Nehru Port	410.53	2	10.89	12.23	21	0.5	33096	200
		Pointe Noire - Cotonou	1266.25	5	13.39	12.03	21	0.5	33096	200
75	Kyparissia	Walvis Bay - Durban	1558.73	7	9.33	11.4	21.5	0.5	36288	200
		Onne - Walvis Bay	1815.59	7	11.25	9.89	21.5	0.5	36288	200
		Cotonou - Onne	770.77	4	8.41	10.76	21.5	0.5	36288	200
		Durban - Tanjung Pelepas	4888.15	13	15.86	11.59	21.5	0.5	36288	200
		Tanjung Pelepas - Nansha	1499.4	6	11.24	9.23	21.5	0.5	36288	200
76	Leonidio	Lagos - Cotonou	57.99	8 hrs	7.73	11.3	21.5	0.5	36288	200

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		Cotonou - Lagos	56.09	8 hrs	7.6	11.3	21.5	0.5	36288	200
77	ALS Ceres	Surabaya - Singapore	850.4	6	6.43	8.6	24	0.5	49027	200
		Jakarta (Tanjung Priok) - Surabaya	423.6	36 hrs	14.78	8.9	24	0.5	49027	200
		Shenzhen - Jakarta (Tanjung Priok)	1810	5	15.9	11.7	24	0.5	49027	200
		Shantou - Shenzhen	209.37	20 hrs	10.92	11.21	24	0.5	49027	200
		Ningbo Zhousan - Shantou	585.05	36 hrs	16.76	10.07	24	0.5	49027	200
78	Rosa	Ningbo Zhousan - Shanghai	184.83	26 hrs	9.38	9.37	24	0.5	49027	200
		Qingdao - Ningbo Zhousan	480.46	2	11.12	9.68	24	0.5	49027	200
		Busan - Qingdao	490.82	3	11.99	9.88	24	0.5	49027	200
		Portland - Busan	4744.9	13	14.95	9.64	24	0.5	49027	200
79	Lana	Douala - Cotonou	591.41	3	8.38	7.32	24	0.5	49027	200
		Porto de Luanda - Douala	896.42	5	8.21	7.5	24	0.5	49027	200
		Pointe Noire - Porto de Luanda	357.41	19 hrs	19.23	9.9	24	0.5	49027	200
		Algericas - Pointe Noire	3773.44	13	12.53	12.61	24	0.5	49027	200
		Tanger Mediterranean - Algericas	51.25	23 hrs	2.49	9.26	24	0.5	49027	200
80	Schubert	Shanghai - Busan	469.78	34 hrs	14.86	10.88	24.1	0.5	48491	200
		Ningbo Zhoushan - Shanghai	218.41	35 hrs	6.79	9.3	24.1	0.5	48491	200
		Qingdao - Ningbo Zhoushan	559.46	2	13.32	9.6	24.1	0.5	48491	200
		Busan - Qingdao	461.63	3	12.59	9.88	24.1	0.5	48491	200
		Portland - Busan	4788.62	13	15.09	9.9	24.1	0.5	48491	200
81	Northern Guard	Shanghai - Hong Kong	853.31	3	13.19	11.14	23	0.5	49027	200
		Qingdao - Shanghai	396.59	2	10.85	11.56	23	0.5	49027	200
		Busan - Qingdao	628.44	3	11.18	10.55	23	0.5	49027	200

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		Hong Kong - Johor	1876.37	7	13.17	1.13	23	0.5	49027	200
		Johor - Singapore	33.36	22 hrs	3.51	11.89	23	0.5	49027	200
82	Kea	Rotterdam - Hamburg	322.11	2	8.84	10.5	22.5	0.5	45152	200
		Le Havre - Rotterdam	260.99	18 hrs	14.64	10.79	22.5	0.5	45152	200
		Hamburg - Newark	3697.55	11	15.26	11.76	22.5	0.5	45152	200
83	YM Wealth	Busan - Yangshan	466.83	2	12.65	11.4	26	0.5	73622	200
		Singapore - Busan	2519.04	6	17.84	11.2	26	0.5	73622	200
		Jeddah - Singapore	4395.61	14	13.4	10.4	26	0.5	73622	200
		Sokhna - Jeddah	621.91	2	13.04	10.13	26	0.5	73622	200
		Al Aqabah - Sokhna	328.29	3	6.3	11.7	26	0.5	73622	200
84	E R France	Hong Kong - Shenzhen	18.94	3 hrs	9.25	9.7	24.9	0.5	73541	200
		Kaohsing - Hong Kong	356.02	29 hrs	12.17	9.7	24.9	0.5	73541	200
		Busan - Kaohsiung	935.06	3	13.05	11.1	24.9	0.5	73541	200
		Manzanillo - Busan	6397.38	17	16.28	11.4	24.9	0.5	73541	200
		Guayaquil - Manzanillo	2011.96	6	12.84	9.8	24.9	0.5	73541	200
85	SC Mara	Sydney - Brisbane	554.46	33 hrs	17.2	10.9	23.7	0.5	55156	200
		Melbourne - Sydney	588.9	2	14.09	11.48	23.7	0.5	55156	200
		Yantian - Melbourne	5033.09	14	14.7	11.2	23.7	0.5	55156	200
		Brisbane - Busan	4189.36	10	16.88	10.9	23.7	0.5	55156	200
		Shanghai - Yantian	847.67	3	12.97	10.79	23.7	0.5	55156	200
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	68.28	34 hrs	2.75	12.62	23.7	0.5	55424	200
		Qinzhou - Rizhao	1539.98	7	10.82	11.25	23.7	0.5	55424	200

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		Lianyungang - Qinzhou	1526.95	8	9.6	12.55	23.7	0.5	55424	200
87	Miami	Manzanillo - Los Angeles	1253.54	5	11.3	9.7	24.3	0.5	55424	200
		Coronel - San Antonio	233.16	2	7.17	9.37	24.3	0.5	55424	200
		Valparaiso - Coronel	276.67	7	2.14	7.6	24.3	0.5	55424	200
		Los Angeles - Ningbo Zhoushan	5805.59	19	12.85	10.1	24.3	0.5	55424	200
		San Antonio - Manzanillo	3750.36	13	12.23	9.6	24.3	0.5	55424	200
88	Maersk Columbus	Algeciras - Port Said	1935.87	5	17.53	14.2	25	0.5	73622	200
		Tanger Mediterranean - Algericas	114.03	5	2.06	11.99	25	0.5	73622	200
		Port Said - Salalah	2077.73	5	19.1	14.2	25	0.5	73622	200
		Salalah - Dubai (Jebel Ali)	957.34	2	17.08	13.42	25	0.5	73622	200
		Dubai (Jebel Ali) - Muhammad Bin Qasim	785.86	3	13.68	12.46	25	0.5	73622	200
89	Maersk Denver	Newark - Algericas	3288.34	11	12.37	13.49	25	0.5	73622	200
		Norfolk - Newark	321.91	33 hrs	10.09	10.83	25	0.5	73622	200
		Djilbouti - Salalah	753.31	3	12.94	14.11	25	0.5	73622	200
		Port Said - Djibouti	1382.88	4	16.53	14.5	25	0.5	73622	200
		Algericas - Port Said	1933.79	5	16.53	14.5	25	0.5	73622	200
90	Maersk Chicago	Salalah - Algericas	3861.43	10	16.38	14.4	25	0.5	73622	200
		Algericas - Newark	3238.72	7	19.69	12.8	25	0.5	73622	200
		Savannah - Houston	1353.07	3	18.33	9.83	25	0.5	73622	200
		Newark - Charleston	655.63	2	11.63	11.7	25	0.5	73622	200
		Charleston - Savannah	134.63	20 hrs	7.62	10.59	25	0.5	73622	200
91	Maersk Lirquen	Hong Kong - Yangshan	826.78	7	9.12	12.06	22.5	0.5	61391	200
		Singapore - Hong Kong	1450.51	4	17.28	13.2	22.5	0.5	61391	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
92	Maersk Kowloon	Algericas - Sines	277.86	23 hrs	12.22	14	24.3	0.5	91886	200
		Valencia - Algericas	464.01	3	6.2	13.03	24.3	0.5	91886	200
		Genoa - Valencia	522.24	32 hrs	16.17	12.2	24.3	0.5	91886	200
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	1654.37	4	17.2	12.1	24.5	0.5	76572	200
		Sines - Gioia Tauro Harbour	1333.46	5	10.79	10.4	24.5	0.5	76572	200
		Freeport - Sines	3663.55	12	13.18	10.4	24.5	0.5	76572	200
		Charleston - Freeport	405.43	27 hrs	16.37	10.4	24.5	0.5	76572	200
		Savannah - Charleston	130.41	15 hrs	9.46	10.4	24.5	0.5	76572	200
94	Maersk Savannah	Qingdao - Busan	505.32	2	13.1	13.81	25.6	0.5	92047	200
		Yangshan - Qingdao	442.77	2	12.55	13.7	25.6	0.5	92047	200
		Ningbo Zhoushan - Yangshan	106.25	25 hrs	2.15	13.57	25.6	0.5	92047	200
		Shenzhen - Ningbo Zhoushan	808.45	3	14.14	13.5	25.6	0.5	92047	200
		Hong Kong - Shenzhen	41.71	9 hrs	7.03	14	25.6	0.5	92047	200
95	Maersk Sarnia	Busan - Vancouver	4639.29	12	16.44	12.4	24.5	0.5	82982	200
		Yangshan - Busan	515.15	4	9.08	11.78	24.5	0.5	82982	200
		Ningbo Zhousan - Yangshan	122.09	20 hrs	10.56	11.27	24.5	0.5	82982	200
		Yantian - Ningbo Zhousan	737.77	2	16.47	11.5	24.5	0.5	82982	200
		Vancouver - Seattle	165.01	12 hrs	14.34	13.84	24.5	0.5	82982	200
96	Clementine Maersk	Busan - Newark	10290.87	23	18.62	13.75	24.6	0.5	85714	200
		Yangshan - Busan	465.68	3	10.64	13.79	24.6	0.5	85714	200
		Norfolk - Newark	328.83	25 hrs	13.66	11.56	24.6	0.5	85714	200
		Port of Baltimore - Norfolk	171.76	13 hrs	13.82	11.5	24.6	0.5	85714	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Days)	Avg Speed (knots)	Avg Draught (m)	V Design (knots)	V Safety (knots)	P Installed (hp)	SFOC (g/kWh)
		Newark - Port of Baltimore	484.37	2	10	11.9	24.6	0.5	85714	200
97	Axel Maersk	Port of Miami - Freeport	93.08	14 hrs	6.96	11.9	24.6	0.5	85714	200
		Savannah - Port of Miami	463.46	2	9.39	12.78	24.6	0.5	85714	200
		Charleston - Savannah	125.89	15 hrs	8.63	12.24	24.6	0.5	85714	200
		Newark - Charleston	659.71	2	13.27	13.19	24.6	0.5	85714	200
		Singapore - Newark	10193.28	23	19.05	12.99	24.6	0.5	85714	200
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3829.42	9	17.5	14.37	25	0.5	92047	200
		Busan - Yokohama Ko	860.19	2	20.14	14.37	25	0.5	92047	200
		Yangshan - Busan	478.44	3	8.78	13.6	25	0.5	92047	200
		Los Angeles - Oakland	388.55	2	10.32	13.11	25	0.5	92047	200
		Prince Rupert - Loa Angeles	1470.98	5	12.73	14.39	25	0.5	92047	200
99	Emma Maersk	Tanger Mediterranean - Salalah	3958.94	10	16.72	16.14	25.5	0.5	108354	200
		Le Havre - Tanger Mediterranean	1238.14	4	13.38	15.21	25.5	0.5	108354	200
		London Gateway Port - Le Havre	253.73	16 hrs	17.13	14.15	25.5	0.5	108354	200
		Antwerp - London Gateway Port	186.03	24 hrs	8.32	13.3	25.5	0.5	108354	200
		Hamburg - Antwerp	401.8	34 hrs	12.35	10.58	25.5	0.5	108354	200
100	Munich Maersk	Yantian - Tanjung Pelepas	1513.2	3	20.21	16.29	21	0.5	125036	200
		Yangshan - Yantian	822.23	2	17.38	15	21	0.5	125036	200
		Ningbo Zhoushan - Yangshan	121.62	2	3.65	13.13	21	0.5	125036	200
		Busan - Ningbo Zhoushan	534.28	2	12.22	13.73	21	0.5	125036	200
		Tianjin - Busan	750.76	3	11.49	14.15	21	0.5	125036	200

Step 2: Converting the variables to fit the formula

Day = 24 hour
knot = 0.514 m/s
hp = 0.7457 kW

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	612.68	216	2.45178	4.96	7.1446	0.257	1489.9	200
		Port Moresby - Tanjung Bara Coal	2149.63	360	4.09658	4.3	7.1446	0.257	1489.9	200
		Benete - Port Moresby	2708.69	456	3.81388	5.08	7.1446	0.257	1489.9	200
2	Territory Trader	Surabaya - Sorong	1217.44	120	5.2685	4.8	6.168	0.257	1715.1	200
		Sorong - Surabaya	1228.04	192	4.80076	4.85	6.168	0.257	1715.1	200
3	Multi Express	Tangguh LNG - Gresik	1321.35	384	2.26674	5.35	6.168	0.257	1824.7	200
		Tangguh LNG - Ciwadan	1702.42	384	2.86298	5.01	6.168	0.257	1824.7	200
4	Tanto Abadi	Gorontalo - Surabaya	999.99	120	4.01948	6	7.453	0.257	2838.9	200
		Port of Makassar - Surabaya	436.5	72	3.83444	6	7.453	0.257	2838.9	200
		Surabaya - Gorontalo	995.77	120	4.10172	6	7.453	0.257	2838.9	200
5	Meratus Sabang	Surabaya - Benoa (Bali)	282.67	48	4.01434	3.9	6.1166	0.257	1528.7	200
		Benoa (Bali) - Surabaya	283.51	48	3.73164	4.11	6.1166	0.257	1528.7	200
6	Meratus Sibolga	Surabaya - Benoa (Bali)	285.96	48	3.93724	3.8	7.36048	0.257	1528.7	200
		Benoa (Bali) - Surabaya	289.24	29	5.35588	3.83	7.36048	0.257	1528.7	200
7	Tanto Ceria	Banjarmasin - Gresik	256.49	48	2.88868	4.6	7.88476	0.257	3131.9	200
		Surabaya - Banjarmasin	264.65	48	2.96064	4.66	7.88476	0.257	3131.9	200
		Gresik - Surabaya	8.03	2	2.1588	4.6	7.88476	0.257	3131.9	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
8	Meratus Project 1	Gresik - Tangguh LNG	1311.97	264	3.7265	6.5	6.4764	0.257	4381.0	200
		Ciwandan - Surabaya	450.45	72	4.53862	6.67	6.4764	0.257	4381.0	200
		Tangguh LNG - Ciwandan	1744.94	480	3.6751	6.56	6.4764	0.257	4381.0	200
9	Meratus Padang	Surabaya - Dili	876.65	120	4.14798	6.56	9.1492	0.257	4014.8	200
		Dili - Surabaya	880.55	216	2.27702	6.3	9.1492	0.257	4014.8	200
10	Tanto Sentosa	Surabaya - Gresik	8.24	2	3.07372	6.25	7.3502	0.257	4101.4	200
		Surabaya - Port of Makassar	429.49	72	3.855	6.5	7.3502	0.257	4101.4	200
		Gresik - Surabaya	7.16	2	2.6214	6.05	7.3502	0.257	4101.4	200
11	Vitoria S	Istanbul - Galati	414.75	120	2.4415	3.77	5.911	0.257	2400.4	200
		Galati - Haifa	1163.32	336	2.40552	6.57	5.911	0.257	2400.4	200
12	Merartus Benoa	Semarang - Surabaya	190.78	26	3.76248	4.27	5.397	0.257	3892.6	200
		Kumai - Semarang	284.04	96	3.76248	4.09	5.397	0.257	3892.6	200
		Surabaya - Kumai	282.25	96	3.76762	4.27	5.397	0.257	3892.6	200
13	Meratus Bontang	Lembar - Ende	396.98	72	4.2405	4.5	5.397	0.257	3892.6	200
		Surabaya - Lembar	271.06	35	4.17368	3.1	5.397	0.257	3892.6	200
		Ende - Surabaya	606.15	264	2.39524	3.3	5.397	0.257	3892.6	200
14	Meratus Barito	Ende - Surabaya	617.03	216	2.6985	3.5	6.3222	0.257	3892.6	200
		Lembar - Ende	402.1	48	4.11714	4.4	6.3222	0.257	3892.6	200
		Surabaya - Lembar	270.79	48	3.92182	3.7	6.3222	0.257	3892.6	200
15	Tanto Alam	Jakarta - Balikpapan	1579.44	288	3.80874	5.4	6.168	0.257	3968.6	200
		Balikpapan - Jakarta	1577.22	312	3.66482	6.01	6.168	0.257	3968.6	200
16	Tanto Aman	Jakarta - Balikpapan	1583.33	288	3.89612	5.9	6.168	0.257	3968.6	200
		Balikpapan - Jakarta	1585.9	288	3.5466	5.77	6.168	0.257	3968.6	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
17	Meratus Ultima 2	Banjarmasin - Surabaya	264.11	29	4.94982	5.28	7.2988	0.257	4175.9	200
		Surabaya - Banjarmasin	264.13	30	4.82646	4.5	7.2988	0.257	4175.9	200
18	Meratus Ultima 1	Lembar - Surabaya	279.34	72	3.00176	5.74	7.5558	0.257	4175.9	200
		Surabaya - Lembar	280.96	34	4.74422	6	7.5558	0.257	4175.9	200
19	Tanto Subur I	Singapore -Batu Ampar	1.8	1	0.93034	6.5	7.196	0.257	3397.4	200
		Jakarta - Singapore	510.81	72	3.65968	6.5	7.196	0.257	3397.4	200
		Batu Ampar - Jakarta	511.41	144	2.45178	6.5	7.196	0.257	3397.4	200
20	Tanto Subur II	Surabaya - Balikpapan	966.27	144	4.7802	5.93	6.425	0.257	3399.6	200
		Balikpapan - Surabaya	967.54	192	4.10172	5.53	6.425	0.257	3399.6	200
21	Meratus Palembang	Banjarmasin - Surabaya	264.91	72	3.084	5.22	7.6072	0.257	5072.3	200
		Surabaya - Dili	856.19	168	3.10456	4.71	7.6072	0.257	5072.3	200
22	Goteborg	Matadi - Pointe Noire	184.26	120	0.96632	5.18	7.71	0.257	9999.8	200
		Pointe Noire - Douala	672.8	96	3.63398	5.96	7.71	0.257	9999.8	200
		Pointe Noire - Cabinda	170.08	48	2.1074	5.4	7.71	0.257	9999.8	200
		Pointe Noire - Matadi	201.57	48	3.4952	6.26	7.71	0.257	9999.8	200
23	Meratus Dili	Surabaya - Dili	875.76	96	5.17598	6.1	7.3502	0.257	5985.7	200
		Dili - Maumere	244	48	3.4952	4.91	7.3502	0.257	5985.7	200
		Surabaya - Banjarmasin	264.95	48	3.5209	5.46	7.3502	0.257	5985.7	200
24	Meratus Kendari 1	Surabaya - Banjarmasin	264.83	72	2.36954	4.79	6.425	0.257	3346.0	200
		Surabaya - Ambon	978.26	120	4.66712	4.1	6.425	0.257	3346.0	200
		Ambon - Port of Makassar	600.91	72	4.27134	4.19	6.425	0.257	3346.0	200
		Banjarmasin - Surabaya	263.66	48	2.27188	5.49	6.425	0.257	3346.0	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
25	Viola	Boma - Matadi	27.7	4	4.84702	6.2	8.738	0.257	4589.8	200
		Pointe Noire - Boma	194.23	21	5.36102	6.21	8.738	0.257	4589.8	200
		Matadi - Pointe Noire	230.52	96	1.73732	5.91	8.738	0.257	4589.8	200
26	Meratus Kalabahi	Palu - Surabaya	625.72	48	5.61288	6.81	9.252	0.257	7389.9	200
		Tolitoli - Palu	162.98	14	6.22454	5.96	9.252	0.257	7389.9	200
		Ambon - Surabaya	984.4	168	5.8082	6.12	9.252	0.257	7389.9	200
27	Meratus Kupang	Surabaya - Port of Makassar	437.46	48	4.86244	7.3	8.4296	0.257	7281.8	200
		Port of Makassar - Surabaya	439.06	72	3.78818	7.5	8.4296	0.257	7281.8	200
28	Meratus Kelimutu	Palu - Tolitoli	158.08	22	5.30962	7.7	8.2754	0.257	7281.8	200
		Palu - Surabaya	626.68	72	4.98066	8.09	8.2754	0.257	7281.8	200
		Tolitoli - Palu	161.52	17	4.97038	8.1	8.2754	0.257	7281.8	200
		Surabaya - Tolitoli	735.98	72	5.11944	8.1	8.2754	0.257	7281.8	200
29	Ruth	Santa Cruz de Tenerife - Ferrol	1332.9	144	6.72826	6.73	9.509	0.257	8400.3	200
		Las Palmas - Santa Cruz de Tenerife	54.18	5	6.27594	7	9.509	0.257	8400.3	200
		Tilbury - Las Palmas	1711.49	120	7.63804	7.9	9.509	0.257	8400.3	200
		Rotterdam - Tilbury	177.64	20	5.13486	7.8	9.509	0.257	8400.3	200
		Hamburg - Rotterdam	317.68	28	6.2194	8.11	9.509	0.257	8400.3	200
30	Meratus Batam	Surabaya - Kupang	723.96	72	5.54606	6.8	7.8642	0.257	10138.5	200
		Kupang - Surabaya	726.32	192	2.5957	6.85	7.8642	0.257	10138.5	200
31	Tanto Express	Jayapura - Ambon	916.77	96	5.40214	5.8	9.252	0.257	8053.6	200
		Surabaya - Port of Makassar	433.79	48	4.73908	6.13	9.252	0.257	8053.6	200
		Gresik - Surabaya	8.46	2	3.36156	6	9.252	0.257	8053.6	200
		Ambon - Surabaya	975.62	144	4.7545	5.8	9.252	0.257	8053.6	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
32	New York Trader	Evyap - Istanbul	43.66	5	4.99608	6.45	10.28	0.257	9729.9	200
		San Juan - Evyap	5412.36	552	5.18626	7.11	10.28	0.257	9729.9	200
		Kingston - San Juan	664.05	96	3.9578	6.33	10.28	0.257	9729.9	200
		Port of Spain - Kingston	1005.47	96	6.05492	6.6	10.28	0.257	9729.9	200
		Point Lisas - Port of Spain	23.48	16	1.11024	6	10.28	0.257	9729.9	200
33	Maersk Regensburg	Cotonou - Lagos	73.48	7	5.64372	6.3	10.28	0.257	9729.9	200
		Cotonou - Takoradi	283.66	48	5.05776	6.3	10.28	0.257	9729.9	200
34	Maersk Roubaix	Port Owendo - Pointe Noire	444.75	168	1.76816	5.9	10.28	0.257	9729.9	200
		Tema - Port Owendo	1760.54	312	4.05032	6.01	10.28	0.257	9729.9	200
		Pointe Noire - Tema	946.46	72	7.3759	6.4	10.28	0.257	9729.9	200
		Porto de Luanda - Pointe Noire	236.75	23	7.69972	8.19	10.28	0.257	9729.9	200
		Pointe Noire - Porto de Luanda	714.48	192	2.6728	6.58	10.28	0.257	9729.9	200
35	Meratus Mamiri	Kupang - Surabaya	714.13	144	2.69336	5.93	8.224	0.257	10149.0	200
		Surabaya - Port of Makassar	438.33	48	5.01664	7.55	8.224	0.257	10149.0	200
36	Meratus Makassar	Surabaya - Port of Makassar	444.44	96	2.55972	7.8	9.509	0.257	10152.0	200
		Port of Makassar - Surabaya	442.43	48	5.56148	8.84	9.509	0.257	10152.0	200
37	Meratus Malino	Palu - Surabaya	604.39	72	5.48952	7.4	8.224	0.257	10149.0	200
		Surabaya - Port of Makassar	437.59	35	6.45584	7.8	8.224	0.257	10149.0	200
38	X-Press Elbe	Rotterdam - Antwerp	122.36	15	4.5746	7.49	9.766	0.257	8999.9	200
		Sankt Pettersburg - Riga	462.73	48	5.26336	8.1	9.766	0.257	8999.9	200
		Riga - Kiel	555.13	48	8.02868	8.88	9.766	0.257	8999.9	200
		Kiel - Brunsbuttel	50.53	8	3.36156	8.9	9.766	0.257	8999.9	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
		Brunsbuttel - Rotterdam	288.69	21	7.52496	8.8	9.766	0.257	8999.9	200
39	Juliana	Panama City (Balboa) - Corinto	713.72	48	7.78196	9.1	10.28	0.257	12639.6	200
		Corinto - Panama City (Balboa)	720.72	72	6.46612	9.26	10.28	0.257	12639.6	200
		Puerto Caldera - Corinto	277.5	72	2.70878	8.18	10.28	0.257	12639.6	200
		Panama City (Balboa) - Puerto Caldera	503.11	48	4.69282	9.2	10.28	0.257	12639.6	200
40	Wybelsum	Goteborg - Cuxhaven	363.89	31	6.12174	8.8	9.766	0.257	13559.8	200
		Felixstowe - Goteborg	550.18	48	7.84364	8.11	9.766	0.257	13559.8	200
		Bremerhaven - Felixstowe	318.18	31	5.98296	7.8	9.766	0.257	13559.8	200
		Sankt Pettersburg - Bremerhaven	1001.09	192	5.07318	9.91	9.766	0.257	13559.8	200
		Kiel - Sankt Pettersburg	784.23	48	7.97214	8.3	9.766	0.257	13559.8	200
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	263.78	34	4.01948	7.34	5.8596	0.257	11573.3	200
		Port of Makassar - Semarang	593.41	48	6.40444	7.5	5.8596	0.257	11573.3	200
		Jakarta (Tanjjung Priok) - Surabaya	408.51	96	2.87326	5.6	5.8596	0.257	11573.3	200
		Jakarta (Tanjung Priok) - Port of Makassar	793.79	96	4.4718	7.5	5.8596	0.257	11573.3	200
		Surabaya - Bitung	1055.01	72	6.65116	5.6	5.8596	0.257	11573.3	200
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	231.37	24	5.14514	7.5	10.28	0.257	15819.3	200
		Puerto Cortes - Puerto Colon	786.44	72	5.66428	8.17	10.28	0.257	15819.3	200
		Santo Tomas De Castilla - Puerto Cortes	64.17	8	4.74422	7.48	10.28	0.257	15819.3	200
		Fort Lauderdale - Santo Tomas De Castilla	893.65	72	7.68944	7.4	10.28	0.257	15819.3	200
		Savannah - Fort Lauderdale	391.1	25	8.29082	7.41	10.28	0.257	15819.3	200
43	AS Samanta	Cartagena - Santa Marta	129.22	15	4.86758	7.49	10.28	0.257	15819.3	200
		Barranquilla - Cartagena	101.55	12	4.61058	7.4	10.28	0.257	15819.3	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
		Kingston - Barranquilla	443.18	35	6.86704	7.47	10.28	0.257	15819.3	200
		Port of Miami - Kingston	927.94	72	8.23428	7.56	10.28	0.257	15819.3	200
		Puerto De Haina - Port of Miami	1087.71	72	9.00014	7.57	10.28	0.257	15819.3	200
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	57.17	8	5.34046	7	10.28	0.257	15819.3	200
		Fort Lauderdale - Santo Tomas de Castilla	897	48	8.04924	6.8	10.28	0.257	15819.3	200
		Savannah - Fort Lauderdale	411.68	48	5.53064	6.8	10.28	0.257	15819.3	200
		Wilmington (NC) - Savannah	247.95	33	4.34844	7.1	10.28	0.257	15819.3	200
		Gloucester City - Wilmington (NC)	540.28	48	5.54092	7.2	10.28	0.257	15819.3	200
45	RHL Agilitas	Halifax - Kingston	1841.17	120	7.71514	9.2	10.537	0.257	16659.7	200
		Newark - Halifark	647.08	48	6.10118	7.5	10.537	0.257	16659.7	200
		Kingston - Newark	1527.21	120	7.16002	8.56	10.537	0.257	16659.7	200
46	Viona	Bremerhaven - Rotterdam	273.68	17	8.74314	9.39	10.9482	0.257	16979.6	200
		Arhus - Bremerhaven	496.75	28	9.44218	8.9	10.9482	0.257	16979.6	200
		Reykjavik - Arhus	1376.91	72	9.18518	9.55	10.9482	0.257	16979.6	200
		Grundartangi - Reykjavik	15.55	3	6.02922	8.3	10.9482	0.257	16979.6	200
47	Maersk Vallvik	Charleston - Freeport	408.49	30	7.28338	10.3	10.3828	0.257	16599.3	200
		Norfolk - Charleston	456.95	48	6.35818	9.49	10.3828	0.257	16599.3	200
		Freeport - Port Elizabeth	7013.3	456	7.84364	10.3	10.3828	0.257	16599.3	200
		Port Elizabeth - Durban	395.61	29	7.49926	10.27	10.3828	0.257	16599.3	200
48	Maersk Vilnius	Durban - Cape Town	819.94	192	3.084	7.4	10.3828	0.257	16599.3	200
		Salalah - Durban	3628.87	288	7.57636	8.18	10.3828	0.257	16599.3	200
		Al Duqm - Salalah	352.12	72	4.41526	7.07	10.3828	0.257	16599.3	200
		Cape Town - Newark	6951.03	528	6.87218	7.7	10.3828	0.257	16599.3	200

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		Newark - Port of Baltimore	429.55	48	6.02922	8.21	10.3828	0.257	16599.3	200
49	Maersk Visby	Port Elizabeth - Durban	412.78	48	4.8573	9.9	10.3828	0.257	16599.3	200
		Freeport - Port Elizabeth	7030.25	504	7.59178	9.8	10.3828	0.257	16599.3	200
		Charleston - Freeport	408.37	28	7.39646	8.79	10.3828	0.257	16599.3	200
		Norfolk - Charleston	442.14	48	6.55864	8.5	10.3828	0.257	16599.3	200
		Durban - Cape Town	817.51	48	9.22116	8.7	10.3828	0.257	16599.3	200
50	Bernard A	Samsun - Istanbul	395.39	35	5.82876	7.8	9.766	0.257	13279.4	200
		Poti - Samsun	242.18	22	7.45814	7.2	9.766	0.257	13279.4	200
		Istanbul - Poti	630.81	72	4.5232	8.49	9.766	0.257	13279.4	200
		Constanta - Istanbul	215.29	32	5.18112	7.7	9.766	0.257	13279.4	200
		Samsun - Constanta	387.73	35	5.8853	7.6	9.766	0.257	13279.4	200
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	253.09	27	4.10686	7.48	9.509	0.257	10738.1	200
		Port of Makassar - Semarang	582.99	48	6.53808	7.5	9.509	0.257	10738.1	200
		Surabaya - Port of Makassar	443.11	72	4.00406	7.5	9.509	0.257	10738.1	200
52	Nexo Maersk	Tanger Mediterranean - Algeciras	24.19	4	3.92182	10.4	11.2052	0.257	28761.6	200
		Vado Ligure - Tanger Mediterranean	883.92	72	5.62316	8.9	11.2052	0.257	28761.6	200
		For sur mer - Vado Ligure	235.7	48	4.55404	8	11.2052	0.257	28761.6	200
		Algericas - Montreal	3327.24	240	7.4016	10.3	11.2052	0.257	28761.6	200
		Tanger Mediterranean - For sur mer	713.53	48	7.0675	8	11.2052	0.257	28761.6	200
53	Nele Maersk	Novorossiysk - Port Said	1307.73	120	6.4507	11.29	11.2052	0.257	28761.6	200
		Port Said - Novorossiysk	1372.17	192	4.40498	8.85	11.2052	0.257	28761.6	200
		Istanbul - Novorossiysk	496.12	72	3.78304	9.97	11.2052	0.257	28761.6	200

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		Damietta - Istanbul	770.36	96	8.18288	9.84	11.2052	0.257	28761.6	200
		Port Said - Damietta	70.86	33	1.77844	9.3	11.2052	0.257	28761.6	200
54	Tanto Nusantara	Jakarta - Belawan	869.18	96	5.20682	7	10.794	0.257	21734.9	200
		Belawan - Jakarta	902.82	144	4.4204	7.54	10.794	0.257	21734.9	200
55	EMS Trader	Puerto Colon - Cartagena	278.18	17	9.01042	9.2	11.308	0.257	19809.5	200
		Puerto Cortes - Puerto Colon	768.94	48	7.02638	9.58	11.308	0.257	19809.5	200
		Santo Tomas de Castilla - Puerto Cortes	64.3	15	3.5209	9.5	11.308	0.257	19809.5	200
		Mariel - Santo Tomas De Castilla	603.32	72	4.74422	9.65	11.308	0.257	19809.5	200
		New Orleans - Mariel	614.14	48	8.11092	10.5	11.308	0.257	19809.5	200
56	Miami Trader	Jawaharlal Nehru Port - Colombo	926.1	72	6.76938	10.98	11.051	0.257	20929.6	200
		Mundra - Jawaharlal Nehru Port	423.06	48	5.3456	10.45	11.051	0.257	20929.6	200
		Dubai (Jebel Ali) - Mundra	952.39	72	6.2708	10.18	11.051	0.257	20929.6	200
		Colombo - Durban	3659.54	360	6.64088	11	11.051	0.257	20929.6	200
		Port Louis - Dubai (Jebel Ali)	3032.51	264	5.94698	9.5	11.051	0.257	20929.6	200
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	2287.52	168	7.16002	7.44	10.794	0.257	21734.9	200
		Djibouti - Salalah	784.31	72	6.6306	7.9	10.794	0.257	21734.9	200
		Toamasina - Victoria	909.66	48	8.89734	8.5	10.794	0.257	21734.9	200
		Port Louis - Toamasina	476.07	27	9.23658	9.55	10.794	0.257	21734.9	200
		Le Port (Pointe des Galets) - Port Louis	142.29	216	0.70418	11.1	10.794	0.257	21734.9	200
58	X-Press Machu Picchu	Puerto Colon - Cartagena	482.62	120	2.10226	8.69	10.794	0.257	21734.9	200
		Mariel - Puerto Colon	1005.04	72	7.11376	9.49	10.794	0.257	21734.9	200
		Cartagena - Mariel	1058.44	96	6.69228	10.69	10.794	0.257	21734.9	200

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59	JPO Aries	Valencia - Lisbon	720.55	72	5.68484	9.5	11.051	0.257	19809.5	200
		Lisbon - Halifax	2561.35	216	6.31706	9.71	11.051	0.257	19809.5	200
		Barcelona - Valencia	177.56	17	5.8082	9.68	11.051	0.257	19809.5	200
60	Nordatlantic	Toamasina - Salalah	2223.83	264	6.12688	8.55	11.7706	0.257	21559.7	200
		Port Louis - Toamasina	476.55	48	5.23766	8.83	11.7706	0.257	21559.7	200
		Le Port (Pointe des Galets) - Port Louis	139.6	17	4.3176	10.9	11.7706	0.257	21559.7	200
		Salalah - Port Louis	2269.76	216	5.99838	11.04	11.7706	0.257	21559.7	200
61	Ballenita	Tacoma - Vancouver	178.69	13	8.13662	7.91	11.308	0.257	21489.6	200
		Everett - Tacoma	47.97	4	7.21142	8.7	11.308	0.257	21489.6	200
		Tokyo Ko - Everett	4561.24	312	7.77682	9.2	11.308	0.257	21489.6	200
62	Maersk Norfolk	Fos sur mer - Genoa	241.65	48	3.1097	7.6	11.051	0.257	21770.0	200
		Tanger Mediterranean - Fos sur mer	709.62	48	7.35534	7.69	11.051	0.257	21770.0	200
		Montreal - Tanger Mediterranean	3316.55	288	5.8339	9.25	11.051	0.257	21770.0	200
		Tanger Mediterranean - Algericas	169.32	48	1.91722	8	11.051	0.257	21770.0	200
		Genoa - Tanger Mediterranean	1146.06	72	5.7054	8	11.051	0.257	21770.0	200
63	Maersk Newport	Istanbul - Evyap	57.2	7	4.86758	9.4	11.051	0.257	21770.0	200
		Piraeus (Athens) - Istanbul	352	31	6.23996	10.7	11.051	0.257	21770.0	200
		For sur mer - Piraeus (Athens)	1105.23	72	7.84878	11.4	11.051	0.257	21770.0	200
		Barcelona - For sur mer	203.82	27	3.93724	11.3	11.051	0.257	21770.0	200
		Castellon de la Plana - Barcelona	132.16	13	5.5512	9.64	11.051	0.257	21770.0	200
64	City of Hongkong	Conarky - San Pedro	620.77	48	5.82876	8	11.308	0.257	21559.7	200
		Dakar - Conarky	504.3	72	4.10686	9.92	11.308	0.257	21559.7	200
		Durban - Cape Town	894.88	72	7.12918	9.4	11.308	0.257	21559.7	200

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		Ngqura - Durban	403.62	27	8.13662	8.3	11.308	0.257	21559.7	200
		San Pedro - Ngqura	3171.3	360	4.59002	7.54	11.308	0.257	21559.7	200
65	Maersk Brani	Hamburg - Bremerhaven	122.21	10	6.84134	9	11.3594	0.257	28879.5	200
		Antwerp - Hamburg	393.82	30	7.22684	9.4	11.3594	0.257	28879.5	200
		Bremerhaven - Altamira	5506.03	336	8.65576	11.18	11.3594	0.257	28879.5	200
66	Porto	Nagoya Ko - Yokkaichi	12.69	5	3.8293	9.77	11.565	0.257	21770.0	200
		Yokkaichi - Taipei	1064.21	72	8.93846	9.09	11.565	0.257	21770.0	200
		Taipei - Taichung	95.25	9	5.89558	9.1	11.565	0.257	21770.0	200
		Taichung - Kaohsiung	151.81	12	6.74882	9.57	11.565	0.257	21770.0	200
		Kaohsiung - Hong Kong	355.56	23	8.14176	10.3	11.565	0.257	21770.0	200
67	Burgundy	Constanta - Istanbul	329.81	72	2.29244	9.66	11.9762	0.257	28879.5	200
		Odessa - Constanta	204.68	16	6.86704	8.9	11.9762	0.257	28879.5	200
		Diliskelesi - Odessa	401.67	36	6.00352	9.49	11.9762	0.257	28879.5	200
		Piraeus (Athens) - Diliskelesi	387.11	72	3.76762	8.8	11.9762	0.257	28879.5	200
		Malta Freeport - Piraeus (Athens)	542.64	48	6.3993	8.29	11.9762	0.257	28879.5	200
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	89.15	48	5.56148	8.88	12.0276	0.257	31919.7	200
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	252.58	31	5.01664	11.2	12.0276	0.257	31919.7	200
		Shuaiba - Khalifa Bin Salman Port	443.24	72	4.29704	9.84	12.0276	0.257	31919.7	200
		Khalifa Bin Salman Port - Shuaiba	443.24	24	6.26052	11.1	12.0276	0.257	31919.7	200
69	Maersk Izmir	Sydney - Melbourne	583.6	48	5.8853	8.9	12.079	0.257	28879.5	200
		Tauranga - Sydney	1596.45	96	7.7614	9.8	12.079	0.257	28879.5	200
		Panama City - Tauranga	6513.73	432	7.55066	10.79	12.079	0.257	28879.5	200

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		Cartagena - Panama City	324.8	48	3.88584	10.37	12.079	0.257	28879.5	200
		Charleston - Cartagena	1472.67	120	6.17314	9.7	12.079	0.257	28879.5	200
70	Nordautumn	Algericas - Tanger Mediterranean	26.14	6	2.87326	11.67	12.0276	0.257	32489.4	200
		Dakar Abidjan	1188.65	72	8.95902	9.9	12.0276	0.257	32489.4	200
		Tanger Mediterranean - Dakar	1526.1	96	8.738	12.1	12.0276	0.257	32489.4	200
		Abidjan - Lome	399.95	23	8.98472	10.05	12.0276	0.257	32489.4	200
71	Maersk Cabinda	Lagos - Onne	506.42	48	5.80306	11	11.051	0.257	27060.0	200
		Onne - Pointe Noire	824.53	96	5.20682	10.07	11.051	0.257	27060.0	200
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	741.33	72	6.48668	11.95	10.794	0.257	24679.7	200
		Yangshan - Ningbo Zhousan	127.21	16	4.5232	11.4	10.794	0.257	24679.7	200
		Qingdao - Yangshan	427.97	48	6.1166	10.7	10.794	0.257	24679.7	200
		Busan - Qingdao	468.9	34	8.224	11.3	10.794	0.257	24679.7	200
		Hong Kong - Sydney	4491.55	312	7.1703	12.8	10.794	0.257	24679.7	200
73	Wide Alpha	Yangshan - Ningbo Zhousan	138.21	15	4.92926	11.15	10.794	0.257	24679.7	200
		Qingdao - Yangshan	432.08	28	8.16746	10.39	10.794	0.257	24679.7	200
		Busan - Qingdao	493.93	32	8.31138	11.8	10.794	0.257	24679.7	200
		Osaka - Busan	656.05	48	7.05208	11.91	10.794	0.257	24679.7	200
74	Maersk Indus	Colombo - Pointe Noire	6202.31	408	8.0441	13.31	10.794	0.257	24679.7	200
		Jawaharlal Nehru Port - Colombo	913.03	48	8.55296	13.39	10.794	0.257	24679.7	200
		Mundra - Jawaharlal Nehru Port	410.53	48	5.59746	12.23	10.794	0.257	24679.7	200
		Pointe Noire - Cotonou	1266.25	120	6.88246	12.03	10.794	0.257	24679.7	200
75	Kyparissia	Walvis Bay - Durban	1558.73	168	4.79562	11.4	11.051	0.257	27060.0	200
		Onne - Walvis Bay	1815.59	168	5.7825	9.89	11.051	0.257	27060.0	200

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		Cotonou - Onne	770.77	96	4.32274	10.76	11.051	0.257	27060.0	200
		Durban - Tanjung Pelepas	4888.15	312	8.15204	11.59	11.051	0.257	27060.0	200
		Tanjung Pelepas - Nansha	1499.4	144	5.77736	9.23	11.051	0.257	27060.0	200
76	Leonidio	Lagos - Cotonou	57.99	8	3.97322	11.3	11.051	0.257	27060.0	200
		Cotonou - Lagos	56.09	8	3.9064	11.3	11.051	0.257	27060.0	200
77	ALS Ceres	Surabaya - Singapore	850.4	144	3.30502	8.6	12.336	0.257	36559.4	200
		Jakarta (Tanjung Priok) - Surabaya	423.6	36	7.59692	8.9	12.336	0.257	36559.4	200
		Shenzhen - Jakarta (Tanjung Priok)	1810	120	8.1726	11.7	12.336	0.257	36559.4	200
		Shantou - Shenzhen	209.37	20	5.61288	11.21	12.336	0.257	36559.4	200
		Ningbo Zhousan - Shantou	585.05	36	8.61464	10.07	12.336	0.257	36559.4	200
78	Rosa	Ningbo Zhousan - Shanghai	184.83	26	4.82132	9.37	12.336	0.257	36559.4	200
		Qingdao - Ningbo Zhousan	480.46	48	5.71568	9.68	12.336	0.257	36559.4	200
		Busan - Qingdao	490.82	72	6.16286	9.88	12.336	0.257	36559.4	200
		Portland - Busan	4744.9	312	7.6843	9.64	12.336	0.257	36559.4	200
79	Lana	Douala - Cotonou	591.41	72	4.30732	7.32	12.336	0.257	36559.4	200
		Porto de Luanda - Douala	896.42	120	4.21994	7.5	12.336	0.257	36559.4	200
		Pointe Noire - Porto de Luanda	357.41	19	9.88422	9.9	12.336	0.257	36559.4	200
		Algericas - Pointe Noire	3773.44	312	6.44042	12.61	12.336	0.257	36559.4	200
		Tanger Mediterranean - Algericas	51.25	23	1.27986	9.26	12.336	0.257	36559.4	200
80	Schubert	Shanghai - Busan	469.78	34	7.63804	10.88	12.3874	0.257	36159.7	200
		Ningbo Zhoushan - Shanghai	218.41	35	3.49006	9.3	12.3874	0.257	36159.7	200
		Qingdao - Ningbo Zhoushan	559.46	48	6.84648	9.6	12.3874	0.257	36159.7	200
		Busan - Qingdao	461.63	72	6.47126	9.88	12.3874	0.257	36159.7	200

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		Portland - Busan	4788.62	312	7.75626	9.9	12.3874	0.257	36159.7	200
81	Northern Guard	Shanghai - Hong Kong	853.31	72	6.77966	11.14	11.822	0.257	36559.4	200
		Qingdao - Shanghai	391.91	48	5.5769	11.56	11.822	0.257	36559.4	200
		Busan - Qingdao	628.44	72	5.74652	10.55	11.822	0.257	36559.4	200
		Hong Kong - Johor	1876.37	168	6.76938	1.13	11.822	0.257	36559.4	200
		Johor - Singapore	33.36	22	1.80414	11.89	11.822	0.257	36559.4	200
82	Kea	Rotterdam - Hamburg	322.11	48	4.54376	10.5	11.565	0.257	33669.8	200
		Le Havre - Rotterdam	260.99	18	7.52496	10.79	11.565	0.257	33669.8	200
		Hamburg - Newark	3697.55	264	7.84364	11.76	11.565	0.257	33669.8	200
83	YM Wealth	Busan - Yangshan	466.83	48	6.5021	11.4	13.364	0.257	54899.9	200
		Singapore - Busan	2519.04	144	9.16976	11.2	13.364	0.257	54899.9	200
		Jeddah - Singapore	4395.61	336	6.8876	10.4	13.364	0.257	54899.9	200
		Sokhna - Jeddah	621.91	48	6.70256	10.13	13.364	0.257	54899.9	200
		Al Aqabah - Sokhna	328.29	72	3.2382	11.7	13.364	0.257	54899.9	200
84	E R France	Hong Kong - Shenzhen	18.94	3	4.7545	9.7	12.7986	0.257	54839.5	200
		Kaohsing - Hong Kong	356.02	29	6.25538	9.7	12.7986	0.257	54839.5	200
		Busan - Kaohsiung	935.06	72	6.7077	11.1	12.7986	0.257	54839.5	200
		Manzanillo - Busan	6397.38	408	8.36792	11.4	12.7986	0.257	54839.5	200
		Guayaquil - Manzanillo	2011.96	144	6.59976	9.8	12.7986	0.257	54839.5	200
85	SC Mara	Sydney - Brisbane	554.46	33	8.8408	10.9	12.1818	0.257	41129.8	200
		Melbourne - Sydney	588.9	48	7.24226	11.48	12.1818	0.257	41129.8	200
		Yantian - Melbourne	5033.09	336	7.5558	11.2	12.1818	0.257	41129.8	200
		Brisbane - Busan	4189.36	240	8.67632	10.9	12.1818	0.257	41129.8	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
		Shanghai - Yantian	847.67	72	6.66658	10.79	12.1818	0.257	41129.8	200
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	68.28	34	1.4135	12.62	12.1818	0.257	41329.7	200
		Qinzhou - Rizhao	1539.98	168	5.56148	11.25	12.1818	0.257	41329.7	200
		Lianyungang - Qinzhou	1526.95	192	4.9344	12.55	12.1818	0.257	41329.7	200
87	Miami	Manzanillo - Los Angeles	1253.54	120	5.8082	9.7	12.4902	0.257	41329.7	200
		Coronel - San Antonio	233.16	48	3.68538	9.37	12.4902	0.257	41329.7	200
		Valparaiso - Coronel	276.67	168	1.09996	7.6	12.4902	0.257	41329.7	200
		Los Angeles - Ningbo Zhoushan	5805.59	456	6.6049	10.1	12.4902	0.257	41329.7	200
		San Antonio - Manzanillo	3750.36	312	6.28622	9.6	12.4902	0.257	41329.7	200
88	Maersk Columbus	Algeciras - Port Said	1935.87	120	9.01042	14.2	12.85	0.257	54899.9	200
		Tanger Mediterranean - Algericas	114.03	120	1.05884	11.99	12.85	0.257	54899.9	200
		Port Said - Salalah	2077.73	120	9.8174	14.2	12.85	0.257	54899.9	200
		Salalah - Dubai (Jebel Ali)	957.34	48	8.77912	13.42	12.85	0.257	54899.9	200
		Dubai (Jebel Ali) - Muhammad Bin Qasim	785.86	72	7.03152	12.46	12.85	0.257	54899.9	200
89	Maersk Denver	Newark - Algericas	3288.34	264	6.35818	13.49	12.85	0.257	54899.9	200
		Norfolk - Newark	321.91	33	5.18626	10.83	12.85	0.257	54899.9	200
		Djilbouti - Salalah	753.31	72	6.65116	14.11	12.85	0.257	54899.9	200
		Port Said - Djibouti	1382.88	96	8.49642	14.5	12.85	0.257	54899.9	200
		Algericas - Port Said	1933.79	120	8.49642	14.5	12.85	0.257	54899.9	200
90	Maersk Chicago	Salalah - Algericas	3861.43	240	8.41932	14.4	12.85	0.257	54899.9	200
		Algericas - Newark	3238.72	168	10.12066	12.8	12.85	0.257	54899.9	200
		Savannah - Houston	1353.07	72	9.42162	9.83	12.85	0.257	54899.9	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
		Newark - Charleston	655.63	48	5.97782	11.7	12.85	0.257	54899.9	200
		Charleston - Savannah	134.63	20	3.91668	10.59	12.85	0.257	54899.9	200
91	Maersk Lirquen	Hong Kong - Yangshan	826.78	168	4.68768	12.06	11.565	0.257	45779.3	200
		Singapore - Hong Kong	1450.51	96	8.88192	13.2	11.565	0.257	45779.3	200
92	Maersk Kowloon	Algericas - Sines	277.86	23	6.28108	14	12.4902	0.257	68519.4	200
		Valencia - Algericas	464.01	72	3.1868	13.03	12.4902	0.257	68519.4	200
		Genoa - Valencia	522.24	32	8.31138	12.2	12.4902	0.257	68519.4	200
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	1654.37	96	8.8408	12.1	12.593	0.257	57099.7	200
		Sines - Gioia Tauro Harbour	1333.46	120	5.54606	10.4	12.593	0.257	57099.7	200
		Freeport - Sines	3663.55	288	6.77452	10.4	12.593	0.257	57099.7	200
		Charleston - Freeport	405.43	27	8.41418	10.4	12.593	0.257	57099.7	200
		Savannah - Charleston	130.41	15	4.86244	10.4	12.593	0.257	57099.7	200
94	Maersk Savannah	Qingdao - Busan	505.32	48	6.7334	13.81	13.1584	0.257	68639.4	200
		Yangshan - Qingdao	442.77	48	6.4507	13.7	13.1584	0.257	68639.4	200
		Ningbo Zhoushan - Yangshan	106.25	25	1.1051	13.57	13.1584	0.257	68639.4	200
		Shenzhen - Ningbo Zhoushan	808.45	72	7.26796	13.5	13.1584	0.257	68639.4	200
		Hong Kong - Shenzhen	41.71	9	3.61342	14	13.1584	0.257	68639.4	200
95	Maersk Sarnia	Busan - Vancouver	4639.29	288	8.45016	12.4	12.593	0.257	61879.7	200
		Yangshan - Busan	515.15	96	4.66712	11.78	12.593	0.257	61879.7	200
		Ningbo Zhousan - Yangshan	122.09	20	5.42784	11.27	12.593	0.257	61879.7	200
		Yantian - Ningbo Zhousan	737.77	48	8.46558	11.5	12.593	0.257	61879.7	200
		Vancouver - Seattle	165.01	12	7.37076	13.84	12.593	0.257	61879.7	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
96	Clementine Maersk	Busan - Newark	10290.87	552	9.57068	13.75	12.6444	0.257	63916.9	200
		Yangshan - Busan	465.68	72	5.46896	13.79	12.6444	0.257	63916.9	200
		Norfolk - Newark	328.83	25	7.02124	11.56	12.6444	0.257	63916.9	200
		Port of Baltimore - Norfolk	171.76	13	7.10348	11.5	12.6444	0.257	63916.9	200
		Newark - Port of Baltimore	484.37	48	5.14	11.9	12.6444	0.257	63916.9	200
97	Axel Maersk	Port of Miami - Freeport	93.08	14	3.57744	11.9	12.6444	0.257	63916.9	200
		Savannah - Port of Miami	463.46	48	4.82646	12.78	12.6444	0.257	63916.9	200
		Charleston - Savannah	125.89	15	4.43582	12.24	12.6444	0.257	63916.9	200
		Newark - Charleston	659.71	48	6.82078	13.19	12.6444	0.257	63916.9	200
		Singapore - Newark	10193.28	552	9.7917	12.99	12.6444	0.257	63916.9	200
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3829.42	216	8.995	14.37	12.85	0.257	68639.4	200
		Busan - Yokohama Ko	860.19	48	10.35196	14.37	12.85	0.257	68639.4	200
		Yangshan - Busan	478.44	72	4.51292	13.6	12.85	0.257	68639.4	200
		Los Angeles - Oakland	388.55	48	5.30448	13.11	12.85	0.257	68639.4	200
		Prince Rupert - Loa Angeles	1470.98	120	6.54322	14.39	12.85	0.257	68639.4	200
99	Emma Maersk	Tanger Mediterranean - Salalah	3958.94	240	8.59408	16.14	13.107	0.257	80799.6	200
		Le Havre - Tanger Mediterranean	1238.14	96	6.87732	15.21	13.107	0.257	80799.6	200
		London Gateway Port - Le Havre	253.73	16	8.80482	14.15	13.107	0.257	80799.6	200
		Antwerp - London Gateway Port	186.03	24	4.27648	13.3	13.107	0.257	80799.6	200
		Hamburg - Antwerp	401.8	34	6.3479	10.58	13.107	0.257	80799.6	200
100	Munich Maersk	Yantian - Tanjung Pelepas	1513.2	72	10.38794	16.29	10.794	0.257	93239.3	200
		Yangshan - Yantian	822.23	48	8.93332	15	10.794	0.257	93239.3	200

No	Ship	Trip	Distance Traveled (nm)	Travel Time (Hours)	Avg Speed (m/s)	Avg Draught (m)	V Design (m/s)	V Safety (m/s)	P Installed (kW)	SFOC (g/kWh)
		Ningbo Zhoushan - Yangshan	121.62	48	1.8761	13.13	10.794	0.257	93239.3	200
		Busan - Ningbo Zhoushan	534.28	48	6.28108	13.73	10.794	0.257	93239.3	200
		Tianjin - Busan	750.76	72	5.90586	14.15	10.794	0.257	93239.3	200

Step 3: Calculate each coefficient & the fuel oil consumption estimation

$$\boldsymbol{k} = \boldsymbol{0.514^3} * \frac{\boldsymbol{\varepsilon_p} * \boldsymbol{P_{installed}}}{(\boldsymbol{V_{design}} + \boldsymbol{V_{safety}})}$$

$$\boldsymbol{P_{transient}} = \frac{\boldsymbol{kV^3_{transient}}}{\boldsymbol{0.514^3}}$$

$$\boldsymbol{FOC_{hour}} = \boldsymbol{SFOC} * \boldsymbol{P_{transient}}$$

$$\boldsymbol{FOC_{estimation}} = \boldsymbol{FOC_{hour}} * \boldsymbol{Voyage\ Time}$$

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
1	Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	0.399174	43.32288	8664.5751	1.872
		Port Moresby - Tanjung Bara Coal	0.399174	202.0864	40417.2813	14.550

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Benete - Port Moresby	0.399174	163.0699	32613.9837	14.872
2	Territory Trader	Surabaya - Sorong	0.702509	756.5254	151305.083	18.157
		Sorong - Surabaya	0.702509	572.3907	114478.137	21.980
3	Multi Express	Tangguh LNG - Gresik	0.747409	64.10233	12820.4664	4.923
		Tangguh LNG - Ciwadan	0.747409	129.1587	25831.7389	9.919
4	Tanto Abadi	Gorontalo - Surabaya	0.67292	321.7981	64359.622	7.723
		Port of Makassar - Surabaya	0.67292	279.37	55873.9928	4.023
		Surabaya - Gorontalo	0.67292	341.9573	68391.4638	8.207
5	Meratus Sabang	Surabaya - Benoa (Bali)	0.641421	305.5597	61111.9347	2.933
		Benoa (Bali) - Surabaya	0.641421	245.4442	49088.8427	2.356
6	Meratus Sibolga	Surabaya - Benoa (Bali)	0.375719	168.8689	33773.7811	1.621
		Benoa (Bali) - Surabaya	0.375719	425.076	85015.1906	2.465
7	Tanto Ceria	Banjarmasin - Gresik	0.630431	111.9043	22380.8631	1.074
		Surabaya - Banjarmasin	0.630431	120.4773	24095.4663	1.157
		Gresik - Surabaya	0.630431	46.70741	9341.48145	0.019
8	Meratus Project 1	Gresik - Tangguh LNG	1.559007	594.1035	118820.706	31.369
		Ciwandan - Surabaya	1.559007	1073.322	214664.496	15.456
		Tangguh LNG - Ciwandan	1.559007	569.8575	113971.492	54.706
9	Meratus Padang	Surabaya - Dili	0.52409	275.4397	55087.9374	6.611
		Dili - Surabaya	0.52409	45.5635	9112.70028	1.968
10	Tanto Sentosa	Surabaya - Gresik	1.012119	216.4389	43287.7708	0.087
		Surabaya - Port of Makassar	1.012119	426.9878	85397.5594	6.149
		Gresik - Surabaya	1.012119	134.2586	26851.7254	0.054

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
11	Vitoria S	Istanbul - Galati	1.1113	119.1001	23820.0239	2.858
		Galati - Haifa	1.1113	113.9119	22782.3712	7.655
12	Merartus Benoa	Semarang - Surabaya	2.339627	917.6558	183531.163	4.772
		Kumai - Semarang	2.339627	917.6558	183531.163	17.619
		Surabaya - Kumai	2.339627	921.4218	184284.368	17.691
13	Meratus Bontang	Lembar - Ende	2.339627	1313.737	262747.395	18.918
		Surabaya - Lembar	2.339627	1252.607	250521.302	8.768
		Ende - Surabaya	2.339627	236.7578	47351.5635	12.501
14	Meratus Barito	Ende - Surabaya	1.484892	214.8684	42973.6884	9.282
		Lembar - Ende	1.484892	763.119	152623.802	7.326
		Surabaya - Lembar	1.484892	659.5813	131916.261	6.332
15	Tanto Alam	Jakarta - Balikpapan	1.625545	661.3838	132276.77	38.096
		Balikpapan - Jakarta	1.625545	589.2065	117841.306	36.766
16	Tanto Aman	Jakarta - Balikpapan	1.625545	707.9565	141591.302	40.778
		Balikpapan - Jakarta	1.625545	534.0061	106801.224	30.759
17	Meratus Ultima 2	Banjarmasin - Surabaya	1.051696	939.2236	187844.728	5.447
		Surabaya - Banjarmasin	1.051696	870.7369	174147.372	5.224
18	Meratus Ultima 1	Lembar - Surabaya	0.951287	189.4741	37894.8271	2.728
		Surabaya - Lembar	0.951287	748.0257	149605.132	5.087
19	Tanto Subur I	Singapore -Batu Ampar	0.891526	5.286516	1057.30323	0.001
		Jakarta - Singapore	0.891526	321.7909	64358.1891	4.634
		Batu Ampar - Jakarta	0.891526	96.75847	19351.6933	2.787
20	Tanto Subur II	Surabaya - Balikpapan	1.237923	995.7321	199146.421	28.677

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Balikpapan - Surabaya	1.237923	629.0749	125814.975	24.156
21	Meratus Palembang	Banjarmasin - Surabaya	1.132965	244.7204	48944.0848	3.524
		Surabaya - Dili	1.132965	249.6475	49929.5069	8.388
22	Goteborg	Matadi - Pointe Noire	2.148265	14.27451	2854.903	0.343
		Pointe Noire - Douala	2.148265	759.1823	151836.453	14.576
		Pointe Noire - Cabinda	2.148265	148.0606	29612.1117	1.421
		Pointe Noire - Matadi	2.148265	675.4832	135096.64	6.485
23	Meratus Dili	Surabaya - Dili	1.477142	1508.38	301675.926	28.961
		Dili - Maumere	1.477142	464.4607	92892.1427	4.459
		Surabaya - Banjarmasin	1.477142	474.7817	94956.3379	4.558
24	Meratus Kendari 1	Surabaya - Banjarmasin	1.218373	119.3666	23873.3252	1.719
		Surabaya - Ambon	1.218373	912.09	182417.997	21.890
		Ambon - Port of Makassar	1.218373	699.1707	139834.138	10.068
		Banjarmasin - Surabaya	1.218373	105.2076	21041.5121	1.010
25	Viola	Boma - Matadi	0.685122	574.5173	114903.462	0.460
		Pointe Noire - Boma	0.685122	777.3578	155471.562	3.265
		Matadi - Pointe Noire	0.685122	26.45563	5291.12642	0.508
26	Meratus Kalabahi	Palu - Surabaya	0.933711	1215.851	243170.289	11.672
		Tolitoli - Palu	0.933711	1658.231	331646.199	4.643
		Ambon - Surabaya	0.933711	1347.249	269449.837	45.268
27	Meratus Kupang	Surabaya - Port of Makassar	1.206886	1021.738	204347.66	9.809
		Port of Makassar - Surabaya	1.206886	483.1353	96627.0505	6.957
28	Meratus Kelimutu	Palu - Tolitoli	1.273509	1403.793	280758.604	6.177

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Palu - Surabaya	1.273509	1158.707	231741.301	16.685
		Tolitoli - Palu	1.273509	1151.547	230309.33	3.915
		Surabaya - Tolitoli	1.273509	1258.288	251657.643	18.119
29	Ruth	Santa Cruz de Tenerife - Ferrol	0.979771	2197.574	439514.754	63.290
		Las Palmas - Santa Cruz de Tenerife	0.979771	1783.493	356698.687	1.783
		Tilbury - Las Palmas	0.979771	3215	642999.962	77.160
		Rotterdam - Tilbury	0.979771	976.8345	195366.899	3.907
		Hamburg - Rotterdam	0.979771	1735.724	347144.773	9.720
30	Meratus Batam	Surabaya - Kupang	2.056336	2583.202	516640.389	37.198
		Kupang - Surabaya	2.056336	264.8306	52966.1194	10.169
31	Tanto Express	Jayapura - Ambon	1.017566	1181.329	236265.791	22.682
		Surabaya - Port of Makassar	1.017566	797.5455	159509.098	7.656
		Gresik - Surabaya	1.017566	284.64	56928.0019	0.114
		Ambon - Surabaya	1.017566	805.356	161071.2	23.194
32	New York Trader	Evyap - Istanbul	0.903517	829.7271	165945.426	0.830
		San Juan - Evyap	0.903517	928.1325	185626.506	102.466
		Kingston - San Juan	0.903517	412.4855	82497.097	7.920
		Port of Spain - Kingston	0.903517	1476.972	295394.471	28.358
		Point Lisas - Port of Spain	0.903517	9.105373	1821.07463	0.029
33	Maersk Regensburg	Cotonou - Lagos	0.903517	1196.034	239206.794	1.674
		Cotonou - Takoradi	0.903517	860.8387	172167.743	8.264
34	Maersk Roubaix	Port Owendo - Pointe Noire	0.903517	36.78001	7356.00166	1.236
		Tema - Port Owendo	0.903517	442.0945	88418.9072	27.587

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Pointe Noire - Tema	0.903517	2669.883	533976.561	38.446
		Porto de Luanda - Pointe Noire	0.903517	3037.19	607437.963	13.971
		Pointe Noire - Porto de Luanda	0.903517	127.0418	25408.3534	4.878
35	Meratus Mamiri	Kupang - Surabaya	1.807426	260.0485	52009.6917	7.489
		Surabaya - Port of Makassar	1.807426	1680.389	336077.835	16.132
36	Meratus Makassar	Surabaya - Port of Makassar	1.184075	146.2403	29248.0622	2.808
		Port of Makassar - Surabaya	1.184075	1499.895	299978.999	14.399
37	Meratus Malino	Palu - Surabaya	1.807426	2201.781	440356.262	31.706
		Surabaya - Port of Makassar	1.807426	3581.206	716241.262	25.068
38	X-Press Elbe	Rotterdam - Antwerp	0.971005	684.5286	136905.722	2.054
		Sankt Pettersburg - Riga	0.971005	1042.609	208521.792	10.009
		Riga - Kiel	0.971005	3700.536	740107.265	35.525
		Kiel - Brunsbuttel	0.971005	271.6157	54323.1348	0.435
		Brunsbuttel - Rotterdam	0.971005	3046.806	609361.216	12.797
39	Juliana	Panama City (Balboa) - Corinto	1.173714	4073.239	814647.765	39.103
		Corinto - Panama City (Balboa)	1.173714	2336.707	467341.307	33.649
		Puerto Caldera - Corinto	1.173714	171.7885	34357.7006	2.474
		Panama City (Balboa) - Puerto Caldera	1.173714	893.2532	178650.641	8.575
40	Wybelsum	Goteborg - Cuxhaven	1.462984	2471.582	494316.377	15.324
		Felixstowe - Goteborg	1.462984	5198.803	1039760.5	49.909
		Bremerhaven - Felixstowe	1.462984	2307.271	461454.255	14.305
		Sankt Pettersburg - Bremerhaven	1.462984	1406.667	281333.321	54.016
		Kiel - Sankt Pettersburg	1.462984	5458.523	1091704.52	52.402

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
41	Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	5.494206	2627.394	525478.822	17.866
		Port of Makassar - Semarang	5.494206	10628.18	2125636.92	102.031
		Jakarta (Tanjjung Priok) - Surabaya	5.494206	959.7108	191942.162	18.426
		Jakarta (Tanjung Priok) - Port of Makassar	5.494206	3617.951	723590.267	69.465
		Surabaya - Bitung	5.494206	11904.41	2380881.54	171.423
42	Maersk Wolfsburg	Wilmington (NC) - Savannah	1.468977	1473.389	294677.746	7.072
		Puerto Cortes - Puerto Colon	1.468977	1965.893	393178.617	28.309
		Santo Tomas De Castilla - Puerto Cortes	1.468977	1155.102	231020.335	1.848
		Fort Lauderdale - Santo Tomas De Castilla	1.468977	4918.242	983648.395	70.823
		Savannah - Fort Lauderdale	1.468977	6164.789	1232957.79	30.824
43	AS Samanta	Cartagena - Santa Marta	1.468977	1247.57	249514.072	3.743
		Barranquilla - Cartagena	1.468977	1060.211	212042.266	2.545
		Kingston - Barranquilla	1.468977	3502.954	700590.883	24.521
		Port of Miami - Kingston	1.468977	6039.523	1207904.62	86.969
		Puerto De Haina - Port of Miami	1.468977	7886.305	1577260.93	113.563
44	Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	1.468977	1647.638	329527.565	2.636
		Fort Lauderdale - Santo Tomas de Castilla	1.468977	5641.445	1128289.07	54.158
		Savannah - Fort Lauderdale	1.468977	1830.004	366000.704	17.568
		Wilmington (NC) - Savannah	1.468977	889.4595	177891.909	5.870
		Gloucester City - Wilmington (NC)	1.468977	1840.227	368045.396	17.666
45	RHL Agilitas	Halifax - Kingston	1.439126	4866.771	973354.244	116.803
		Newark - Halifark	1.439126	2406.861	481372.202	23.106
		Kingston - Newark	1.439126	3890.023	778004.662	93.361

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
46	Viona	Bremerhaven - Rotterdam	1.311136	6452.984	1290596.9	21.940
		Arhus - Bremerhaven	1.311136	8127.84	1625568.01	45.516
		Reykjavik - Arhus	1.311136	7482.063	1496412.52	107.742
		Grundartangi - Reykjavik	1.311136	2116.127	423225.388	1.270
47	Maersk Vallvik	Charleston - Freeport	1.49716	4259.688	851937.627	25.558
		Norfolk - Charleston	1.49716	2833.853	566770.645	27.205
		Freeport - Port Elizabeth	1.49716	5320.248	1064049.54	485.207
		Port Elizabeth - Durban	1.49716	4649.798	929959.692	26.969
48	Maersk Vilnius	Durban - Cape Town	1.49716	323.3866	64677.3177	12.418
		Salalah - Durban	1.49716	4794.692	958938.378	276.174
		Al Duqm - Salalah	1.49716	948.9596	189791.929	13.665
		Cape Town - Newark	1.49716	3578.182	715636.48	377.856
		Newark - Port of Baltimore	1.49716	2416.364	483272.726	23.197
49	Maersk Visby	Port Elizabeth - Durban	1.49716	1263.466	252693.27	12.129
		Freeport - Port Elizabeth	1.49716	4824.027	964805.422	486.262
		Charleston - Freeport	1.49716	4461.189	892237.826	24.983
		Norfolk - Charleston	1.49716	3110.429	622085.778	29.860
		Durban - Cape Town	1.49716	8644.414	1728882.85	82.986
50	Bernard A	Samsun - Istanbul	1.432734	2089.318	417863.659	14.625
		Poti - Samsun	1.432734	4376.911	875382.129	19.258
		Istanbul - Poti	1.432734	976.3678	195273.565	14.060
		Constanta - Istanbul	1.432734	1467.395	293479.003	9.391
		Samsun - Constanta	1.432734	2150.71	430142.048	15.055

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
51	Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	1.252437	638.846	127769.193	3.450
		Port of Makassar - Semarang	1.252437	2577.61	515521.935	24.745
		Surabaya - Port of Makassar	1.252437	592.0634	118412.674	8.526
52	Nexo Maersk	Tanger Mediterranean - Algeciras	2.074862	921.6431	184328.627	0.737
		Vado Ligure - Tanger Mediterranean	2.074862	2716.697	543339.328	39.120
		For sur mer - Vado Ligure	2.074862	1443.08	288615.959	13.854
		Algericas - Montreal	2.074862	6195.504	1239100.84	297.384
		Tanger Mediterranean - For sur mer	2.074862	5393.83	1078766.05	51.781
53	Nele Maersk	Novorossiysk - Port Said	2.074862	4101.289	820257.77	98.431
		Port Said - Novorossiysk	2.074862	1305.965	261193.065	50.149
		Istanbul - Novorossiysk	2.074862	827.223	165444.608	11.912
		Damietta - Istanbul	2.074862	8371.791	1674358.17	160.738
		Port Said - Damietta	2.074862	85.94438	17188.8757	0.567
54	Tanto Nusantara	Jakarta - Belawan	1.749575	1818.699	363739.9	34.919
		Belawan - Jakarta	1.749575	1112.828	222565.559	32.049
55	EMS Trader	Puerto Colon - Cartagena	1.391286	7494.836	1498967.23	25.482
		Puerto Cortes - Puerto Colon	1.391286	3554.037	710807.392	34.119
		Santo Tomas de Castilla - Puerto Cortes	1.391286	447.1859	89437.1818	1.342
		Mariel - Santo Tomas De Castilla	1.391286	1094.011	218802.104	15.754
		New Orleans - Mariel	1.391286	5466.853	1093370.59	52.482
56	Miami Trader	Jawaharlal Nehru Port - Colombo	1.572469	3592.025	718405.093	51.725
		Mundra - Jawaharlal Nehru Port	1.572469	1768.814	353762.746	16.981
		Dubai (Jebel Ali) - Mundra	1.572469	2855.365	571072.924	41.117

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Colombo - Durban	1.572469	3391.327	678265.331	244.176
		Port Louis - Dubai (Jebel Ali)	1.572469	2435.466	487093.299	128.593
57	Happy Helena	Salalah - Le Port (Pointe des Galets)	1.749575	4729.181	945836.253	158.900
		Djibouti - Salalah	1.749575	3755.794	751158.763	54.083
		Toamasina - Victoria	1.749575	9074.523	1814904.64	87.115
		Port Louis - Toamasina	1.749575	10152.59	2030517.97	54.824
		Le Port (Pointe des Galets) - Port Louis	1.749575	4.498775	899.755082	0.194
58	X-Press Machu Picchu	Puerto Colon - Cartagena	1.749575	119.7023	23940.4622	2.873
		Mariel - Puerto Colon	1.749575	4638.108	927621.652	66.789
		Cartagena - Mariel	1.749575	3861.585	772316.938	74.142
59	JPO Aries	Valencia - Lisbon	1.488319	2013.545	402708.953	28.995
		Lisbon - Halifax	1.488319	2762.813	552562.684	119.354
		Barcelona - Valencia	1.488319	2147.49	429498.087	7.301
60	Nordatlantic	Toamasina - Salalah	1.346123	2279.888	455977.544	120.378
		Port Louis - Toamasina	1.346123	1424.319	284863.785	13.673
		Le Port (Pointe des Galets) - Port Louis	1.346123	797.8524	159570.478	2.713
		Salalah - Port Louis	1.346123	2139.426	427885.192	92.423
61	Ballenita	Tacoma - Vancouver	1.509282	5987.054	1197410.75	15.566
		Everett - Tacoma	1.509282	4168.151	833630.166	3.335
		Tokyo Ko - Everett	1.509282	5227.418	1045483.52	326.191
62	Maersk Norfolk	Fos sur mer - Genoa	1.63561	362.1978	72439.5612	3.477
		Tanger Mediterranean - Fos sur mer	1.63561	4792.902	958580.496	46.012
		Montreal - Tanger Mediterranean	1.63561	2391.483	478296.576	137.749

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Tanger Mediterranean - Algericas	1.63561	84.88016	16976.0319	0.815
		Genoa - Tanger Mediterranean	1.63561	2236.911	447382.12	32.212
63	Maersk Newport	Istanbul - Evyap	1.63561	1389.088	277817.516	1.945
		Piraeus (Athens) - Istanbul	1.63561	2926.414	585282.781	18.144
		For sur mer - Piraeus (Athens)	1.63561	5823.671	1164734.12	83.861
		Barcelona - For sur mer	1.63561	735.1331	147026.628	3.970
		Castellon de la Plana - Barcelona	1.63561	2060.397	412079.446	5.357
64	City of Hongkong	Conarky - San Pedro	1.514205	2208.126	441625.224	21.198
		Dakar - Conarky	1.514205	772.3694	154473.876	11.122
		Durban - Cape Town	1.514205	4040.304	808060.894	58.180
		Ngqura - Durban	1.514205	6006.583	1201316.53	32.436
		San Pedro - Ngqura	1.514205	1078.299	215659.743	77.638
65	Maersk Brani	Hamburg - Bremerhaven	2.001492	4719.414	943882.74	9.439
		Antwerp - Hamburg	2.001492	5563.01	1112602.01	33.378
		Bremerhaven - Altamira	2.001492	9558.289	1911657.74	642.317
66	Porto	Nagoya Ko - Yokkaichi	1.431411	591.8792	118375.831	0.592
		Yokkaichi - Taipei	1.431411	7527.712	1505542.32	108.399
		Taipei - Taichung	1.431411	2160.004	432000.724	3.888
		Taichung - Kaohsiung	1.431411	3240.1	648019.985	7.776
		Kaohsiung - Hong Kong	1.431411	5688.919	1137783.82	26.169
67	Burgundy	Constanta - Istanbul	1.713753	152.0383	30407.653	2.189
		Odessa - Constanta	1.713753	4086.652	817330.487	13.077
		Diliskelesi - Odessa	1.713753	2730.718	546143.605	19.661

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Piraeus (Athens) - Diliskelesi	1.713753	674.9324	134986.472	9.719
		Malta Freeport - Piraeus (Athens)	1.713753	3307.169	661433.792	31.749
68	Northern Discovery	Dubai (Jebel Ali) - Sharjah	1.870488	2369.391	473878.174	22.746
		Khalifa Bin Salman Port - Dubai (Jebel Ali)	1.870488	1739.019	347803.844	10.782
		Shuaiba - Khalifa Bin Salman Port	1.870488	1092.883	218576.646	15.738
		Khalifa Bin Salman Port - Shuaiba	1.870488	3379.845	675969.015	16.223
69	Maersk Izmir	Sydney - Melbourne	1.671266	2508.776	501755.256	24.084
		Tauranga - Sydney	1.671266	5754.086	1150817.12	110.478
		Panama City - Tauranga	1.671266	5297.987	1059597.34	457.746
		Cartagena - Panama City	1.671266	722.1225	144424.495	6.932
		Charleston - Cartagena	1.671266	2895.173	579034.569	69.484
70	Nordautumn	Algericas - Tanger Mediterranean	1.903873	332.5626	66512.5255	0.399
		Dakar Abidjan	1.903873	10081.62	2016323.34	145.175
		Tanger Mediterranean - Dakar	1.903873	9353.729	1870745.8	179.592
		Abidjan - Lome	1.903873	10168.63	2033725.34	46.776
71	Maersk Cabinda	Lagos - Onne	2.033055	2925.708	585141.556	28.087
		Onne - Pointe Noire	2.033055	2113.379	422675.867	40.577
72	Maersk Euphrates	Ningbo Zhousan - Hong Kong	1.986618	3992.936	798587.152	57.498
		Yangshan - Ningbo Zhousan	1.986618	1353.824	270764.841	4.332
		Qingdao - Yangshan	1.986618	3347.766	669553.274	32.139
		Busan - Qingdao	1.986618	8137.185	1627437.06	55.333
		Hong Kong - Sydney	1.986618	5393.08	1078616.05	336.528
73	Wide Alpha	Yangshan - Ningbo Zhousan	1.986618	1752.145	350429.029	5.256

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Qingdao - Yangshan	1.986618	7970.507	1594101.41	44.635
		Busan - Qingdao	1.986618	8399.324	1679864.74	53.756
		Osaka - Busan	1.986618	5130.7	1026139.93	49.255
74	Maersk Indus	Colombo - Pointe Noire	1.986618	7614.779	1522955.73	621.366
		Jawaharlal Nehru Port - Colombo	1.986618	9153.227	1830645.36	87.871
		Mundra - Jawaharlal Nehru Port	1.986618	2565.653	513130.575	24.630
		Pointe Noire - Cotonou	1.986618	4769.315	953862.96	114.464
75	Kyparissia	Walvis Bay - Durban	2.033055	1651.179	330235.72	55.480
		Onne - Walvis Bay	2.033055	2894.721	578944.168	97.263
		Cotonou - Onne	2.033055	1209.309	241861.701	23.219
		Durban - Tanjung Pelepas	2.033055	8110.706	1622141.24	506.108
		Tanjung Pelepas - Nansha	2.033055	2887.008	577401.689	83.146
76	Leonidio	Lagos - Cotonou	2.033055	939.0476	187809.518	1.502
		Cotonou - Lagos	2.033055	892.4623	178492.467	1.428
77	ALS Ceres	Surabaya - Singapore	1.9888	528.718	105743.605	15.227
		Jakarta (Tanjung Priok) - Surabaya	1.9888	6421.175	1284234.98	46.232
		Shenzhen - Jakarta (Tanjung Priok)	1.9888	7994.339	1598867.83	191.864
		Shantou - Shenzhen	1.9888	2589.758	517951.514	10.359
		Ningbo Zhousan - Shantou	1.9888	9362.962	1872592.31	67.413
78	Rosa	Ningbo Zhousan - Shanghai	1.9888	1641.344	328268.875	8.535
		Qingdao - Ningbo Zhousan	1.9888	2734.674	546934.795	26.253
		Busan - Qingdao	1.9888	3428.063	685612.522	49.364
		Portland - Busan	1.9888	6645.303	1329060.56	414.667

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
79	Lana	Douala - Cotonou	1.9888	1170.37	234074.038	16.853
		Porto de Luanda - Douala	1.9888	1100.578	220115.519	26.414
		Pointe Noire - Porto de Luanda	1.9888	14142.59	2828518.64	53.742
		Algericas - Pointe Noire	1.9888	3912.41	782482.088	244.134
		Tanger Mediterranean - Algericas	1.9888	30.7036	6140.71912	0.141
80	Schubert	Shanghai - Busan	1.943166	6376.265	1275253.06	43.359
		Ningbo Zhoushan - Shanghai	1.943166	608.302	121660.408	4.258
		Qingdao - Ningbo Zhoushan	1.943166	4592.219	918443.869	44.085
		Busan - Qingdao	1.943166	3877.815	775563.095	55.841
		Portland - Busan	1.943166	6676.943	1335388.6	416.641
81	Northern Guard	Shanghai - Hong Kong	2.253647	5171.544	1034308.86	74.470
		Qingdao - Shanghai	2.253647	2878.559	575711.723	27.634
		Busan - Qingdao	2.253647	3149.28	629855.997	45.350
		Hong Kong - Johor	2.253647	5148.055	1029611.02	172.975
		Johor - Singapore	2.253647	97.45569	19491.1385	0.429
82	Kea	Rotterdam - Hamburg	2.213847	1529.341	305868.255	14.682
		Le Havre - Rotterdam	2.213847	6946.577	1389315.37	25.008
		Hamburg - Newark	2.213847	7867.037	1573407.48	415.380
83	YM Wealth	Busan - Yangshan	2.360066	4777.445	955489	45.863
		Singapore - Busan	2.360066	13400.12	2680023.89	385.923
		Jeddah - Singapore	2.360066	5678.564	1135712.77	381.599
		Sokhna - Jeddah	2.360066	5233.074	1046614.84	50.238
		Al Aqabah - Sokhna	2.360066	590.1274	118025.477	8.498

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
84	E R France	Hong Kong - Shenzhen	2.67721	2118.887	423777.315	1.271
		Kaohsing - Hong Kong	2.67721	4825.633	965126.503	27.989
		Busan - Kaohsiung	2.67721	5949.96	1189992	85.679
		Manzanillo - Busan	2.67721	11551.69	2310339	942.618
		Guayaquil - Manzanillo	2.67721	5667.318	1133463.6	163.219
85	SC Mara	Sydney - Brisbane	2.321672	11813.71	2362741.08	77.970
		Melbourne - Sydney	2.321672	6494.321	1298864.27	62.345
		Yantian - Melbourne	2.321672	7374.843	1474968.67	495.589
		Brisbane - Busan	2.321672	11166.53	2233305.41	535.993
		Shanghai - Yantian	2.321672	5065.481	1013096.28	72.943
86	Fan Ya Guang Zhou	Rizhao - Lianyungang	2.332953	48.51812	9703.62434	0.330
		Qinzhou - Rizhao	2.332953	2955.205	591041.092	99.295
		Lianyungang - Qinzhou	2.332953	2064.047	412809.414	79.259
87	Miami	Manzanillo - Los Angeles	2.167689	3127.752	625550.362	75.066
		Coronel - San Antonio	2.167689	799.0141	159802.812	7.671
		Valparaiso - Coronel	2.167689	21.2441	4248.81938	0.714
		Los Angeles - Ningbo Zhoushan	2.167689	4599.455	919890.92	419.470
		San Antonio - Manzanillo	2.167689	3965.303	793060.502	247.435
88	Maersk Columbus	Algeciras - Port Said	2.648751	14268.78	2853756.7	342.451
		Tanger Mediterranean - Algericas	2.648751	23.1549	4630.97948	0.556
		Port Said - Salalah	2.648751	18456.16	3691231.62	442.948
		Salalah - Dubai (Jebel Ali)	2.648751	13197.9	2639579.79	126.700
		Dubai (Jebel Ali) - Muhammad Bin Qasim	2.648751	6781.09	1356217.95	97.648

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
89	Maersk Denver	Newark - Algericas	2.648751	5013.607	1002721.43	264.718
		Norfolk - Newark	2.648751	2720.913	544182.654	17.958
		Djilbouti - Salalah	2.648751	5739.103	1147820.63	82.643
		Port Said - Djibouti	2.648751	11963.54	2392708.3	229.700
		Algericas - Port Said	2.648751	11963.54	2392708.3	287.125
90	Maersk Chicago	Salalah - Algericas	2.648751	11640.8	2328160.35	558.758
		Algericas - Newark	2.648751	20219.87	4043973.9	679.388
		Savannah - Houston	2.648751	16312.8	3262560.63	234.904
		Newark - Charleston	2.648751	4166.586	833317.188	39.999
		Charleston - Savannah	2.648751	1171.942	234388.397	4.688
91	Maersk Lirquen	Hong Kong - Yangshan	3.010061	2283.284	456656.707	76.718
		Singapore - Hong Kong	3.010061	15531.25	3106250.96	298.200
92	Maersk Kowloon	Algericas - Sines	3.593755	6557.859	1311571.73	30.166
		Valencia - Algericas	3.593755	856.4924	171298.476	12.333
		Genoa - Valencia	3.593755	15194.22	3038844.58	97.243
93	Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	2.923507	14876.11	2975222.37	285.621
		Sines - Gioia Tauro Harbour	2.923507	3672.556	734511.203	88.141
		Freeport - Sines	2.923507	6693.455	1338690.93	385.543
		Charleston - Freeport	2.923507	12824.79	2564957.24	69.254
		Savannah - Charleston	2.923507	2475.013	495002.622	7.425
94	Maersk Savannah	Qingdao - Busan	3.088462	6943.143	1388628.68	66.654
		Yangshan - Qingdao	3.088462	6104.828	1220965.58	58.606
		Ningbo Zhoushan - Yangshan	3.088462	30.69429	6138.85849	0.153

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Shenzhen - Ningbo Zhoushan	3.088462	8731.533	1746306.5	125.734
		Hong Kong - Shenzhen	3.088462	1073.021	214604.2	1.931
95	Maersk Sarnia	Busan - Vancouver	3.168239	14077.43	2815486.42	810.860
		Yangshan - Busan	3.168239	2371.786	474357.25	45.538
		Ningbo Zhousan - Yangshan	3.168239	3730.867	746173.381	14.923
		Yantian - Ningbo Zhousan	3.168239	14154.64	2830927.81	135.885
		Vancouver - Seattle	3.168239	9342.551	1868510.11	22.422
96	Clementine Maersk	Busan - Newark	3.233588	20874.87	4174973.8	2304.586
		Yangshan - Busan	3.233588	3895.019	779003.857	56.088
		Norfolk - Newark	3.233588	8242.08	1648416	41.210
		Port of Baltimore - Norfolk	3.233588	8535.105	1707020.96	22.191
		Newark - Port of Baltimore	3.233588	3233.588	646717.665	31.042
97	Axel Maersk	Port of Miami - Freeport	3.233588	1090.216	218043.148	3.053
		Savannah - Port of Miami	3.233588	2677.204	535440.849	25.701
		Charleston - Savannah	3.233588	2078.342	415668.497	6.235
		Newark - Charleston	3.233588	7556.097	1511219.3	72.539
		Singapore - Newark	3.233588	22354.74	4470948.47	2467.964
98	Gunvor Maersk	Yokohama Ko - Prince Rupert	3.311641	17748.33	3549665.01	766.728
		Busan - Yokohama Ko	3.311641	27053.39	5410677.16	259.713
		Yangshan - Busan	3.311641	2241.438	448287.646	32.277
		Los Angeles - Oakland	3.311641	3639.84	727968.043	34.942
		Prince Rupert - Loa Angeles	3.311641	6831.695	1366338.9	163.961
99	Emma Maersk	Tanger Mediterranean - Salalah	3.677723	17190.47	3438094.82	825.143

No	Ship	Trip	k	P Trans (kW)	FOC (g/hour)	FOC Estimation (ton)
		Le Havre - Tanger Mediterranean	3.677723	8809.421	1761884.24	169.141
		London Gateway Port - Le Havre	3.677723	18486.35	3697269.59	59.156
		Antwerp - London Gateway Port	3.677723	2118.112	423622.49	10.167
		Hamburg - Antwerp	3.677723	6927.554	1385510.76	47.107
100	Munich Maersk	Yantian - Tanjung Pelepas	7.5054	61954.49	12390897.3	892.145
		Yangshan - Yantian	7.5054	39402.44	7880488.4	378.263
		Ningbo Zhoushan - Yangshan	7.5054	364.966	72993.2013	3.504
		Busan - Ningbo Zhoushan	7.5054	13695.8	2739160.22	131.480
		Tianjin - Busan	7.5054	11385.02	2277004.58	163.944

Step 4: Comparing with the actual fuel oil consumption value based on the noon report

Noon Report of MV Meratus Benoa

Voyage Number	Trip Number	Route		Noon Report Date	Ship's Course (Degree)	Weather/Wind Direction (Compass)	Weather/Wind Force (Beaufort Scale/Knot)	Voyage Time (Hour)	Traveled Distance (nm)	Avg Speed (Knot)	Engine Speed (rpm)	FOC MFO (ton)	Draft (Meter)		Avg. Draught (m)	P installed (hp)
		Origin	Destination										Fore	Aft		
1901	MBN-2	Kumai	Semarang	13/01/2019	199	South West	3	32.000	271.932	7.53	630	7.234	3.9	4.1	4	5220
1901	MBN-3	Semarang	Surabaya	14/01/2019	79	South East	2	17.500	193.150	9.19	630	5.088	3.6	3.5	3.55	5220
1902	MBN-4	Surabaya	Samarinda	17/01/2019	55	South West	2	63.500	522.215	8.09	630	13.671	3.6	3.8	3.7	5220

Voyage Number	Trip Number	Route		Noon Report Date	Ship's Course (Degree)	Weather/Wind Direction (Compass)	Weather/Wind Force (Beaufort Scale/Knot)	Voyage Time (Hour)	Traveled Distance (nm)	Avg Speed (Knot)	Engine Speed (rpm)	FOC MFO (ton)	Draft (Meter)		Avg. Draught (m)	P installed (hp)
		Origin	Destination										Fore	Aft		
1903	MBN-6	Surabaya	Kumai	28/01/2019	342	West	4	45.700	294.166	7.63	580	12.924	4.2	4.5	4.35	5220
1903	MBN-7	Kumai	Semarang	01/02/2019	199	South West	2	34.400	274.713	7.09	580	7.916	4	4.5	4.25	5220
1903	MBN-8	Semarang	Surabaya	03/02/2019	124	North East	1	21.200	190.480	8.32	630	4.202	3.4	4	3.7	5220
1904	MBN-10	Sampit	Surabaya	08/02/2019	180	West	2	29.300	286.072	7.61	630	6.882	2.8	4.4	3.6	5220
1905	MBN-11	Surabaya	Semarang	11/02/2019	284	South West	1	22.600	191.630	8.57	600	5.104	3.4	4	3.7	5220
1905	MBN-12	Semarang	Kumai	12/02/2019	19	North	3	28.800	276.760	8.24	-	7.727	4.3	4.4	4.35	5220
1905	MBN-13	Kumai	Surabaya	14/02/2019	160	South East	3	30.200	292.877	7.87	630	6.494	3.4	4	3.7	5220
1906	MBN-14	Surabaya	Kumai	17/02/2019	340	North West	3	37.700	292.389	6.64	580	7.472	4.2	4.5	4.35	5220
1906	MBN-15	Kumai	Surabaya	20/02/2019	160	North West	1	30.900	291.270	8.15	580	6.634	2.6	3.8	3.2	5220
1907	MBN-16	Surabaya	Kumai	23/02/2019	200		-	35.500	291.939	7.08	-	8.132	4.2	4.5	4.35	5220
1907	MBN-17	Kumai	Surabaya	27/02/2019	160	South East	3	31.200	291.490	7.79	600	6.802	3.9	4.1	4	5220
1908	MBN-18	Surabaya	Kumai	03/03/2019	342	North West	1	31.400	292.678	8.32	600	9.178	4.25	4.5	4.375	5220
1908	MBN-20	Semarang	Surabaya	08/03/2019			-	20.200	192.360	7.68	-	4.513	4.3	3	3.65	5220
1909	MBN-21	Surabaya	Kumai	11/03/2019	7	North West	1	26.800	292.113	8.66	600	12.084	4.5	4.7	4.6	5220
1909	MBN-23	Semarang	Surabaya	17/03/2019			-	20.000	193.654	7.94	-	4.493	2.8	4.4	3.6	5220
1910	MBN-25	Kumai	Semarang	23/03/2019	200	South	1	35.200	273.540	6.73	580	8.066	2.8	4.4	3.6	5220

Voyage Number	Trip Number	Route		Noon Report Date	Ship's Course (Degree)	Weather/Wind Direction (Compass)	Weather/Wind Force (Beaufort Scale/Knot)	Voyage Time (Hour)	Traveled Distance (nm)	Avg Speed (Knot)	Engine Speed (rpm)	FOC MFO (ton)	Draft (Meter)		Avg. Draught (m)	P installed (hp)
		Origin	Destination										Fore	Aft		
1910	MBN-26	Semarang	Surabaya	26/03/2019	104	North East	1	19.200	193.512	8.23	620	4.376	1.9	3.5	2.7	5220

Voyage Number	Trip Number	Route		k	Power Transient (kW)	Actual FOC (Ton)	Estimated FOC (Ton)	Error Rate
		Origin	Destination					
1901	MBN-2	Kumai	2.339627	2.339627	999.718	7.234	6.398195	12%
1901	MBN-3	Semarang	2.339627	2.339627	1818.277	5.088	6.36397	25%
1902	MBN-4	Surabaya	2.339627	2.339627	1236.938	13.671	15.70911	15%
1903	MBN-6	Surabaya	2.339627	2.339627	1038.025	12.924	9.487549	27%
1903	MBN-7	Kumai	2.339627	2.339627	832.7869	7.916	5.729574	28%
1903	MBN-8	Semarang	2.339627	2.339627	1347.948	4.202	5.7153	36%
1904	MBN-10	Sampit	2.339627	2.339627	1031.099	6.882	6.042243	12%
1905	MBN-11	Surabaya	2.339627	2.339627	1471.068	5.104	6.649229	30%
1905	MBN-12	Semarang	2.339627	2.339627	1308.966	7.727	7.539641	2%
1905	MBN-13	Kumai	2.339627	2.339627	1141.74	6.494	6.896111	6%
1906	MBN-14	Surabaya	2.339627	2.339627	685.5564	7.472	5.169095	31%
1906	MBN-15	Kumai	2.339627	2.339627	1265.609	6.634	7.821465	18%

Voyage Number	Trip Number	Route		k	Power Transient (kW)	Actual FOC (Ton)	Estimated FOC (Ton)	Error Rate
		Origin	Destination					
1907	MBN-16	Surabaya	2.339627	2.339627	830.6735	8.132	5.897782	27%
1907	MBN-17	Kumai	2.339627	2.339627	1106.01	6.802	6.901501	1%
1908	MBN-18	Surabaya	2.339627	2.339627	1348.92	9.178	8.471219	8%
1908	MBN-20	Semarang	2.339627	2.339627	1061.058	4.513	4.286674	5%
1909	MBN-21	Surabaya	2.339627	2.339627	1521.078	12.084	8.152979	33%
1909	MBN-23	Semarang	2.339627	2.339627	1168.927	4.493	4.675708	4%
1910	MBN-25	Kumai	2.339627	2.339627	711.897	8.066	5.011755	38%
1910	MBN-26	Semarang	2.339627	2.339627	1303.73	4.376	5.006324	14%
							MAPE = 14%	

ATTACHMENT 2:

EEOI CALCULATION

Step 1: Collecting database & calculate the EEOI

- $EEOI = \frac{\Sigma_j FC_j \times C_{Fj}}{m_{cargo} \times D}$
- **Diesel/Gas Oil Carbon Factor = 3.206000 Ton CO_2/Ton fuel**
- $CO_2 emission = FOC * Cf$

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
Meratus Sangatta	Tanjung Bara Coal Terminal - Benete	612.68	216	4.77	4.96	1.872	6.000183601	167	0.0000586
	Port Moresby - Tanjung Bara Coal	2149.63	360	7.97	4.3	14.550	46.64800944	167	0.0001299
	Benete - Port Moresby	2708.69	456	7.42	5.08	14.872	47.67955681	167	0.0001054
Territory Trader	Surabaya - Sorong	1217.44	120	10.25	4.8	18.157	58.21009164	256	0.0001868
	Sorong - Surabaya	1228.04	192	9.34	4.85	21.980	70.4672459	256	0.0002241
Multi Express	Tangguh LNG - Gresik	1321.35	384	4.41	5.35	4.923	15.78332745	256	0.0000467
	Tangguh LNG - Ciwadan	1702.42	384	5.57	5.01	9.919	31.80155703	256	0.0000730
Tanto Abadi	Gorontalo - Surabaya	999.99	120	7.82	6	7.723	24.76043377	270	0.0000917
	Port of Makassar - Surabaya	436.5	72	7.46	6	4.023	12.89750552	270	0.0001094
	Surabaya - Gorontalo	995.77	120	7.98	6	8.207	26.31156397	270	0.0000979
Meratus Sabang	Surabaya - Benoa (Bali)	282.67	48	7.81	3.9	2.933	9.404393407	136	0.0002446
	Benoa (Bali) - Surabaya	283.51	48	7.26	4.11	2.356	7.554183825	136	0.0001959
Meratus Sibolga	Surabaya - Benoa (Bali)	285.96	48	7.66	3.8	1.621	5.197379632	136	0.0001336
	Benoa (Bali) - Surabaya	289.24	29	10.42	3.83	2.465	7.90420233	136	0.0002009
Tanto Ceria	Banjarmasin - Gresik	256.49	48	5.62	4.6	1.074	3.444146264	361	0.0000372
	Surabaya - Banjarmasin	264.65	48	5.76	4.66	1.157	3.708003113	361	0.0000388

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Gresik - Surabaya	8.03	2	4.2	4.6	0.019	0.059897579	361	0.0000207
Meratus Project 1	Gresik - Tangguh LNG	1311.97	264	7.25	6.5	31.369	100.5679446	512	0.0001497
	Ciwandan - Surabaya	450.45	72	8.83	6.67	15.456	49.55143487	512	0.0002149
	Tangguh LNG - Ciwandan	1744.94	480	7.15	6.56	54.706	175.3884502	512	0.0001963
Meratus Padang	Surabaya - Dili	876.65	120	8.07	6.56	6.611	21.19343128	630	0.0000384
	Dili - Surabaya	880.55	216	4.43	6.3	1.968	6.310508494	630	0.0000114
Tanto Sentosa	Surabaya - Gresik	8.24	2	5.98	6.25	0.087	0.277561186	256	0.0001316
	Surabaya - Port of Makassar	429.49	72	7.5	6.5	6.149	19.71248944	256	0.0001793
	Gresik - Surabaya	7.16	2	5.1	6.05	0.054	0.172173263	256	0.0000939
Vitoria S	Istanbul - Galati	414.75	120	4.75	3.77	2.858	9.1640396	285	0.0000775
	Galati - Haifa	1163.32	336	4.68	6.57	7.655	24.54153477	285	0.0000740
Merartus Benoa	Semarang - Surabaya	190.78	26	7.32	4.27	4.772	15.29842362	368	0.0002179
	Kumai - Semarang	284.04	96	7.32	4.09	17.619	56.4864872	368	0.0005404
	Surabaya - Kumai	282.25	96	7.33	4.27	17.691	56.7183056	368	0.0005461
Meratus Bontang	Lembar - Ende	396.98	72	8.25	4.5	18.918	60.65050668	368	0.0004152
	Surabaya - Lembar	271.06	35	8.12	3.1	8.768	28.11099535	368	0.0002818
	Ende - Surabaya	606.15	264	4.66	3.3	12.501	40.0776057	368	0.0001797
Meratus Barito	Ende - Surabaya	617.03	216	5.25	3.5	9.282	29.75910729	368	0.0001311
	Lembar - Ende	402.1	48	8.01	4.4	7.326	23.48697164	368	0.0001587
	Surabaya - Lembar	270.79	48	7.63	3.7	6.332	20.30032959	368	0.0002037
Tanto Alam	Jakarta - Balikpapan	1579.44	288	7.41	5.4	38.096	122.1348453	338	0.0002288
	Balikpapan - Jakarta	1577.22	312	7.13	6.01	36.766	117.8733587	338	0.0002211

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
Tanto Aman	Jakarta - Balikpapan	1583.33	288	7.58	5.9	40.778	130.7352132	338	0.0002443
	Balikpapan - Jakarta	1585.9	288	6.9	5.77	30.759	98.61256037	338	0.0001840
Meratus Ultima 2	Banjarmasin - Surabaya	264.11	29	9.63	5.28	5.447	17.46467571	455	0.0001453
	Surabaya - Banjarmasin	264.13	30	9.39	4.5	5.224	16.74949425	455	0.0001394
Meratus Ultima 1	Lembar - Surabaya	279.34	72	5.84	5.74	2.728	8.747338737	455	0.0000688
	Surabaya - Lembar	280.96	34	9.23	6	5.087	16.30755782	455	0.0001276
Tanto Subur I	Singapore -Batu Ampar	1.8	1	1.81	6.5	0.001	0.003389714	385	0.0000049
	Jakarta - Singapore	510.81	72	7.12	6.5	4.634	14.8559295	385	0.0000755
	Batu Ampar - Jakarta	511.41	144	4.77	6.5	2.787	8.933980119	385	0.0000454
Tanto Subur II	Surabaya - Balikpapan	966.27	144	9.3	5.93	28.677	91.93873349	385	0.0002471
	Balikpapan - Surabaya	967.54	192	7.98	5.53	24.156	77.44565939	385	0.0002079
Meratus Palembang	Banjarmasin - Surabaya	264.91	72	6	5.22	3.524	11.29786098	630	0.0000677
	Surabaya - Dili	856.19	168	6.04	4.71	8.388	26.89243184	630	0.0000499
Goteborg	Matadi - Pointe Noire	184.26	120	1.88	5.18	0.343	1.098338282	618	0.0000096
	Pointe Noire - Douala	672.8	96	7.07	5.96	14.576	46.73161623	618	0.0001124
	Pointe Noire - Cabinda	170.08	48	4.1	5.4	1.421	4.556948649	618	0.0000434
	Pointe Noire - Matadi	201.57	48	6.8	6.26	6.485	20.78975171	618	0.0001669
Meratus Dili	Surabaya - Dili	875.76	96	10.07	6.1	28.961	92.84860974	600	0.0001767
	Dili - Maumere	244	48	6.8	4.91	4.459	14.29498606	600	0.0000976
	Surabaya - Banjarmasin	264.95	48	6.85	5.46	4.558	14.61264092	600	0.0000919
Meratus Kendari 1	Surabaya - Banjarmasin	264.83	72	4.61	4.79	1.719	5.510727409	599	0.0000347
	Surabaya - Ambon	978.26	120	9.08	4.1	21.890	70.179852	599	0.0001198

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Ambon - Port of Makassar	600.91	72	8.31	4.19	10.068	32.27819375	599	0.0000897
	Banjarmasin - Surabaya	263.66	48	4.42	5.49	1.010	3.238036216	599	0.0000205
Viola	Boma - Matadi	27.7	4	9.43	6.2	0.460	1.473522001	713	0.0000746
	Pointe Noire - Boma	194.23	21	10.43	6.21	3.265	10.46727839	713	0.0000756
	Matadi - Pointe Noire	230.52	96	3.38	5.91	0.508	1.628481724	713	0.0000099
Meratus Kalabahi	Palu - Surabaya	625.72	48	10.92	6.81	11.672	37.42098936	831	0.0000720
	Tolitoli - Palu	162.98	14	12.11	5.96	4.643	14.885608	831	0.0001099
	Ambon - Surabaya	984.4	168	11.3	6.12	45.268	145.1278379	831	0.0001774
Meratus Kupang	Surabaya - Port of Makassar	437.46	48	9.46	7.3	9.809	31.44665269	802	0.0000896
	Port of Makassar - Surabaya	439.06	72	7.37	7.5	6.957	22.30461532	802	0.0000633
Meratus Kelimutu	Palu - Tolitoli	158.08	22	10.33	7.7	6.177	19.80246583	831	0.0001507
	Palu - Surabaya	626.68	72	9.69	8.09	16.685	53.49330795	831	0.0001027
	Tolitoli - Palu	161.52	17	9.67	8.1	3.915	12.55231909	831	0.0000935
	Surabaya - Tolitoli	735.98	72	9.96	8.1	18.119	58.09063702	831	0.0000950
Ruth	Santa Cruz de Tenerife - Ferrol	1332.9	144	13.09	6.73	63.290	202.9081395	868	0.0001754
	Las Palmas - Santa Cruz de Tenerife	54.18	5	12.21	7	1.783	5.717879954	868	0.0001216
	Tilbury - Las Palmas	1711.49	120	14.86	7.9	77.160	247.3749454	868	0.0001665
	Rotterdam - Tilbury	177.64	20	9.99	7.8	3.907	12.52692558	868	0.0000812
	Hamburg - Rotterdam	317.68	28	12.1	8.11	9.720	31.16249195	868	0.0001130
Meratus Batam	Surabaya - Kupang	723.96	72	10.79	6.8	37.198	119.2571343	910	0.0001810
	Kupang - Surabaya	726.32	192	5.05	6.85	10.169	32.60340072	910	0.0000493
Tanto Express	Jayapura - Ambon	916.77	96	10.51	5.8	22.682	72.71694002	662	0.0001198

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Surabaya - Port of Makassar	433.79	48	9.22	6.13	7.656	24.54653607	662	0.0000855
	Gresik - Surabaya	8.46	2	6.54	6	0.114	0.365022348	662	0.0000652
	Ambon - Surabaya	975.62	144	9.25	5.8	23.194	74.36077448	662	0.0001151
New York Trader	Evyap - Istanbul	43.66	5	9.72	6.45	0.830	2.660105173	1102	0.0000553
	San Juan - Evyap	5412.36	552	10.09	7.11	102.466	328.5054546	1102	0.0000551
	Kingston - San Juan	664.05	96	7.7	6.33	7.920	25.39062651	1102	0.0000347
	Port of Spain - Kingston	1005.47	96	11.78	6.6	28.358	90.91532865	1102	0.0000821
	Point Lisas - Port of Spain	23.48	16	2.16	6	0.029	0.093413844	1102	0.0000036
Maersk Regensburg	Cotonou - Lagos	73.48	7	10.98	6.3	1.674	5.368278878	1118	0.0000653
	Cotonou - Takoradi	283.66	48	9.84	6.3	8.264	26.49454962	1118	0.0000835
Maersk Roubaix	Port Owendo - Pointe Noire	444.75	168	3.44	5.9	1.236	3.96200134	1118	0.0000080
	Tema - Port Owendo	1760.54	312	7.88	6.01	27.587	88.44295716	1118	0.0000449
	Pointe Noire - Tema	946.46	72	14.35	6.4	38.446	123.2588775	1118	0.0001165
	Porto de Luanda - Pointe Noire	236.75	23	14.98	8.19	13.971	44.79126054	1118	0.0001692
	Pointe Noire - Porto de Luanda	714.48	192	5.2	6.58	4.878	15.64016276	1118	0.0000196
Meratus Mamiri	Kupang - Surabaya	714.13	144	5.24	5.93	7.489	24.0110023	1104	0.0000305
	Surabaya - Port of Makassar	438.33	48	9.76	7.55	16.132	51.71834593	1104	0.0001069
Meratus Makassar	Surabaya - Port of Makassar	444.44	96	4.98	7.8	2.808	9.001851587	1104	0.0000183
	Port of Makassar - Surabaya	442.43	48	10.82	8.84	14.399	46.16316818	1104	0.0000945
Meratus Malino	Palu - Surabaya	604.39	72	10.68	7.4	31.706	101.6483166	1104	0.0001523
	Surabaya - Port of Makassar	437.59	35	12.56	7.8	25.068	80.36943197	1104	0.0001664
X-Press Elbe	Rotterdam - Antwerp	122.36	15	8.9	7.49	2.054	6.583796155	1036	0.0000519

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Sankt Pettersburg - Riga	462.73	48	10.24	8.1	10.009	32.08900155	1036	0.0000669
	Riga - Kiel	555.13	48	15.62	8.88	35.525	113.8936269	1036	0.0001980
	Kiel - Brunsbuttel	50.53	8	6.54	8.9	0.435	1.393279762	1036	0.0000266
	Brunsbuttel - Rotterdam	288.69	21	14.64	8.8	12.797	41.02585322	1036	0.0001372
Juliana	Panama City (Balboa) - Corinto	713.72	48	15.14	9.1	39.103	125.3645153	1338	0.0001313
	Corinto - Panama City (Balboa)	720.72	72	12.58	9.26	33.649	107.8773285	1338	0.0001119
	Puerto Caldera - Corinto	277.5	72	5.27	8.18	2.474	7.930856743	1338	0.0000214
	Panama City (Balboa) - Puerto Caldera	503.11	48	9.13	9.2	8.575	27.49218977	1338	0.0000408
Wybelsum	Goteborg - Cuxhaven	363.89	31	11.91	8.8	15.324	49.12812741	1306	0.0001034
	Felixstowe - Goteborg	550.18	48	15.26	8.11	49.909	160.006664	1306	0.0002227
	Bremerhaven - Felixstowe	318.18	31	11.64	7.8	14.305	45.86209263	1306	0.0001104
	Sankt Pettersburg - Bremerhaven	1001.09	192	9.87	9.91	54.016	173.1752882	1306	0.0001325
	Kiel - Sankt Pettersburg	784.23	48	15.51	8.3	52.402	168.0002249	1306	0.0001640
Meratus Gorontalo	Semarang - Jakarta (Tanjung Priok)	263.78	34	7.82	7.34	17.866	57.27929352	1005	0.0002161
	Port of Makassar - Semarang	593.41	48	12.46	7.5	102.031	327.1100149	1005	0.0005485
	Jakarta (Tanjjung Priok) - Surabaya	408.51	96	5.59	5.6	18.426	59.07519083	1005	0.0001439
	Jakarta (Tanjung Priok) - Port of Makassar	793.79	96	8.7	7.5	69.465	222.7037179	1005	0.0002792
	Surabaya - Bitung	1055.01	72	12.94	5.6	171.423	549.5836473	1005	0.0005183
Maersk Wolfsburg	Wilmington (NC) - Savannah	231.37	24	10.01	7.5	7.072	22.6736845	1713	0.0000572
	Puerto Cortes - Puerto Colon	786.44	72	11.02	8.17	28.309	90.7582065	1713	0.0000674
	Santo Tomas De Castilla - Puerto Cortes	64.17	8	9.23	7.48	1.848	5.925209564	1713	0.0000539

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Fort Lauderdale - Santo Tomas De Castilla	893.65	72	14.96	7.4	70.823	227.0575263	1713	0.0001483
	Savannah - Fort Lauderdale	391.1	25	16.13	7.41	30.824	98.82156695	1713	0.0001475
AS Samanta	Cartagena - Santa Marta	129.22	15	9.47	7.49	3.743	11.99913173	1713	0.0000542
	Barranquilla - Cartagena	101.55	12	8.97	7.4	2.545	8.157690049	1713	0.0000469
	Kingston - Barranquilla	443.18	35	13.36	7.47	24.521	78.613303	1713	0.0001036
	Port of Miami - Kingston	927.94	72	16.02	7.56	86.969	278.8230392	1713	0.0001754
	Puerto De Haina - Port of Miami	1087.71	72	17.51	7.57	113.563	364.0822948	1713	0.0001954
Maersk Winnipeg	Santo Tomas de Castilla - Puerto Cortes	57.17	8	10.39	7	2.636	8.451722998	1713	0.0000863
	Fort Lauderdale - Santo Tomas de Castilla	897	48	15.66	6.8	54.158	173.6301481	1713	0.0001130
	Savannah - Fort Lauderdale	411.68	48	10.76	6.8	17.568	56.32311638	1713	0.0000799
	Wilmington (NC) - Savannah	247.95	33	8.46	7.1	5.870	18.82060821	1713	0.0000443
	Gloucester City - Wilmington (NC)	540.28	48	10.78	7.2	17.666	56.63776994	1713	0.0000612
RHL Agilitas	Halifax - Kingston	1841.17	120	15.01	9.2	116.803	374.4688448	1732	0.0001174
	Newark - Halifark	647.08	48	11.87	7.5	23.106	74.07740537	1732	0.0000661
	Kingston - Newark	1527.21	120	13.93	8.56	93.361	299.3139536	1732	0.0001132
Viona	Bremerhaven - Rotterdam	273.68	17	17.01	9.39	21.940	70.34011205	1719	0.0001495
	Arhus - Bremerhaven	496.75	28	18.37	8.9	45.516	145.9239892	1719	0.0001709
	Reykjavik - Arhus	1376.91	72	17.87	9.55	107.742	345.4198948	1719	0.0001459
	Grundartangi - Reykjavik	15.55	3	11.73	8.3	1.270	4.070581783	1719	0.0001523
Maersk Vallvik	Charleston - Freeport	408.49	30	14.17	10.3	25.558	81.93936101	1800	0.0001114
	Norfolk - Charleston	456.95	48	12.37	9.49	27.205	87.21920096	1800	0.0001060

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Freeport - Port Elizabeth	7013.3	456	15.26	10.3	485.207	1555.572335	1800	0.0001232
	Port Elizabeth - Durban	395.61	29	14.59	10.27	26.969	86.46207242	1800	0.0001214
Maersk Vilnius	Durban - Cape Town	819.94	192	6	7.4	12.418	39.81225226	1810	0.0000268
	Salalah - Durban	3628.87	288	14.74	8.18	276.174	885.4146545	1810	0.0001348
	Al Duqm - Salalah	352.12	72	8.59	7.07	13.665	43.81005065	1810	0.0000687
	Cape Town - Newark	6951.03	528	13.37	7.7	377.856	1211.406534	1810	0.0000963
	Newark - Port of Baltimore	429.55	48	11.73	8.21	23.197	74.36987322	1810	0.0000957
Maersk Visby	Port Elizabeth - Durban	412.78	48	9.45	9.9	12.129	38.88646188	1810	0.0000520
	Freeport - Port Elizabeth	7030.25	504	14.77	9.8	486.262	1558.955756	1810	0.0001225
	Charleston - Freeport	408.37	28	14.39	8.79	24.983	80.0944052	1810	0.0001084
	Norfolk - Charleston	442.14	48	12.76	8.5	29.860	95.73153617	1810	0.0001196
	Durban - Cape Town	817.51	48	17.94	8.7	82.986	266.0543236	1810	0.0001798
Bernard A	Samsun - Istanbul	395.39	35	11.34	7.8	14.625	46.88848112	1604	0.0000739
	Poti - Samsun	242.18	22	14.51	7.2	19.258	61.74245229	1604	0.0001589
	Istanbul - Poti	630.81	72	8.8	8.49	14.060	45.07538757	1604	0.0000445
	Constanta - Istanbul	215.29	32	10.08	7.7	9.391	30.10859787	1604	0.0000872
	Samsun - Constanta	387.73	35	11.45	7.6	15.055	48.26623922	1604	0.0000776
Meratus Medan - 2	Semarang - Jakarta (Tanjung Priok)	253.09	27	7.99	7.48	3.450	11.05995691	1380	0.0000317
	Port of Makassar - Semarang	582.99	48	12.72	7.5	24.745	79.33263954	1380	0.0000986
	Surabaya - Port of Makassar	443.11	72	7.79	7.5	8.526	27.33343433	1380	0.0000447
Nexo Maersk	Tanger Mediterranean - Algeciras	24.19	4	7.63	10.4	0.737	2.363830319	2230	0.0000438
	Vado Ligure - Tanger Mediterranean	883.92	72	10.94	8.9	39.120	125.4201038	2230	0.0000636

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	For sur mer - Vado Ligure	235.7	48	8.86	8	13.854	44.41453264	2230	0.0000845
	Algericas - Montreal	3327.24	240	14.4	10.3	297.384	953.4137511	2230	0.0001285
	Tanger Mediterranean - For sur mer	713.53	48	13.75	8	51.781	166.0091498	2230	0.0001043
Nele Maersk	Novorossiysk - Port Said	1307.73	120	12.55	11.29	98.431	315.5695692	2230	0.0001082
	Port Said - Novorossiysk	1372.17	192	8.57	8.85	50.149	160.7779134	2230	0.0000525
	Istanbul - Novorossiysk	496.12	72	7.36	9.97	11.912	38.18990983	2230	0.0000345
	Damietta - Istanbul	770.36	96	15.92	9.84	160.738	515.3272602	2230	0.0003000
	Port Said - Damietta	70.86	33	3.46	9.3	0.567	1.818548675	2230	0.0000115
Tanto Nusantara	Jakarta - Belawan	869.18	96	10.13	7	34.919	111.9504115	2312	0.0000557
	Belawan - Jakarta	902.82	144	8.6	7.54	32.049	102.7505064	2312	0.0000492
EMS Trader	Puerto Colon - Cartagena	278.18	17	17.53	9.2	25.482	81.69671223	2452	0.0001198
	Puerto Cortes - Puerto Colon	768.94	48	13.67	9.58	34.119	109.3847279	2452	0.0000580
	Santo Tomas de Castilla - Puerto Cortes	64.3	15	6.85	9.5	1.342	4.301034074	2452	0.0000273
	Mariel - Santo Tomas De Castilla	603.32	72	9.23	9.65	15.754	50.50652737	2452	0.0000341
	New Orleans - Mariel	614.14	48	15.78	10.5	52.482	168.2566135	2452	0.0001117
Miami Trader	Jawaharlal Nehru Port - Colombo	926.1	72	13.17	10.98	51.725	165.8308845	2462	0.0000727
	Mundra - Jawaharlal Nehru Port	423.06	48	10.4	10.45	16.981	54.43984139	2462	0.0000523
	Dubai (Jebel Ali) - Mundra	952.39	72	12.2	10.18	41.117	131.8219053	2462	0.0000562
	Colombo - Durban	3659.54	360	12.92	11	244.176	782.8267142	2462	0.0000869
	Port Louis - Dubai (Jebel Ali)	3032.51	264	11.57	9.5	128.593	412.2679746	2462	0.0000552
Happy Helena	Salalah - Le Port (Pointe des Galets)	2287.52	168	13.93	7.44	158.900	509.4349727	2529	0.0000881
	Djibouti - Salalah	784.31	72	12.9	7.9	54.083	173.3914795	2529	0.0000874

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Toamasina - Victoria	909.66	48	17.31	8.5	87.115	279.292045	2529	0.0001214
	Port Louis - Toamasina	476.07	27	17.97	9.55	54.824	175.7656969	2529	0.0001460
	Le Port (Pointe des Galets) - Port Louis	142.29	216	1.37	11.1	0.194	0.623076795	2529	0.0000017
X-Press Machu Picchu	Puerto Colon - Cartagena	482.62	120	4.09	8.69	2.873	9.210374623	2529	0.0000075
	Mariel - Puerto Colon	1005.04	72	13.84	9.49	66.789	214.1247613	2529	0.0000842
	Cartagena - Mariel	1058.44	96	13.02	10.69	74.142	237.7006179	2529	0.0000888
JPO Aries	Valencia - Lisbon	720.55	72	11.06	9.5	28.995	92.95811293	2470	0.0000522
	Lisbon - Halifax	2561.35	216	12.29	9.71	119.354	382.6474481	2470	0.0000605
	Barcelona - Valencia	177.56	17	11.3	9.68	7.301	23.40850475	2470	0.0000534
Nordatlantic	Toamasina - Salalah	2223.83	264	11.92	8.55	120.378	385.9320975	2478	0.0000700
	Port Louis - Toamasina	476.55	48	10.19	8.83	13.673	43.83711817	2478	0.0000371
	Le Port (Pointe des Galets) - Port Louis	139.6	17	8.4	10.9	2.713	8.696910211	2478	0.0000251
	Salalah - Port Louis	2269.76	216	11.67	11.04	92.423	296.3087839	2478	0.0000527
Ballenita	Tacoma - Vancouver	178.69	13	15.83	7.91	15.566	49.90568526	2546	0.0001097
	Everett - Tacoma	47.97	4	14.03	8.7	3.335	10.69047324	2546	0.0000875
	Tokyo Ko - Everett	4561.24	312	15.13	9.2	326.191	1045.767894	2546	0.0000901
Maersk Norfolk	Fos sur mer - Genoa	241.65	48	6.05	7.6	3.477	11.14757919	2478	0.0000186
	Tanger Mediterranean - Fos sur mer	709.62	48	14.31	7.69	46.012	147.5140354	2478	0.0000839
	Montreal - Tanger Mediterranean	3316.55	288	11.35	9.25	137.749	441.6246206	2478	0.0000537
	Tanger Mediterranean - Algericas	169.32	48	3.73	8	0.815	2.612407595	2478	0.0000062
	Genoa - Tanger Mediterranean	1146.06	72	11.1	8	32.212	103.2701096	2478	0.0000364

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
Maersk Newport	Istanbul - Evyap	57.2	7	9.47	9.4	1.945	6.234780695	2478	0.0000440
	Piraeus (Athens) - Istanbul	352	31	12.14	10.7	18.144	58.16891445	2478	0.0000667
	For sur mer - Piraeus (Athens)	1105.23	72	15.27	11.4	83.861	268.8579065	2478	0.0000982
	Barcelona - For sur mer	203.82	27	7.66	11.3	3.970	12.72691894	2478	0.0000252
	Castellon de la Plana - Barcelona	132.16	13	10.8	9.64	5.357	17.17464717	2478	0.0000524
City of Hongkong	Conarky - San Pedro	620.77	48	11.34	8	21.198	67.9608224	2578	0.0000425
	Dakar - Conarky	504.3	72	7.99	9.92	11.122	35.65751381	2578	0.0000274
	Durban - Cape Town	894.88	72	13.87	9.4	58.180	186.5263124	2578	0.0000809
	Ngqura - Durban	403.62	27	15.83	8.3	32.436	103.9883611	2578	0.0000999
	San Pedro - Ngqura	3171.3	360	8.93	7.54	77.638	248.905849	2578	0.0000304
Maersk Brani	Hamburg - Bremerhaven	122.21	10	13.31	9	9.439	30.26088063	3398	0.0000729
	Antwerp - Hamburg	393.82	30	14.06	9.4	33.378	107.0100613	3398	0.0000800
	Bremerhaven - Altamira	5506.03	336	16.84	11.18	642.317	2059.268304	3398	0.0001101
Porto	Nagoya Ko - Yokkaichi	12.69	5	7.45	9.77	0.592	1.897564566	2798	0.0000534
	Yokkaichi - Taipei	1064.21	72	17.39	9.09	108.399	347.5273445	2798	0.0001167
	Taipei - Taichung	95.25	9	11.47	9.1	3.888	12.4649489	2798	0.0000468
	Taichung - Kaohsiung	151.81	12	13.13	9.57	7.776	24.93062486	2798	0.0000587
	Kaohsiung - Hong Kong	355.56	23	15.84	10.3	26.169	83.89790324	2798	0.0000843
Burgundy	Constanta - Istanbul	329.81	72	4.46	9.66	2.189	7.019059353	3476	0.0000061
	Odessa - Constanta	204.68	16	13.36	8.9	13.077	41.92578465	3476	0.0000589
	Diliskelesi - Odessa	401.67	36	11.68	9.49	19.661	63.03371029	3476	0.0000451
	Piraeus (Athens) - Diliskelesi	387.11	72	7.33	8.8	9.719	31.1591974	3476	0.0000232

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Malta Freeport - Piraeus (Athens)	542.64	48	12.45	8.29	31.749	101.7867233	3476	0.0000540
Northern Discovery	Dubai (Jebel Ali) - Sharjah	89.15	48	10.82	8.88	22.746	72.92416449	3534	0.0002315
	Khalifa Bin Salman Port - Dubai (Jebel Ali)	252.58	31	9.76	11.2	10.782	34.56683281	3534	0.0000387
	Shuaiba - Khalifa Bin Salman Port	443.24	72	8.36	9.84	15.738	50.45448424	3534	0.0000322
	Khalifa Bin Salman Port - Shuaiba	443.24	24	12.18	11.1	16.223	52.01175988	3534	0.0000332
Maersk Izmir	Sydney - Melbourne	583.6	48	11.45	8.9	24.084	77.21411279	3460	0.0000382
	Tauranga - Sydney	1596.45	96	15.1	9.8	110.478	354.1938884	3460	0.0000641
	Panama City - Tauranga	6513.73	432	14.69	10.79	457.746	1467.533833	3460	0.0000651
	Cartagena - Panama City	324.8	48	7.56	10.37	6.932	22.22519664	3460	0.0000198
	Charleston - Cartagena	1472.67	120	12.01	9.7	69.484	222.7661794	3460	0.0000437
Nordautumn	Algericas - Tanger Mediterranean	26.14	6	5.59	11.67	0.399	1.279434941	3586	0.0000136
	Dakar Abidjan	1188.65	72	17.43	9.9	145.175	465.4319481	3586	0.0001092
	Tanger Mediterranean - Dakar	1526.1	96	17	12.1	179.592	575.7706597	3586	0.0001052
	Abidjan - Lome	399.95	23	17.48	10.05	46.776	149.9628391	3586	0.0001046
Maersk Cabinda	Lagos - Onne	506.42	48	11.29	11	28.087	90.04626371	4496	0.0000395
	Onne - Pointe Noire	824.53	96	10.13	10.07	40.577	130.0894877	4496	0.0000351
Maersk Euphrates	Ningbo Zhousan - Hong Kong	741.33	72	12.62	11.95	57.498	184.3394694	5400	0.0000460
	Yangshan - Ningbo Zhousan	127.21	16	8.8	11.4	4.332	13.88915329	5400	0.0000202
	Qingdao - Yangshan	427.97	48	11.9	10.7	32.139	103.0362142	5400	0.0000446
	Busan - Qingdao	468.9	34	16	11.3	55.333	177.3971494	5400	0.0000701
	Hong Kong - Sydney	4491.55	312	13.95	12.8	336.528	1078.909429	5400	0.0000445
Wide Alpha	Yangshan - Ningbo Zhousan	138.21	15	9.59	11.15	5.256	16.85213201	5400	0.0000226

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Qingdao - Yangshan	432.08	28	15.89	10.39	44.635	143.0992952	5400	0.0000613
	Busan - Qingdao	493.93	32	16.17	11.8	53.756	172.3406831	5400	0.0000646
	Osaka - Busan	656.05	48	13.72	11.91	49.255	157.9106217	5400	0.0000446
Maersk Indus	Colombo - Pointe Noire	6202.31	408	15.65	13.31	621.366	1992.099198	5400	0.0000595
	Jawaharlal Nehru Port - Colombo	913.03	48	16.64	13.39	87.871	281.7143535	5400	0.0000571
	Mundra - Jawaharlal Nehru Port	410.53	48	10.89	12.23	24.630	78.96463796	5400	0.0000356
	Pointe Noire - Cotonou	1266.25	120	13.39	12.03	114.464	366.9701581	5400	0.0000537
Kyparissia	Walvis Bay - Durban	1558.73	168	9.33	11.4	55.480	177.8676008	4770	0.0000239
	Onne - Walvis Bay	1815.59	168	11.25	9.89	97.263	311.8239605	4770	0.0000360
	Cotonou - Onne	770.77	96	8.41	10.76	23.219	74.439227	4770	0.0000202
	Durban - Tanjung Pelepas	4888.15	312	15.86	11.59	506.108	1622.582461	4770	0.0000696
	Tanjung Pelepas - Nansha	1499.4	144	11.24	9.23	83.146	266.5655733	4770	0.0000373
Leonidio	Lagos - Cotonou	57.99	8	7.73	11.3	1.502	4.816938516	4770	0.0000174
	Cotonou - Lagos	56.09	8	7.6	11.3	1.428	4.577974803	4770	0.0000171
ALS Ceres	Surabaya - Singapore	850.4	144	6.43	8.6	15.227	48.81801548	4300	0.0000134
	Jakarta (Tanjung Priok) - Surabaya	423.6	36	14.78	8.9	46.232	148.2212641	4300	0.0000814
	Shenzhen - Jakarta (Tanjung Priok)	1810	120	15.9	11.7	191.864	615.1164322	4300	0.0000790
	Shantou - Shenzhen	209.37	20	10.92	11.21	10.359	33.21105109	4300	0.0000369
	Ningbo Zhousan - Shantou	585.05	36	16.76	10.07	67.413	216.1271137	4300	0.0000859
Rosa	Ningbo Zhousan - Shanghai	184.83	26	9.38	9.37	8.535	27.36318036	4380	0.0000338
	Qingdao - Ningbo Zhousan	480.46	48	11.12	9.68	26.253	84.1667018	4380	0.0000400
	Busan - Qingdao	490.82	72	11.99	9.88	49.364	158.2613098	4380	0.0000736

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Portland - Busan	4744.9	312	14.95	9.64	414.667	1329.422063	4380	0.0000640
Lana	Douala - Cotonou	591.41	72	8.38	7.32	16.853	54.03177841	4387	0.0000208
	Porto de Luanda - Douala	896.42	120	8.21	7.5	26.414	84.6828425	4387	0.0000215
	Pointe Noire - Porto de Luanda	357.41	19	19.23	9.9	53.742	172.2963842	4387	0.0001099
	Algericas - Pointe Noire	3773.44	312	12.53	12.61	244.134	782.6949233	4387	0.0000473
	Tanger Mediterranean - Algericas	51.25	23	2.49	9.26	0.141	0.452804347	4387	0.0000020
Schubert	Shanghai - Busan	469.78	34	14.86	10.88	43.359	139.0076842	4255	0.0000695
	Ningbo Zhoushan - Shanghai	218.41	35	6.79	9.3	4.258	13.65151435	4255	0.0000147
	Qingdao - Ningbo Zhoushan	559.46	48	13.32	9.6	44.085	141.3374901	4255	0.0000594
	Busan - Qingdao	461.63	72	12.59	9.88	55.841	179.0247804	4255	0.0000911
	Portland - Busan	4788.62	312	15.09	9.9	416.641	1335.751825	4255	0.0000656
Northern Guard	Shanghai - Hong Kong	853.31	72	13.19	11.14	74.470	238.7515827	4294	0.0000652
	Qingdao - Shanghai	391.91	48	10.85	11.56	27.634	88.59512559	4294	0.0000526
	Busan - Qingdao	628.44	72	11.18	10.55	45.350	145.3909195	4294	0.0000539
	Hong Kong - Johor	1876.37	168	13.17	1.13	172.975	554.5567334	4294	0.0000688
	Johor - Singapore	33.36	22	3.51	11.89	0.429	1.374748981	4294	0.0000096
Kea	Rotterdam - Hamburg	322.11	48	8.84	10.5	14.682	47.06945396	6900	0.0000212
	Le Havre - Rotterdam	260.99	18	14.64	10.79	25.008	80.1746113	6900	0.0000445
	Hamburg - Newark	3697.55	264	15.26	11.76	415.380	1331.706917	6900	0.0000522
YM Wealth	Busan - Yangshan	466.83	48	12.65	11.4	45.863	147.0382913	5551	0.0000567
	Singapore - Busan	2519.04	144	17.84	11.2	385.923	1237.270549	5551	0.0000885
	Jeddah - Singapore	4395.61	336	13.4	10.4	381.599	1223.407971	5551	0.0000501

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Sokhna - Jeddah	621.91	48	13.04	10.13	50.238	161.0614649	5551	0.0000467
	Al Aqabah - Sokhna	328.29	72	6.3	11.7	8.498	27.24405686	5551	0.0000150
E R France	Hong Kong - Shenzhen	18.94	3	9.25	9.7	1.271	4.075890217	5762	0.0000373
	Kaohsing - Hong Kong	356.02	29	12.17	9.7	27.989	89.73167145	5762	0.0000437
	Busan - Kaohsiung	935.06	72	13.05	11.1	85.679	274.6882335	5762	0.0000510
	Manzanillo - Busan	6397.38	408	16.28	11.4	942.618	3022.034303	5762	0.0000820
	Guayaquil - Manzanillo	2011.96	144	12.84	9.8	163.219	523.2793399	5762	0.0000451
SC Mara	Sydney - Brisbane	554.46	33	17.2	10.9	77.970	249.9732803	5089	0.0000886
	Melbourne - Sydney	588.9	48	14.09	11.48	62.345	199.8796248	5089	0.0000667
	Yantian - Melbourne	5033.09	336	14.7	11.2	495.589	1588.859849	5089	0.0000620
	Brisbane - Busan	4189.36	240	16.88	10.9	535.993	1718.394513	5089	0.0000806
	Shanghai - Yantian	847.67	72	12.97	10.79	72.943	233.8550396	5089	0.0000542
Fan Ya Guang Zhou	Rizhao - Lianyungang	68.28	34	2.75	12.62	0.330	1.057733868	5089	0.0000030
	Qinzhou - Rizhao	1539.98	168	10.82	11.25	99.295	318.3394605	5089	0.0000406
	Lianyungang - Qinzhou	1526.95	192	9.6	12.55	79.259	254.1056605	5089	0.0000327
Miami	Manzanillo - Los Angeles	1253.54	120	11.3	9.7	75.066	240.6617353	5085	0.0000378
	Coronel - San Antonio	233.16	48	7.17	9.37	7.671	24.59173508	5085	0.0000207
	Valparaiso - Coronel	276.67	168	2.14	7.6	0.714	2.288448108	5085	0.0000016
	Los Angeles - Ningbo Zhoushan	5805.59	456	12.85	10.1	419.470	1344.821653	5085	0.0000456
	San Antonio - Manzanillo	3750.36	312	12.23	9.6	247.435	793.2762141	5085	0.0000416
Maersk Columbus	Algeciras - Port Said	1935.87	120	17.53	14.2	342.451	1097.897277	6188	0.0000917
	Tanger Mediterranean - Algericas	114.03	120	2.06	11.99	0.556	1.781630426	6188	0.0000025

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Port Said - Salalah	2077.73	120	19.1	14.2	442.948	1420.090629	6188	0.0001105
	Salalah - Dubai (Jebel Ali)	957.34	48	17.08	13.42	126.700	406.1996549	6188	0.0000686
	Dubai (Jebel Ali) - Muhammad Bin Qasim	785.86	72	13.68	12.46	97.648	313.0585016	6188	0.0000644
Maersk Denver	Newark - Algericas	3288.34	264	12.37	13.49	264.718	848.6873706	6188	0.0000417
	Norfolk - Newark	321.91	33	10.09	10.83	17.958	57.57343643	6188	0.0000289
	Djilbouti - Salalah	753.31	72	12.94	14.11	82.643	264.9537308	6188	0.0000568
	Port Said - Djibouti	1382.88	96	16.53	14.5	229.700	736.4181902	6188	0.0000861
	Algericas - Port Said	1933.79	120	16.53	14.5	287.125	920.5227378	6188	0.0000769
Maersk Chicago	Salalah - Algericas	3861.43	240	16.38	14.4	558.758	1791.379697	6188	0.0000750
	Algericas - Newark	3238.72	168	19.69	12.8	679.388	2178.116695	6188	0.0001087
	Savannah - Houston	1353.07	72	18.33	9.83	234.904	753.1033943	6188	0.0000899
	Newark - Charleston	655.63	48	11.63	11.7	39.999	128.2375155	6188	0.0000316
	Charleston - Savannah	134.63	20	7.62	10.59	4.688	15.02898404	6188	0.0000180
Maersk Lirquen	Hong Kong - Yangshan	826.78	168	9.12	12.06	76.718	245.9589555	8850	0.0000336
	Singapore - Hong Kong	1450.51	96	17.28	13.2	298.200	956.0294944	8850	0.0000745
Maersk Kowloon	Algericas - Sines	277.86	23	12.22	14	30.166	96.71267621	7455	0.0000467
	Valencia - Algericas	464.01	72	6.2	13.03	12.333	39.5411697	7455	0.0000114
	Genoa - Valencia	522.24	32	16.17	12.2	97.243	311.7611433	7455	0.0000801
Northern Jubilee	Gioia Tauro Harbour - King Abdullah Port	1654.37	96	17.2	12.1	285.621	915.702041	8814	0.0000628
	Sines - Gioia Tauro Harbour	1333.46	120	10.79	10.4	88.141	282.5811502	8814	0.0000240
	Freeport - Sines	3663.55	288	13.18	10.4	385.543	1236.05082	8814	0.0000383

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
	Charleston - Freeport	405.43	27	16.37	10.4	69.254	222.0278282	8814	0.0000621
	Savannah - Charleston	130.41	15	9.46	10.4	7.425	23.8046761	8814	0.0000207
Maersk Savannah	Qingdao - Busan	505.32	48	13.1	13.81	66.654	213.6932896	9662	0.0000438
	Yangshan - Qingdao	442.77	48	12.55	13.7	58.606	187.8919506	9662	0.0000439
	Ningbo Zhoushan - Yangshan	106.25	25	2.15	13.57	0.153	0.492029508	9662	0.0000005
	Shenzhen - Ningbo Zhoushan	808.45	72	14.14	13.5	125.734	403.1034221	9662	0.0000516
	Hong Kong - Shenzhen	41.71	9	7.03	14	1.931	6.192189588	9662	0.0000154
Maersk Sarnia	Busan - Vancouver	4639.29	288	16.44	12.4	810.860	2599.617447	8478	0.0000661
	Yangshan - Busan	515.15	96	9.08	11.78	45.538	145.9957771	8478	0.0000334
	Ningbo Zhousan - Yangshan	122.09	20	10.56	11.27	14.923	47.84463721	8478	0.0000462
	Yantian - Ningbo Zhousan	737.77	48	16.47	11.5	135.885	435.6458191	8478	0.0000696
	Vancouver - Seattle	165.01	12	14.34	13.84	22.422	71.88532087	8478	0.0000514
Clementine Maersk	Busan - Newark	10290.87	552	18.62	13.75	2304.586	7388.501226	7226	0.0000994
	Yangshan - Busan	465.68	72	10.64	13.79	56.088	179.8190183	7226	0.0000534
	Norfolk - Newark	328.83	25	13.66	11.56	41.210	132.1205426	7226	0.0000556
	Port of Baltimore - Norfolk	171.76	13	13.82	11.5	22.191	71.14521948	7226	0.0000573
	Newark - Port of Baltimore	484.37	48	10	11.9	31.042	99.52208808	7226	0.0000284
Axel Maersk	Port of Miami - Freeport	93.08	14	6.96	11.9	3.053	9.78664864	7226	0.0000146
	Savannah - Port of Miami	463.46	48	9.39	12.78	25.701	82.39792141	7226	0.0000246
	Charleston - Savannah	125.89	15	8.63	12.24	6.235	19.98949802	7226	0.0000220
	Newark - Charleston	659.71	48	13.27	13.19	72.539	232.5585163	7226	0.0000488
	Singapore - Newark	10193.28	552	19.05	12.99	2467.964	7912.291152	7226	0.0001074

Ship	Trip	Distance Traveled nm	Travel Time Days	Avg Speed knots	Avg Draught m	FOC Estimation ton	CO2 Emission Estimation ton CO2	Container Capacity (TEU)	EEOI ton CO2/TEU nm
Gunvor Maersk	Yokohama Ko - Prince Rupert	3829.42	216	17.5	14.37	766.728	2458.128817	9930	0.0000646
	Busan - Yokohama Ko	860.19	48	20.14	14.37	259.713	832.6382869	9930	0.0000975
	Yangshan - Busan	478.44	72	8.78	13.6	32.277	103.4791339	9930	0.0000218
	Los Angeles - Oakland	388.55	48	10.32	13.11	34.942	112.0255462	9930	0.0000290
	Prince Rupert - Loa Angeles	1470.98	120	12.73	14.39	163.961	525.6579028	9930	0.0000360
Emma Maersk	Tanger Mediterranean - Salalah	3958.94	240	16.72	16.14	825.143	2645.407675	13460	0.0000496
	Le Havre - Tanger Mediterranean	1238.14	96	13.38	15.21	169.141	542.2656835	13460	0.0000325
	London Gateway Port - Le Havre	253.73	16	17.13	14.15	59.156	189.6551411	13460	0.0000555
	Antwerp - London Gateway Port	186.03	24	8.32	13.3	10.167	32.59520891	13460	0.0000130
	Hamburg - Antwerp	401.8	34	12.35	10.58	47.107	151.0262149	13460	0.0000279
Munich Maersk	Yantian - Tanjung Pelepas	1513.2	72	20.21	16.29	892.145	2860.215612	20568	0.0000919
	Yangshan - Yantian	822.23	48	17.38	15	378.263	1212.712599	20568	0.0000717
	Ningbo Zhoushan - Yangshan	121.62	48	3.65	13.13	3.504	11.23277776	20568	0.0000045
	Busan - Ningbo Zhoushan	534.28	48	12.22	13.73	131.480	421.5238876	20568	0.0000384
	Tianjin - Busan	750.76	72	11.49	14.15	163.944	525.6055209	20568	0.0000340

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ATTACHMENT 3:

Multiple Linear Regression (MLR) EQUATION

Step 1: Data Preprocessing

EEOI	LOA	B	H	T	Vs	Container Capacity	Avg Speed	Avg Draught	P Installed	Travel Time
0.00005864275	87.9	12.8	7.1	5.5	13.9	167	4.77	4.96	1998	216
0.00012994301	87.9	12.8	7.1	5.5	13.9	167	7.97	4.3	1998	360
0.00010540384	87.9	12.8	7.1	5.5	13.9	167	7.42	5.08	1998	456
0.00018677156	91	14.7	7.6	5	12	256	10.25	4.8	2300	120
0.00022414798	91	14.7	7.6	5	12	256	9.34	4.85	2300	192
0.00004665957	91	14.7	7.6	4.98	12	256	4.41	5.35	2447	384
0.00007296956	91	14.7	7.6	4.98	12	256	5.57	5.01	2447	384
0.00009170623	93.5	17.6	7.6	5.8	14.5	270	7.82	6	3807	120
0.00010943537	93.5	17.6	7.6	5.8	14.5	270	7.46	6	3807	72
0.00009786420	93.5	17.6	7.6	5.8	14.5	270	7.98	6	3807	120
0.00024463138	98	16.5	7.8	5.4	11.9	136	7.81	3.9	2050	48
0.00019592067	98	16.5	7.8	5.4	11.9	136	7.26	4.11	2050	48
0.00013364116	98	16.5	7.8	5.4	14.32	136	7.66	3.8	2050	48
0.00020093740	98	16.5	7.8	5.4	14.32	136	10.42	3.83	2050	29
0.00003719666	98.84	16	7.1	5.73	15.34	361	5.62	4.6	4200	48
0.00003881155	98.84	16	7.1	5.73	15.34	361	5.76	4.66	4200	48
0.00002066267	98.84	16	7.1	5.73	15.34	361	4.2	4.6	4200	2
0.00014971514	99.95	18.2	8.4	5.7	12.6	512	7.25	6.5	5875	264
0.00021485214	99.95	18.2	8.4	5.7	12.6	512	8.83	6.67	5875	72
0.00019631367	99.95	18.2	8.4	5.7	12.6	512	7.15	6.56	5875	480
0.00003837377	100.58	18.8	8.4	6.65	17.8	630	8.07	6.56	5384	120
0.00001137548	100.58	18.8	8.4	6.65	17.8	630	4.43	6.3	5384	216
0.00013158051	105	20	8.7	6.71	14.3	256	5.98	6.25	5500	2

0.00017928686	105	20	8.7	6.71	14.3	256	7.5	6.5	5500	72
0.00009393182	105	20	8.7	6.71	14.3	256	5.1	6.05	5500	2
0.00007752749	106.6	16.8	9.1	7.1	11.5	285	4.75	3.77	3219	120
0.00007402146	106.6	16.8	9.1	7.1	11.5	285	4.68	6.57	3219	336
0.00021790441	106.68	20.6	5.8	4.21	10.5	368	7.32	4.27	5220	26
0.00054040237	106.68	20.6	5.8	4.21	10.5	368	7.32	4.09	5220	96
0.00054606140	106.68	20.6	5.8	4.21	10.5	368	7.33	4.27	5220	96
0.00041516237	106.68	20.6	5.8	4.21	10.5	368	8.25	4.5	5220	72
0.00028181426	106.68	20.6	5.8	4.21	10.5	368	8.12	3.1	5220	35
0.00017966929	106.68	20.6	5.8	4.21	10.5	368	4.66	3.3	5220	264
0.00013105868	106.68	20.6	5.8	11	12.3	368	5.25	3.5	5220	216
0.00015872493	106.68	20.6	5.8	11	12.3	368	8.01	4.4	5220	48
0.00020371483	106.68	20.6	5.8	11	12.3	368	7.63	3.7	5220	48
0.00022878089	107	17.2	8.3	6.54	12	338	7.41	5.4	5322	288
0.00022110913	107	17.2	8.3	6.54	12	338	7.13	6.01	5322	312
0.00024428930	107	17.2	8.3	6.54	12	338	7.58	5.9	5322	288
0.00018396692	107	17.2	8.3	6.54	12	338	6.9	5.77	5322	288
0.00014533302	107	18.2	8.8	11.1	14.2	455	9.63	5.28	5600	29
0.00013937105	107	18.2	8.8	11.1	14.2	455	9.39	4.5	5600	30
0.00006882265	108	18.2	8.8	9.1	14.7	455	5.84	5.74	5600	72
0.00012756544	108	18.2	8.8	9.1	14.7	455	9.23	6	5600	34
0.00000489136	113	19	8.5	6.5	14	385	1.81	6.5	4556	1
0.00007554047	113	19	8.5	6.5	14	385	7.12	6.5	4556	72
0.00004537483	113	19	8.5	6.5	14	385	4.77	6.5	4556	144
0.00024713787	113	19	8.5	6.5	12.5	385	9.3	5.93	4559	144
0.00020790619	113	19	8.5	6.5	12.5	385	7.98	5.53	4559	192

0.00006769511	117	19.7	8.5	6.45	14.8	630	6	5.22	6802	72
0.00004985622	117	19.7	8.5	6.45	14.8	630	6.04	4.71	6802	168
0.00000964532	117	19.7	8.5	6.5	15	618	1.88	5.18	13410	120
0.00011239224	117	19.7	8.5	6.5	15	618	7.07	5.96	13410	96
0.00004335432	117	19.7	8.5	6.5	15	618	4.1	5.4	13410	48
0.00016689177	117	19.7	8.5	6.5	15	618	6.8	6.26	13410	48
0.00017670102	118	18.8	8.5	6.47	14.3	600	10.07	6.1	8027	96
0.00009764335	118	18.8	8.5	6.47	14.3	600	6.8	4.91	8027	48
0.00009192075	118	18.8	8.5	6.47	14.3	600	6.85	5.46	8027	48
0.00003473881	120	19.6	8	6.16	12.5	599	4.61	4.79	4487	72
0.00011976539	120	19.6	8	6.16	12.5	599	9.08	4.1	4487	120
0.00008967533	120	19.6	8	6.16	12.5	599	8.31	4.19	4487	72
0.00002050268	120	19.6	8	6.16	12.5	599	4.42	5.49	4487	48
0.00007460833	123.1	21	7.1	7.1	17	713	9.43	6.2	6155	4
0.00007558366	123.1	21	7.1	7.1	17	713	10.43	6.21	6155	21
0.00000990797	123.1	21	7.1	7.1	17	713	3.38	5.91	6155	96
0.00007196713	128.84	23	11.2	7.8	18	831	10.92	6.81	9910	48
0.00010990849	128.84	23	11.2	7.8	18	831	12.11	5.96	9910	14
0.00017741000	128.84	23	11.2	7.8	18	831	11.3	6.12	9910	168
0.00008963172	128.84	23	11.2	7.8	16.4	802	9.46	7.3	9765	48
0.00006334269	128.84	23	11.2	7.8	16.4	802	7.37	7.5	9765	72
0.00015074445	128.84	23	11.2	7.8	16.1	831	10.33	7.7	9765	22
0.00010271943	128.84	23	11.2	7.8	16.1	831	9.69	8.09	9765	72
0.00009351831	128.84	23	11.2	7.8	16.1	831	9.67	8.1	9765	17
0.00009498152	128.84	23	11.2	7.8	16.1	831	9.96	8.1	9765	72
0.00017538085	134.4	22.5	11.3	8.7	18.5	868	13.09	6.73	11265	144

0.00012158397	134.4	22.5	11.3	8.7	18.5	868	12.21	7	11265	5
0.00016651817	134.4	22.5	11.3	8.7	18.5	868	14.86	7.9	11265	120
0.00008124264	134.4	22.5	11.3	8.7	18.5	868	9.99	7.8	11265	20
0.00011301148	134.4	22.5	11.3	8.7	18.5	868	12.1	8.11	11265	28
0.00018102077	138.87	23.9	11.85	9.15	15.3	910	10.79	6.8	13596	72
0.00004932800	138.87	23.9	11.85	9.15	15.3	910	5.05	6.85	13596	192
0.00011981666	144.02	21.8	10.7	7.72	18	662	10.51	5.8	10800	96
0.00008547767	144.02	21.8	10.7	7.72	18	662	9.22	6.13	10800	48
0.00006517651	144.02	21.8	10.7	7.72	18	662	6.54	6	10800	2
0.00011513443	144.02	21.8	10.7	7.72	18	662	9.25	5.8	10800	144
0.00005528833	146.5	22.7	11.2	6.5	20	1102	9.72	6.45	13048	5
0.00005507751	146.5	22.7	11.2	6.5	20	1102	10.09	7.11	13048	552
0.00003469693	146.5	22.7	11.2	6.5	20	1102	7.7	6.33	13048	96
0.00008205148	146.5	22.7	11.2	6.5	20	1102	11.78	6.6	13048	96
0.00000361020	146.5	22.7	11.2	6.5	20	1102	2.16	6	13048	16
0.00006534677	147.8	23.3	11.5	7.3	20	1118	10.98	6.3	13048	7
0.00008354426	147.8	23.3	11.5	7.3	20	1118	9.84	6.3	13048	48
0.00000796814	147.9	23.3	11.5	7.3	20	1118	3.44	5.9	13048	168
0.00004493405	147.9	23.3	11.5	7.3	20	1118	7.88	6.01	13048	312
0.00011648611	147.9	23.3	11.5	7.3	20	1118	14.35	6.4	13048	72
0.00016922382	147.9	23.3	11.5	7.3	20	1118	14.98	8.19	13048	23
0.00001957985	147.9	23.3	11.5	7.3	20	1118	5.2	6.58	13048	192
0.00003045537	149.58	23.1	12.8	8.6	16	1104	5.24	5.93	13610	144
0.00010687456	149.58	23.1	12.8	8.6	16	1104	9.76	7.55	13610	48
0.00001834635	149.6	23.1	12.8	8.57	18.5	1104	4.98	7.8	13614	96
0.00009451091	149.6	23.1	12.8	8.57	18.5	1104	10.82	8.84	13614	48

0.00015233996	149.6	23.1	12.8	8.6	16	1104	10.68	7.4	13610	72
0.00016636212	149.6	23.1	12.8	8.6	16	1104	12.56	7.8	13610	35
0.00005193703	151.7	23.4	11.8	8	19	1036	8.9	7.49	12069	15
0.00006693739	151.7	23.4	11.8	8	19	1036	10.24	8.1	12069	48
0.00019803638	151.7	23.4	11.8	8	19	1036	15.62	8.88	12069	48
0.00002661517	151.7	23.4	11.8	8	19	1036	6.54	8.9	12069	8
0.00013717221	151.7	23.4	11.8	8	19	1036	14.64	8.8	12069	21
0.00013127761	161.3	25	14.9	9.5	20	1338	15.14	9.1	16950	48
0.00011186842	161.3	25	14.9	9.5	20	1338	12.58	9.26	16950	72
0.00002135999	161.3	25	14.9	9.5	20	1338	5.27	8.18	16950	72
0.00004084043	161.3	25	14.9	9.5	20	1338	9.13	9.2	16950	48
0.00010337533	161.4	25	13.9	9.9	19	1306	11.91	8.8	18184	31
0.00022268455	161.4	25	13.9	9.9	19	1306	15.26	8.11	18184	48
0.00011036664	161.4	25	13.9	9.9	19	1306	11.64	7.8	18184	31
0.00013245538	161.4	25	13.9	9.9	19	1306	9.87	9.91	18184	192
0.00016402998	161.4	25	13.9	9.9	19	1306	15.51	8.3	18184	48
0.00021606764	161.85	25.6	12.9	9.06	11.4	1005	7.82	7.34	15520	34
0.00054849531	161.85	25.6	12.9	9.06	11.4	1005	12.46	7.5	15520	48
0.00014389191	161.85	25.6	12.9	9.06	11.4	1005	5.59	5.6	15520	96
0.00027916167	161.85	25.6	12.9	9.06	11.4	1005	8.7	7.5	15520	96
0.00051833575	161.85	25.6	12.9	9.06	11.4	1005	12.94	5.6	15520	72
0.00005720812	175.1	27.9	13.8	8.5	20	1713	10.01	7.5	21214	24
0.00006736944	175.1	27.9	13.8	8.5	20	1713	11.02	8.17	21214	72
0.00005390317	175.1	27.9	13.8	8.5	20	1713	9.23	7.48	21214	8
0.00014832388	175.1	27.9	13.8	8.5	20	1713	14.96	7.4	21214	72
0.00014750494	175.1	27.9	13.8	8.5	20	1713	16.13	7.41	21214	25

0.00005420792	175.1	27.9	13.8	8.5	20	1713	9.47	7.49	21214	15
0.00004689536	175.1	27.9	13.8	8.5	20	1713	8.97	7.4	21214	12
0.00010355201	175.1	27.9	13.8	8.5	20	1713	13.36	7.47	21214	35
0.00017540881	175.1	27.9	13.8	8.5	20	1713	16.02	7.56	21214	72
0.00019540203	175.1	27.9	13.8	8.5	20	1713	17.51	7.57	21214	72
0.00008630177	175.1	27.9	13.8	8.5	20	1713	10.39	7	21214	8
0.00011299919	175.1	27.9	13.8	8.5	20	1713	15.66	6.8	21214	48
0.00007986740	175.1	27.9	13.8	8.5	20	1713	10.76	6.8	21214	48
0.00004431106	175.1	27.9	13.8	8.5	20	1713	8.46	7.1	21214	33
0.00006119697	175.1	27.9	13.8	8.5	20	1713	10.78	7.2	21214	48
0.00011742861	175.5	27.4	14.3	10.9	20.5	1732	15.01	9.2	22341	120
0.00006609672	175.5	27.4	14.3	10.9	20.5	1732	11.87	7.5	22341	48
0.00011315671	175.5	27.4	14.3	10.9	20.5	1732	13.93	8.56	22341	120
0.00014951478	178.6	27.6	14.6	10.7	21.3	1719	17.01	9.39	22770	17
0.00017088854	178.6	27.6	14.6	10.7	21.3	1719	18.37	8.9	22770	28
0.00014593717	178.6	27.6	14.6	10.7	21.3	1719	17.87	9.55	22770	72
0.00015228258	178.6	27.6	14.6	10.7	21.3	1719	11.73	8.3	22770	3
0.00011143937	179.7	27.6	15.9	9	20.2	1800	14.17	10.3	22260	30
0.00010604029	179.7	27.6	15.9	9	20.2	1800	12.37	9.49	22260	48
0.00012322400	179.7	27.6	15.9	9	20.2	1800	15.26	10.3	22260	456
0.00012141878	179.7	27.6	15.9	9	20.2	1800	14.59	10.27	22260	29
0.00002682601	179.9	27.6	15.9	9	20.2	1810	6	7.4	22260	192
0.00013480212	179.9	27.6	15.9	9	20.2	1810	14.74	8.18	22260	288
0.00006873920	179.9	27.6	15.9	9	20.2	1810	8.59	7.07	22260	72
0.00009628578	179.9	27.6	15.9	9	20.2	1810	13.37	7.7	22260	528
0.00009565435	179.9	27.6	15.9	9	20.2	1810	11.73	8.21	22260	48

0.00005204766	179.9	27.6	15.9	9	20.2	1810	9.45	9.9	22260	48
0.00012251364	179.9	27.6	15.9	9	20.2	1810	14.77	9.8	22260	504
0.00010836019	179.9	27.6	15.9	9	20.2	1810	14.39	8.79	22260	28
0.00011962354	179.9	27.6	15.9	9	20.2	1810	12.76	8.5	22260	48
0.00017980372	179.9	27.6	15.9	9	20.2	1810	17.94	8.7	22260	48
0.00007393262	184	24.5	14.2	9	19	1604	11.34	7.8	17808	35
0.00015894294	184	24.5	14.2	9	19	1604	14.51	7.2	17808	22
0.00004454885	184	24.5	14.2	9	19	1604	8.8	8.49	17808	72
0.00008718912	184	24.5	14.2	9	19	1604	10.08	7.7	17808	32
0.00007760857	184	24.5	14.2	9	19	1604	11.45	7.6	17808	35
0.00003166645	186.03	27.6	14	9.53	18.5	1380	7.99	7.48	14400	27
0.00009860790	186.03	27.6	14	9.53	18.5	1380	12.72	7.5	14400	48
0.00004469959	186.03	27.6	14	9.53	18.5	1380	7.79	7.5	14400	72
0.00004382032	198.6	30.2	17.5	10.5	21.8	2230	7.63	10.4	38570	4
0.00006362816	198.6	30.2	17.5	10.5	21.8	2230	10.94	8.9	38570	72
0.00008450077	198.6	30.2	17.5	10.5	21.8	2230	8.86	8	38570	48
0.00012849683	198.6	30.2	17.5	10.5	21.8	2230	14.4	10.3	38570	240
0.00010433137	198.6	30.2	17.5	10.5	21.8	2230	13.75	8	38570	48
0.00010821119	198.6	30.2	17.5	10.5	21.8	2230	12.55	11.29	38570	120
0.00005254285	198.6	30.2	17.5	10.5	21.8	2230	8.57	8.85	38570	192
0.00003451891	198.6	30.2	17.5	10.5	21.8	2230	7.36	9.97	38570	72
0.00029997463	198.6	30.2	17.5	10.5	21.8	2230	15.92	9.84	38570	96
0.00001150851	198.6	30.2	17.5	10.5	21.8	2230	3.46	9.3	38570	33
0.00005570936	199.3	32.2	16.6	11.3	21	2312	10.13	7	29147	96
0.00004922605	199.3	32.2	16.6	11.3	21	2312	8.6	7.54	29147	144
0.00011977280	199.9	29.8	16.5	8.8	22	2452	17.53	9.2	26565	17

0.00005801546	199.9	29.8	16.5	8.8	22	2452	13.67	9.58	26565	48
0.00002727982	199.9	29.8	16.5	8.8	22	2452	6.85	9.5	26565	15
0.00003414124	199.9	29.8	16.5	8.8	22	2452	9.23	9.65	26565	72
0.00011173373	199.9	29.8	16.5	8.8	22	2452	15.78	10.5	26565	48
0.00007273099	199.9	29.8	16.5	11.6	21.5	2462	13.17	10.98	28067	72
0.00005226691	199.9	29.8	16.5	11.6	21.5	2462	10.4	10.45	28067	48
0.00005621921	199.9	29.8	16.5	11.6	21.5	2462	12.2	10.18	28067	72
0.00008688626	199.9	29.8	16.5	11.6	21.5	2462	12.92	11	28067	360
0.00005521910	199.9	29.8	16.5	11.6	21.5	2462	11.57	9.5	28067	264
0.00008805926	200	32.2	16.6	11.2	21	2529	13.93	7.44	29147	168
0.00008741605	200	32.2	16.6	11.2	21	2529	12.9	7.9	29147	72
0.00012140334	200	32.2	16.6	11.2	21	2529	17.31	8.5	29147	48
0.00014598710	200	32.2	16.6	11.2	21	2529	17.97	9.55	29147	27
0.00000173148	200	32.2	16.6	11.2	21	2529	1.37	11.1	29147	216
0.00000754611	200	32.2	16.6	8.9	21	2529	4.09	8.69	29147	120
0.00008424317	200	32.2	16.6	8.9	21	2529	13.84	9.49	29147	72
0.00008880046	200	32.2	16.6	8.9	21	2529	13.02	10.69	29147	96
0.00005223075	207.4	29.8	16.4	11.4	21.5	2470	11.06	9.5	26565	72
0.00006048295	207.4	29.8	16.4	11.4	21.5	2470	12.29	9.71	26565	216
0.00005337423	207.4	29.8	16.4	11.4	21.5	2470	11.3	9.68	26565	17
0.00007003385	207.4	29.8	16.4	11.4	22.9	2478	11.92	8.55	28912	264
0.00003712207	207.4	29.8	16.4	11.4	22.9	2478	10.19	8.83	28912	48
0.00002514075	207.4	29.8	16.4	11.4	22.9	2478	8.4	10.9	28912	17
0.00005268213	207.4	29.8	16.4	11.4	22.9	2478	11.67	11.04	28912	216
0.00010969615	208.9	29.8	16.4	11.6	22	2546	15.83	7.91	28818	13
0.00008753240	208.9	29.8	16.4	11.6	22	2546	14.03	8.7	28818	4

0.00009005213	208.9	29.8	16.4	11.6	22	2546	15.13	9.2	28818	312
0.00001861626	210.5	29.8	16.4	10.1	21.5	2478	6.05	7.6	29194	48
0.00008388923	210.5	29.8	16.4	10.1	21.5	2478	14.31	7.69	29194	48
0.00005373601	210.5	29.8	16.4	10.1	21.5	2478	11.35	9.25	29194	288
0.00000622632	210.5	29.8	16.4	10.1	21.5	2478	3.73	8	29194	48
0.00003636353	210.5	29.8	16.4	10.1	21.5	2478	11.1	8	29194	72
0.00004398695	210.5	29.8	16.4	10.1	21.5	2478	9.47	9.4	29194	7
0.00006668789	210.5	29.8	16.4	10.1	21.5	2478	12.14	10.7	29194	31
0.00009816775	210.5	29.8	16.4	10.1	21.5	2478	15.27	11.4	29194	72
0.00002519853	210.5	29.8	16.4	10.1	21.5	2478	7.66	11.3	29194	27
0.00005244287	210.5	29.8	16.4	10.1	21.5	2478	10.8	9.64	29194	13
0.00004246636	211.9	29.8	16.7	10.1	22	2578	11.34	8	28912	48
0.00002742706	211.9	29.8	16.7	10.1	22	2578	7.99	9.92	28912	72
0.00008085230	211.9	29.8	16.7	10.1	22	2578	13.87	9.4	28912	72
0.00009993765	211.9	29.8	16.7	10.1	22	2578	15.83	8.3	28912	27
0.00003044492	211.9	29.8	16.7	10.1	22	2578	8.93	7.54	28912	360
0.00007287045	222.5	32.2	19.3	10.8	22.1	3398	13.31	9	38728	10
0.00007996565	222.5	32.2	19.3	10.8	22.1	3398	14.06	9.4	38728	30
0.00011006544	222.5	32.2	19.3	10.8	22.1	3398	16.84	11.18	38728	336
0.00005344256	225.3	29.8	16.4	11.4	22.5	2798	7.45	9.77	29194	5
0.00011671158	225.3	29.8	16.4	11.4	22.5	2798	17.39	9.09	29194	72
0.00004677112	225.3	29.8	16.4	11.4	22.5	2798	11.47	9.1	29194	9
0.00005869283	225.3	29.8	16.4	11.4	22.5	2798	13.13	9.57	29194	12
0.00008433163	225.3	29.8	16.4	11.4	22.5	2798	15.84	10.3	29194	23
0.00000612259	228.6	32.2	18.6	12.2	23.3	3476	4.46	9.66	38728	72
0.00005892859	228.6	32.2	18.6	12.2	23.3	3476	13.36	8.9	38728	16

0.00004514646	228.6	32.2	18.6	12.2	23.3	3476	11.68	9.49	38728	36
0.00002315646	228.6	32.2	18.6	12.2	23.3	3476	7.33	8.8	38728	72
0.00005396343	228.6	32.2	18.6	12.2	23.3	3476	12.45	8.29	38728	48
0.00023146406	230.9	32.2	18.8	12	23.4	3534	10.82	8.88	42805	48
0.00003872524	230.9	32.2	18.8	12	23.4	3534	9.76	11.2	42805	31
0.00003221026	230.9	32.2	18.8	12	23.4	3534	8.36	9.84	42805	72
0.00003320443	230.9	32.2	18.8	12	23.4	3534	12.18	11.1	42805	24
0.00003823889	232	32.2	16.6	10.8	23.5	3460	11.45	8.9	38728	48
0.00006412238	232	32.2	16.6	10.8	23.5	3460	15.1	9.8	38728	96
0.00006511518	232	32.2	16.6	10.8	23.5	3460	14.69	10.79	38728	432
0.00001977668	232	32.2	16.6	10.8	23.5	3460	7.56	10.37	38728	48
0.00004371875	232	32.2	16.6	10.8	23.5	3460	12.01	9.7	38728	120
0.00001364905	246.8	32.2	19.3	12.3	23.4	3586	5.59	11.67	43569	6
0.00010919227	246.8	32.2	19.3	12.3	23.4	3586	17.43	9.9	43569	72
0.00010520981	246.8	32.2	19.3	12.3	23.4	3586	17	12.1	43569	96
0.00010456050	246.8	32.2	19.3	12.3	23.4	3586	17.48	10.05	43569	23
0.00003954837	249.1	37.4	22.1	12.5	21.5	4496	11.29	11	36288	48
0.00003509211	249.1	37.4	22.1	12.5	21.5	4496	10.13	10.07	36288	96
0.00004604824	255	37.3	22	12	21	5400	12.62	11.95	33096	72
0.00002021905	255	37.3	22	12	21	5400	8.8	11.4	33096	16
0.00004458439	255	37.3	22	12	21	5400	11.9	10.7	33096	48
0.00007006041	255	37.3	22	12	21	5400	16	11.3	33096	34
0.00004448309	255	37.3	22	12	21	5400	13.95	12.8	33096	312
0.00002257988	255	37.3	22	12	21	5400	9.59	11.15	33096	15
0.00006133093	255	37.3	22	12	21	5400	15.89	10.39	33096	28
0.00006461430	255	37.3	22	12	21	5400	16.17	11.8	33096	32

0.00004457390	255	37.3	22	12	21	5400	13.72	11.91	33096	48
0.00005947901	255	37.3	22	12	21	5400	15.65	13.31	33096	408
0.00005713868	255	37.3	22	12	21	5400	16.64	13.39	33096	48
0.00003562001	255	37.3	22	12	21	5400	10.89	12.23	33096	48
0.00005366826	255	37.3	22	12	21	5400	13.39	12.03	33096	120
0.00002392256	255.1	37.3	19.6	11	21.5	4770	9.33	11.4	36288	168
0.00003600587	255.1	37.3	19.6	11	21.5	4770	11.25	9.89	36288	168
0.00002024691	255.1	37.3	19.6	11	21.5	4770	8.41	10.76	36288	96
0.00006958953	255.1	37.3	19.6	11	21.5	4770	15.86	11.59	36288	312
0.00003727075	255.1	37.3	19.6	11	21.5	4770	11.24	9.23	36288	144
0.00001741404	255.1	37.3	19.6	11	21.5	4770	7.73	11.3	36288	8
0.00001711077	255.1	37.3	19.6	11	21.5	4770	7.6	11.3	36288	8
0.00001335022	260.3	32.2	19.2	12.6	24	4300	6.43	8.6	49027	144
0.00008137408	260.3	32.2	19.2	12.6	24	4300	14.78	8.9	49027	36
0.00007903333	260.3	32.2	19.2	12.6	24	4300	15.9	11.7	49027	120
0.00003688924	260.3	32.2	19.2	12.6	24	4300	10.92	11.21	49027	20
0.00008591081	260.3	32.2	19.2	12.6	24	4300	16.76	10.07	49027	36
0.00003380026	260.3	32.2	19.2	12.6	24	4380	9.38	9.37	49027	26
0.00003999530	260.3	32.2	19.2	12.6	24	4380	11.12	9.68	49027	48
0.00007361705	260.3	32.2	19.2	12.6	24	4380	11.99	9.88	49027	72
0.00006396784	260.3	32.2	19.2	12.6	24	4380	14.95	9.64	49027	312
0.00002082538	260.3	32.2	19.2	11	24	4387	8.38	7.32	49027	72
0.00002153358	260.3	32.2	19.2	11	24	4387	8.21	7.5	49027	120
0.00010988586	260.3	32.2	19.2	11	24	4387	19.23	9.9	49027	19
0.00004728108	260.3	32.2	19.2	11	24	4387	12.53	12.61	49027	312
0.00000201395	260.3	32.2	19.2	11	24	4387	2.49	9.26	49027	23

0.00006954161	262	32.2	19.5	12.5	24.1	4255	14.86	10.88	48491	34
0.00001468956	262	32.2	19.5	12.5	24.1	4255	6.79	9.3	48491	35
0.00005937297	262	32.2	19.5	12.5	24.1	4255	13.32	9.6	48491	48
0.00009114221	262	32.2	19.5	12.5	24.1	4255	12.59	9.88	48491	72
0.00006555651	262	32.2	19.5	12.5	24.1	4255	15.09	9.9	48491	312
0.00006515945	264.2	32.2	19.5	12.8	23	4294	13.19	11.14	49027	72
0.00005264552	264.2	32.2	19.5	12.8	23	4294	10.85	11.56	49027	48
0.00005387799	264.2	32.2	19.5	12.8	23	4294	11.18	10.55	49027	72
0.00006882805	264.2	32.2	19.5	12.8	23	4294	13.17	1.13	49027	168
0.00000959700	264.2	32.2	19.5	12.8	23	4294	3.51	11.89	49027	22
0.00002117804	270	42.8	24.8	14.5	22.5	6900	8.84	10.5	45152	48
0.00004452090	270	42.8	24.8	14.5	22.5	6900	14.64	10.79	45152	18
0.00005219700	270	42.8	24.8	14.5	22.5	6900	15.26	11.76	45152	264
0.00005674145	274.8	40	24.2	14	26	5551	12.65	11.4	73622	48
0.00008848270	274.8	40	24.2	14	26	5551	17.84	11.2	73622	144
0.00005013961	274.8	40	24.2	14	26	5551	13.4	10.4	73622	336
0.00004665443	274.8	40	24.2	14	26	5551	13.04	10.13	73622	48
0.00001495006	274.8	40	24.2	14	26	5551	6.3	11.7	73622	72
0.00003734816	277	40	24.3	14	24.9	5762	9.25	9.7	73541	3
0.00004374195	277	40	24.3	14	24.9	5762	12.17	9.7	73541	29
0.00005098323	277	40	24.3	14	24.9	5762	13.05	11.1	73541	72
0.00008198303	277	40	24.3	14	24.9	5762	16.28	11.4	73541	408
0.00004513786	277	40	24.3	14	24.9	5762	12.84	9.8	73541	144
0.00008859127	294.1	32.2	21.6	13.5	23.7	5089	17.2	10.9	55156	33
0.00006669519	294.1	32.2	21.6	13.5	23.7	5089	14.09	11.48	55156	48
0.00006203238	294.1	32.2	21.6	13.5	23.7	5089	14.7	11.2	55156	336

0.00008060143	294.1	32.2	21.6	13.5	23.7	5089	16.88	10.9	55156	240
0.00005421101	294.1	32.2	21.6	13.5	23.7	5089	12.97	10.79	55156	72
0.00000304404	294.1	32.2	21.6	13.5	23.7	5089	2.75	12.62	55424	34
0.00004062028	294.1	32.2	21.6	13.5	23.7	5089	10.82	11.25	55424	168
0.00003270070	294.1	32.2	21.6	13.5	23.7	5089	9.6	12.55	55424	192
0.00003775530	294.1	32.2	21.6	13.5	24.3	5085	11.3	9.7	55424	120
0.00002074169	294.1	32.2	21.6	13.5	24.3	5085	7.17	9.37	55424	48
0.00000162663	294.1	32.2	21.6	13.5	24.3	5085	2.14	7.6	55424	168
0.00004555409	294.1	32.2	21.6	13.5	24.3	5085	12.85	10.1	55424	456
0.00004159686	294.1	32.2	21.6	13.5	24.3	5085	12.23	9.6	55424	312
0.00009165058	299.5	40	24.6	12	25	6188	17.53	14.2	73622	120
0.00000252492	299.5	40	24.6	12	25	6188	2.06	11.99	73622	120
0.00011045278	299.5	40	24.6	12	25	6188	19.1	14.2	73622	120
0.00006856825	299.5	40	24.6	12	25	6188	17.08	13.42	73622	48
0.00006437689	299.5	40	24.6	12	25	6188	13.68	12.46	73622	72
0.00004170813	299.5	40	24.6	12	25	6188	12.37	13.49	73622	264
0.00002890263	299.5	40	24.6	12	25	6188	10.09	10.83	73622	33
0.00005683894	299.5	40	24.6	12	25	6188	12.94	14.11	73622	72
0.00008605769	299.5	40	24.6	12	25	6188	16.53	14.5	73622	96
0.00007692631	299.5	40	24.6	12	25	6188	16.53	14.5	73622	120
0.00007497029	299.5	40	24.6	12	25	6188	16.38	14.4	73622	240
0.00010868195	299.5	40	24.6	12	25	6188	19.69	12.8	73622	168
0.00008994645	299.5	40	24.6	12	25	6188	18.33	9.83	73622	72
0.00003160865	299.5	40	24.6	12	25	6188	11.63	11.7	73622	48
0.00001804004	299.5	40	24.6	12	25	6188	7.62	10.59	73622	20
0.00003361471	299.9	45.2	24.2	12.5	22.5	8850	9.12	12.06	61391	168

0.00007447445	299.9	45.2	24.2	12.5	22.5	8850	17.28	13.2	61391	96
0.00004668848	300.1	42.8	24.6	13	24.3	7455	12.22	14	91886	23
0.00001143074	300.1	42.8	24.6	13	24.3	7455	6.2	13.03	91886	72
0.00008007634	300.1	42.8	24.6	13	24.3	7455	16.17	12.2	91886	32
0.00006279839	333.6	43.3	24.5	14	24.5	8814	17.2	12.1	76572	96
0.00002404308	333.6	43.3	24.5	14	24.5	8814	10.79	10.4	76572	120
0.00003827905	333.6	43.3	24.5	14	24.5	8814	13.18	10.4	76572	288
0.00006213245	333.6	43.3	24.5	14	24.5	8814	16.37	10.4	76572	27
0.00002070992	333.6	43.3	24.5	14	24.5	8814	9.46	10.4	76572	15
0.00004376807	334.1	42.8	24.8	13	25.6	9662	13.1	13.81	92047	48
0.00004392006	334.1	42.8	24.8	13	25.6	9662	12.55	13.7	92047	48
0.00000047929	334.1	42.8	24.8	13	25.6	9662	2.15	13.57	92047	25
0.00005160554	334.1	42.8	24.8	13	25.6	9662	14.14	13.5	92047	72
0.00001536516	334.1	42.8	24.8	13	25.6	9662	7.03	14	92047	9
0.00006609438	335.5	42.8	24.4	14	24.5	8478	16.44	12.4	82982	288
0.00003342821	335.5	42.8	24.4	14	24.5	8478	9.08	11.78	82982	96
0.00004622317	335.5	42.8	24.4	14	24.5	8478	10.56	11.27	82982	20
0.00006964968	335.5	42.8	24.4	14	24.5	8478	16.47	11.5	82982	48
0.00005138502	335.5	42.8	24.4	14	24.5	8478	14.34	13.84	82982	12
0.00009935879	347	42.8	24.1	12.2	24.6	7226	18.62	13.75	85714	552
0.00005343799	347	42.8	24.1	12.2	24.6	7226	10.64	13.79	85714	72
0.00005560335	347	42.8	24.1	12.2	24.6	7226	13.66	11.56	85714	25
0.00005732258	347	42.8	24.1	12.2	24.6	7226	13.82	11.5	85714	13
0.00002843441	347	42.8	24.1	12.2	24.6	7226	10	11.9	85714	48
0.00001455056	352.2	42.8	24.1	12.2	24.6	7226	6.96	11.9	85714	14
0.00002460402	352.2	42.8	24.1	12.2	24.6	7226	9.39	12.78	85714	48

0.00002197418	352.2	42.8	24.1	12.2	24.6	7226	8.63	12.24	85714	15
0.00004878443	352.2	42.8	24.1	12.2	24.6	7226	13.27	13.19	85714	48
0.00010742129	352.2	42.8	24.1	12.2	24.6	7226	19.05	12.99	85714	552
0.00006464313	367.3	42.8	24.1	12.2	25	9930	17.5	14.37	92047	216
0.00009747938	367.3	42.8	24.1	12.2	25	9930	20.14	14.37	92047	48
0.00002178091	367.3	42.8	24.1	12.2	25	9930	8.78	13.6	92047	72
0.00002903494	367.3	42.8	24.1	12.2	25	9930	10.32	13.11	92047	48
0.00003598713	367.3	42.8	24.1	12.2	25	9930	12.73	14.39	92047	120
0.00004964421	397.6	55.9	24.1	14	25.5	13460	16.72	16.14	108354	240
0.00003253848	397.6	55.9	24.1	14	25.5	13460	13.38	15.21	108354	96
0.00005553257	397.6	55.9	24.1	14	25.5	13460	17.13	14.15	108354	16
0.00001301744	397.6	55.9	24.1	14	25.5	13460	8.32	13.3	108354	24
0.00002792527	397.6	55.9	24.1	14	25.5	13460	12.35	10.58	108354	34
0.00009189891	399	58.6	33.2	15	21	20568	20.21	16.29	125036	72
0.00007170881	399	58.6	33.2	15	21	20568	17.38	15	125036	48
0.00000449045	399	58.6	33.2	15	21	20568	3.65	13.13	125036	48
0.00003835846	399	58.6	33.2	15	21	20568	12.22	13.73	125036	48
0.00003403821	399	58.6	33.2	15	21	20568	11.49	14.15	125036	72

Step 2: Generating the multiple linear regression equation

```
%PERSIAPAN WORKSPACE
close all;
clc;
clear all;

%LOAD TRAINING DATA
training_data = csvread("Book4.csv")(2:end, :);
y_training = training_data(:, 1);
x_training = training_data(:, 2:end);
n = length(training_data);

%MENYIAPKAN DATA X
x1_training = [ones(n,1) x_training];

%NORMAL EQUATION FOR LINEAR REGRESSION
theta = (x1_training.'*x1_training)\(x1_training.'*y_training)

%SSE
sse = 0;
for i = 1:n
  sse = sse + power((y_training(i) - theta.'*x1_training(i, :)'), 2);
end
sse

%LOAD TESTING DATA
x_testing = csvread("Book2.csv")(2:end, :)';

%MENYIAPKAN X TESTING
x1_testing = [ones(size(x_testing, 2),1) ; x_testing];

%MENGHITUNG TESTING DATA
res = theta.'*x1_testing
```

θ	Value
0	0.0003963798
1	0.0000005049
2	0.0000036758
3	-0.0000011131
4	-0.0000038011
5	-0.0000283217
6	-0.0000000284
7	0.0000124749
8	-0.0000033527
9	0.0000000028
10	-0.0000000290