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Greedy Approach for Solving Capacitated Vehicle Routing Problem of LNG Distribution to Power Plants

ADE PUTRI AULIA WIJHARNASIR
092116.5001.4036

SUPERVISOR
Prof. Ir. I Nyoman Pujawan, M.Eng, Ph.D
NIP: 196912311994121076

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By:

ADE PUTRI AULIA WIJHARNASIR
NRP. 09211650014036

|	
Thesis Defense on	: 6th November 2018
Graduation on	: March 2019

Approved by,

Supervisor:
Prof. Ir. Nyoman Pujawan, M.Eng, Ph.D.   (............................)
NIP: 196912311994121076

Examiner I:
Dr. Ir. Bustanul Arifin Noer, M.Sc.   (............................)
NIP: 195904301989031001
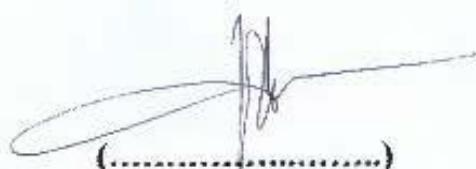
Examiner II:
Prof. Dr. Drs. Mohammad Isa Irawan, M.T.   (............................)
NIP: 196312251989031001
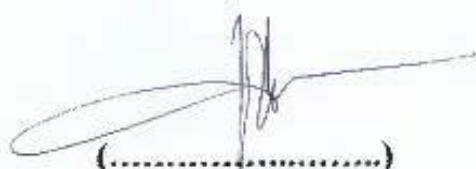
Dean of Faculty of Business and Technology Management,

Prof. Dr. Ir. Udisubakti Ciptomulyono, M.Eng.Sc
NIP. 19590318 198701 1 001

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GREEDY APPROACH FOR SOLVING CAPACITATED VEHICLE ROUTING PROBLEM OF LNG DISTRIBUTION TO POWER PLANTS

Name of Student   : Ade Putri Aulia Wijharnasir

ID Number   : 0911650014036

Name of Supervisor : Prof. Ir. Nyoman Pujawan, M.Eng, Ph.D.

ABSTRACT

Nowadays, LNG industry in Indonesia grows rapidly. It is related to the increasing of electricity demand in Indonesia, in particular, Papua. Since LNG is utilized as fuel of gas turbine power plants. LNG is transported from depot to destinations in order to accomplish the demands at each destination. Furthermore, deciding the number of ships and their routes for transporting LNG to every demand location efficiently is a crucial part to reduce the total operational cost in LNG industries. Hence, the consideration of LNG transportation becomes necessary. The consideration for deciding the number of ships and their routes is not only related to transportation cost but also inventory cost. In addition, the government plan to build some gas turbine power plants in Papua leads to availability of thirteen regasification terminals at there. In response to this problem, this research provided a case study in Papua and proposed a model to determine the number of ships and the optimum ship route to transport LNG from an LNG production terminal to thirteen regasification terminals by considering both transportation cost and inventory cost. The problem in this research is finding and assigning appropriate route and ship, so the demands can be fulfilled. Moreover, distance, power plants demands, transportation cost, and inventory cost were further analyzed by using the greedy approach in order to determine the optimum route for this case. In addition, the ship sizes were limited to four alternatives, which were 2500 m^3, 7500 m^3, 10000 m^3, and 23000 m^3. Thus, this problem considered as a capacitated vehicle routing problem. The result recommended the utilization of smaller size vessels with more frequent shipments compared to the earlier research on the same case study. There are seven ships assigned to some particular routes. They are one ship with capacity 2500 m^3, four ships with capacity 7500 m^3, and two ships with capacity 23000 m^3. Each ship is assigned for particular route. Moreover, the result was proven to perform better under uncertain weather in Papua since the ship draft of the smaller vessel will be more adaptable for changing water depth due to changing tides at particular ports.

Keyword: Capacitated vehicle routing problem, greedy approach, LNG, maritime supply chain.

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"Greedy Approach for Solving Capacitated Vehicle Routing Problem on LNG Distribution to Power Plants"

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I become conscious that this research still needs to be improved. I hope the readers will find this thesis helpful. Please do not hesitate to contact me if there are any comments or questions to be discussed.

Surabaya, August 2018
Ade Putri Aulia Wijharnasir

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NOMENCLATURE

Sets

C   set of ship capacity as constraints

R   set of nodes which defined as routes

R_s set of feasible pair of nodes taken from saving matrix step

G   start nodes consist of LNG production terminal and receiving terminals where $g \cup \{i, j, k, l \dots\}$

h   end nodes consist of LNG receiving terminals where $h \cup \{i, j, k, l \dots\}$

$g \neq h$

$C_{1 \leq n \leq 4} = \{2500, 7500, 10000, 23000\}$

Parameters

d_h demands at receiving terminals

D   total demands of a set of LNG receiving terminals

F_{gh} the total flow of cores from *g* (start nodes) to *h* (end nodes)

m   LNG selling price

n   code number of route

P   net revenue from the project

r   feasible route

v   ship velocity

TRV_{gh} turn round voyage (round trip) from *g* (start nodes) to *h* (end nodes)

Δ_{gh} the distance between *g* (start nodes) to *h* (end nodes)

Variables

A   LNG capacity in each vehicle if LNG is distributed between nodes

I_{gh} inventory cost in *h* if LNG is distributed from *g* (start nodes) to *h* (end nodes)

S   revenue

T_{gh} transportation cost for a round trip to distribute LNG from *g* (start nodes) to *h* (end nodes)

$$x_{gh} = \begin{cases} 1, \text{ if the vehicle moves from } g \text{ to } h \\ 0, \text{ if the vehicle does not move from } g \text{ to } h \end{cases}$$

$$\delta_{gh} = \begin{cases} 1, \text{ if } TRV \leq 8 \\ 0, \text{ if } TRV > 8 \end{cases}$$

$Z_{\delta gh}$ every x_{gh} with $\delta_{gh} = 1$

$C_n \leq A \leq C_{n+1}$

CHAPTER I
INTRODUCTION

This section presented a background study why this research need to be conducted. Some priorly studies related to oil and gas supply chain has been elaborated to support this research. Therefore, the study was concluded with data, which were related to transportation problems in LNG industry in Indonesia. Hence, the background study is delivered as follows.

1.1 Background Study

Indonesia is the 14th country which has the largest natural gas reserves in the world. Indonesia's natural gas reserves were 1.6% of total natural gas reserves in the world in 2012. According to the Report of Ministry of Energy and Mineral Resources in 2012, Indonesia has natural gas reserves about 150 Trillion Standard Cubic Feet (TCF). It is divided into proved reserves in the amount of 101.57 TCF and potential reserves are 48.85 TCF (Ministry of Energy and Mineral Resources, 2012).

Meanwhile, Indonesia government has been planning to develop many aspects, including escalates infrastructure development, especially the power plants recently. This development was expected to improve welfare in Indonesia, in particular, some remote regions (Lubada, 2016). On the other hand, the result of research by BPPT Energy Team showed that the average value of energy demands in Indonesia is about 6.5% every year. The similar result was shown by Ministry of Energy and Mineral Resources, that the increasing of electricity national demand reaches 7.5% every year. Align with both of them, PT. PLN (Persero) through Electricity Supply Business Plan (RUPTL) for 2016-2025, showed that the growth of electricity sale was 8.1% in 2015 (PLN, 2016).

Based on, Table 1.1, there were electricity demand in Indonesia. The highest growth was located in Maluku, Papua, and Nusa Tenggara, with average value was 12.9%. Then Sulawesi's is 11%, Kalimantan's 10.7%, Sumatera's 9.4%, and Jawa-Bali's is 7.5%. It was known that Papua was predicted to be a region with the

highest demand in the future. Additionally, there was another data which represented a prediction of electricity demand in Papua until 2025. The data was shown in Table 1.2. The prediction represents consumer growth may increase become 9.4%. Then based on the data, PT. PLN has been developing 26 gas turbine power plant in Papua. This project aims to fulfill one of Indonesian government's work plan, namely PAPUA TERANG. This is a program to enhance electricity distribution for many places in Papua.

Table 1.1 Electricity Sales from PLN (TWh)

Region	2009	2010	2011	2012	2013	2014	2015*)	Average 2010-2014
Indonesia	133.1	145.7	156.3	172.2	185.5	196.4	200.4	8.1
Growth (%)	4.3	9.5	7.3	10.2	7.7	5.9	2.0	
Jawa-Bali	104.1	113.4	120.8	132.1	142.1	149.4	150.5	7.5
Growth (%)	3.3	8.9	6.5	9.4	7.6	5.1	0.7	
Sumatera	17.6	19.7	21.5	24.2	25.7	27.6	29.3	9.4
Growth (%)	7.2	11.9	9.1	12.6	6.2	7.4	6.2	
Kalimantan	4.7	5.1	5.7	6.4	7	7.7	8.3	10.4
Growth (%)	9.7	8.5	11.8	12.3	9.4	10.0	7.8	
Sulawesi	4.6	5.1	5.6	6.4	7.3	7.7	8.1	10.9
Growth (%)	8.8	10.9	9.8	14.3	14.1	5.5	5.2	
Maluku, Papua & Nusa Tenggara	2.2	2.4	2.7	3.1	3.5	3.9	4.2	12.1
Growth (%)	9.7	9.1	12.5	14.8	12.9	11.4	7.7	

(Source: Electric Supply Business Plan by PLN for 2016-2025)

Table 1.2 Prediction of Electricity Demand in Papua

Year	Economic Growth (%)	Sales (GWh)	Production (GWh)	Peak Load (MW)	Consumer
2016	7.07	839	941	140	409,163
2017	7.61	948	1,063	158	459,950
2018	8.04	1,044	1,171	174	512,407
2019	8.57	1,147	1,286	190	566,598
2020	6.86	1,257	1,410	208	621,931
2021	6.86	1,369	1,534	226	678,404
2022	6.86	1,493	1,673	246	736,227
2023	6.86	1,614	1,809	266	795,354
2024	6.86	1,739	1,949	286	855,763
2025	6.86	1,875	2,101	308	917,403
Growth (%)	7.24	9.40%	9.30%	9.20%	9.40%

(Source: Electric Supply Business Plan by PLN for 2016-2025)

PLN proposed natural gas as the main fuel for gas turbine power plants. This decision related to Ministry of Energy and Mineral Resources Regulation No. 37,

2015 which declared term and conditions of allocation determination, utilization, and natural gas price in Indonesia. Based on this regulation, PLN and SKK Migas made an agreement that stated 40% allocation of LNG production from Train III Tangguh LNG production terminal should be consumed for domestic demands.

LNG is one of the mineral resources which starts to replace crude oil in Indonesia since its reserves start to decrease gradually nowadays. LNG is natural gas that is cooled down until -170° C in 1 atm pressure until changed its phase to liquid. The natural gas had purified to eliminate residual matters such as CO_2, water, sulfur, and mercury before it cooled down to the certain temperature. LNG contains 70-90% methane, 0-20% propane and butane, and other compounds such as CO_2, N_2, and HS as the rest (Soegiono and Artana, 2006).

The distribution will be easier by changing natural gas into LNG. Due to the volumetric efficiency which will rise up to 600 times. In other words, 1 m^3 LNG as equal as 600 m^3 natural gas (Soegiono and Artana, 2006). LNG was carried by LNG carrier which varies in size, then LNG will be regasifying in receiving terminal which well known as regasification terminal. This distribution is well known as LNG supply chain.

LNG supply chain defined as a networked organization in the natural gas industry which started by the distribution of natural gas from the natural gas field to liquefaction plant in order to eliminate residual matters and convert it into LNG, then LNG is stored in the storage tank and was distributed to market by LNG carrier (Antara, 2016). In this case study, the market is a power plant. Nevertheless, a power plant consumes it as gas instead of as LNG, thus LNG has to be regasifief in regasification terminal. It is described well in Figure 1.1 as follows:
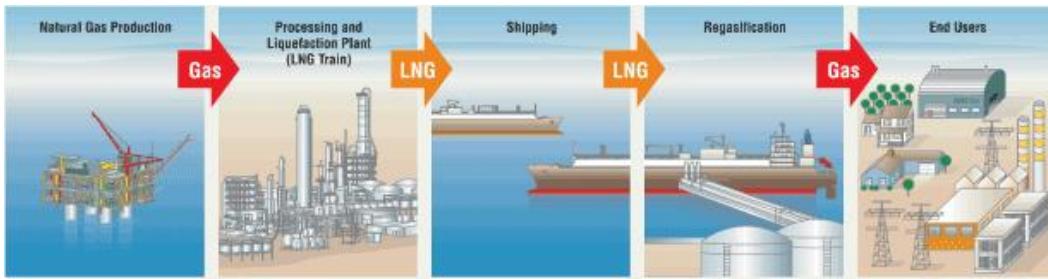
Figure 1.1 LNG Supply Chain
(Source: https://www.sec.gov)

The latest research by Antara (2016), had selected LNG carrier (ship) as the transportation mode to distribute LNG from Tangguh LNG production terminal to some power plants in Papua. The number of LNG carrier, ship capacity, and route of LNG distribution had been determined in that research also. Referring to Antara (2016), LNG would be distributed to all power plants in Papua by considering the minimum transportation cost. On the other hand, this research was considered both transportation cost and inventory cost to propose the model. In addition, the latest data of power plants demand were further analyzed by using a greedy approach to determine the optimum route and numbers of vessels in this research.

The proposed model in this research was a modification from earlier research by Antara (2016) by adapting model proposed by Kır (2017). Nevertheless, the model was adjusted to conform the problem in this case study. The proposed model was expected not only to become more reliable but also easier to be utilized by the user. Furthermore, since this case study was considered as a developing project in Indonesia, this model was proposed to be adaptable to new data either for this case study or for other similar case studies in Indonesia.

1.2 Problem Statements

Based on the background that has been written before, the focus of the problems used as the source for this research are:

1. How many adequate numbers of LNG carriers, if updated data will be used and inventory cost will be considered in this case study?
2. What is the adequate LNG carrier size for this case study, if updated data will be used and inventory cost will be considered in this case study?

3. What is the optimum route of LNG distribution in Papua, if updated data will be used and inventory cost will be considered in this case study?

1.3 Purpose

The aim to be achieved in this study is to optimize the LNG distribution model by referring to the problems described previously.

1. Determine the optimum route of LNG distribution by utilizing adequate LNG carriers to power plants in Papua, if updated data will be used and inventory cost will be considered in this case study.

1.4 Adventages

The benefits obtained from this study based on the objectives of the problems faced are as follows:

1. The model in this research could be utilized to represent other LNG supply chain studies in Indonesia, regarding similar geographical condition.
2. Minimizing both capital and operational cost in LNG distribution to power plants in order to attempt more attractiveness.

1.5 Limitations

The scope of research is needed to limit several aspects so that the process of conducting this research does not come out of its objectives, while the limitations are:

1. LNG Terminal at Tangguh will be assumed that its port can be operated for 2500 m^3, 7500 m^3, $10000 \text{ m}^{3,}$ 23000 m^3 LNG carrier size.
2. Inventory level at regasification terminal during a planning horizon will be assumed unknown and neglected in this model.
3. Transportation cost will be assumed in the same amount for 20 years in this case study.
4. It will be assumed that there is no depreciation for the value of assets during the economic study.
5. The production rate in refineries will be assumed has the same amount for a whole time horizon, thus it will not be considered in the mathematical model.

1.6 Writing Systematics

In the systematics of writing research dividing to five chapters are arranged sequentially as follows:

CHAPTER I INTRODUCTION

This chapter explains the preliminary research which consists of the background of doing research, the formulation of the problem to reveal the problems in the object under study, the objectives to be achieved from the research, the benefits obtained from the research, and the systematic writing of the thesis.

CHAPTER II LITERATURE STUDY

This chapter contains a literature review which describes the theory or grounding found through literature studies from various literatures relating to research problems, including covering theories, concepts, and opinions expressed by experts or prior research about the object to be studied, internal problems distribution process, methods for finding solutions to distribution problems, and the foundation of economic assessment that will be offered to the company. The literature review will then be used on the basis of discussion and problem solving related to research problems.

CHAPTER III RESEARCH METHODOLOGY

This chapter explains how research is conducted, including consisting of research approaches, research flow diagrams, problem identification stages, data collection procedures, and technical data analysis and processing, and drawing conclusions.

CHAPTER IV RESULT AND DISCUSSION

This chapter is the core chapter of the study which outlines the results of data processing that have been carried out, these results will be described including the research writing process starting from data collection and processing, and decision making.

CHAPTER V CONCLUSION AND SUGGESTION

This chapter contains a summary of the results of analysis and data processing that has been done and suggestions for the development of subsequent research.

CHAPTER II
LITERATURE STUDY

Regarding the last section, the problems were concluded into three statements. The problems were related to LNG supply chain, particularly, transportation problem in Papua, Indonesia. Therefore, the literature study was briefly discussed about some information taken from article, journal, book, official website, and so on, related to LNG supply chain, power plants in Papua, vehicle routing problem, and economical assessment.

2.1 Liquified Natural Gas (LNG)

LNG is a method to distribute natural gas by changing natural gas from gas to liquid, thus it can be distributed efficiently. According to the very extremely low temperature, LNG is a cryogenic fluid, which means it can damage living tissue and also hazardous in process. Consequently, LNG must be processed by using special fluid machinery, including during distribution. LNG has an extremely cool temperature, thus material of fluid machinery should be specially treated before being used during the distribution process to avoid damage (Wijharnasir, 2015). The figure 2.1 shows how icing happened in LNG pipeline due to extremely cool temperature.
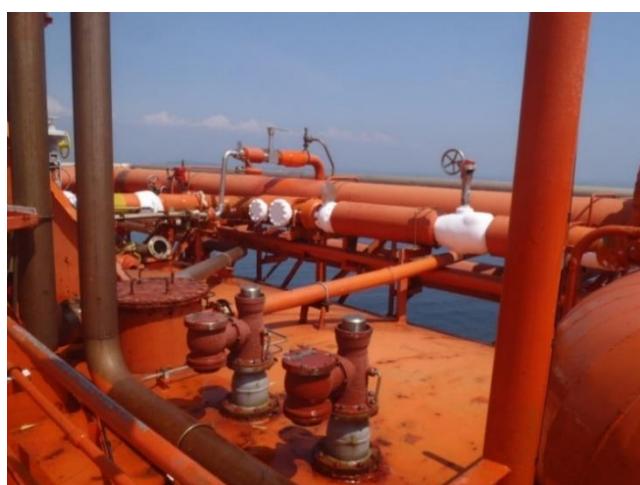
Figure 2.1 Icing in LNG Pipeline
(Source: Personal Documentation at FSRU Jawa Barat, Nusantara Regas)

2.2 LNG Supply Chain in Papua

A supply chain is a networked organization wherein a number of various enterprises such as suppliers, manufacturers, distributors, and retailers collaborate along the entire value chain to acquire raw materials, convert these raw materials into specified final products, and deliver these final products to customers (Ivanodv and Dmitry, 2009). LNG supply chain means a network or chain to distribute LNG from a production terminal or more to end user. In this case which is a downstream gas industry, the represented by power plants.

LNG is distributed by LNG carrier which is a kind of tanker vessel. Nevertheless, it was designed exclusively for LNG. Furthermore, LNG carrier becomes one of the solutions to distribute natural gas in an archipelago country, for instance, Indonesia. In fact, LNG becomes more efficient in investment than a subsea pipeline for more than 1300 nautical miles in distance. Moreover, LNG is truly believed as clean and green energy so it is an appropriate solution for energy consumption in Indonesia (Soegiono and Artana, 2006).

Practically, natural gas consumption in Indonesia has increased in recent times. Since 2010, PT. Indonesia Power and PT. Pertamina have made a subsidiary namely PT. Nusantara Regas. PT. Nusantara Regas operates West Java FSRU to regasify LNG from Bontang production terminal and delivers it to a gas turbine power plant in Jakarta owned by PT. PLN subsidiary, Indonesia Power (Wijharnasir, 2015).
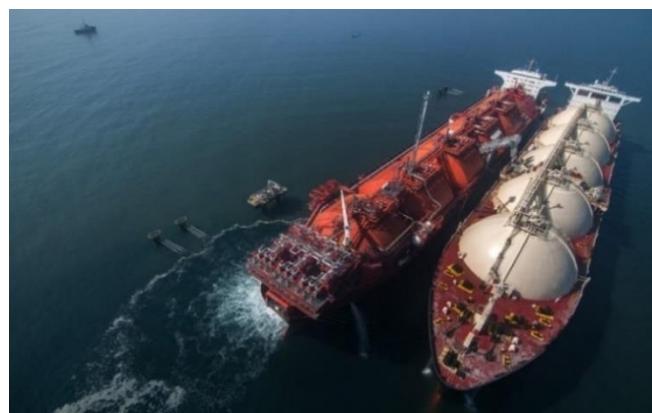
Figure 2.2 FSRU Jawa Barat and LNGC Aquarius

(Source: https://a-z.okeinfo.net/photos/2014/06/22/15174/95456_large.jpg)

Then, there is FSRU Lampung which is operated by PT. PGN since 2014. Recently, in 2016 PT. PLN cooperates with PT. PEL created a floating regasification terminal at Benoa, Bali. The LNG is distributed from Bontang to Bali by small LNG carrier with capacity 23000 m^3. The project in Bali was decided to be a model for other LNG distribution cases in Indonesia hereafter whereas supply and demand separated between some islands (Ramadani, personal communication, 17 November 2017).

Generally, LNG supply chain consists of some main components such as natural gas production, LNG production terminal, LNG carrier, regasification terminal, and end user – in this case study is power plants. However, this case study is particularly focused on LNG carrier as a transportation mode for LNG distribution. Therefore, the main topic in this research is routing problem for LNG distribution to power plants in Papua.

Figure 2.3 Singapore LNG Terminal at Jurong Island in Singapore
(Source: http://gcaptain.com/wp-content/uploads/2014/02/02.jpg)

2.3 Power Plants in Papua

Papua is divided into two provinces, West Papua and Papua. Papua Island has an area 459,411.64 m^2, which are sequentially 319,036.02 m^2 and 140,375.62 m^2. Papua is the largest and also the eastern part of Indonesia, bordered by Papua New Guinea. The government pays more attention to those provinces nowadays, since the development of those two is still lagging behind the other provinces. Papua

geographical conditions become challenges for them to build Papua, including to settle the electricity system in there (Lubad, 2016).

Figure 2.4 Map of Papua Island
(Source: https://assets.irinnews.org)

The electricity system is divided based on the location of provinces. In West Papua, the electricity system is an isolated system which divided into 6 systems of 20 kV and has load over 1 MW. These are Sorong, Fakfak, Manokwari, Kaimana, Teminabuan, and Bintuni system. The data which taken in 2015 represented that West Papua had domestic consumers about 75.87% and reach the peak load until 70.2 MW. It was supplied by some power plants. Otherwise, the electricity consumer ratio is 39.66% in Papua province which was classified as very low (Antara, 2016). Nevertheless, the recent data which was taken from the Electricity Business Plan of PT. PLN on 2017 stated that electricity consumption in Papua island will increase significantly until 2026. Hereby, the following table is a list of the electricity system development plan in Papua until 2026.

Table 2.1 List of Power Plants Development in Papua

No	Project	Type	Capacity (MW)	COD
1	Sorong	PLTG/MG[1]	30	2018
2	Sorong	PLTG/MG	20	2019
3	Sorong III	PLTG/MG/GU[2]	50	2025
4	MPP Fak Fak	PLTG/MG	10	2018
5	Bintuni	PLTMG	10	2018
6	Fak fak	PLTMG	10	2020
7	MPP Manokwari	PLTG/MG	20	2018
8	Manokwari II	PLTMG	20	2019
9	Manokwari III	PLTMG	20	2024
10	Biak	PLTMG	15	2018
11	Biak I	PLTMG	20	2018
12	Biak II	PLTMG	20	2021
13	Biak III	PLTMG	40	2021
14	MPP Nabire	PLTG/MG	20	2018
15	Nabire II	PLTMG	10	2018
16	Nabire II	PLTMG	10	2018
17	Serui I	PLTMG	10	2018
18	Serui II	PLTMG	10	2019
19	Serui III	PLTMG	10	2021
20	MPP Jayapura	PLTG/MG	50	2017
21	Jayapura Peaker	PLTMG	40	2018
22	Jayapura	PLTMG	50	2021
23	Jayapura II	PLTMG	100	2026
24	Jayapura III	PLTMG	100	2025
25	Sarmi	PLTMG	5	2018
26	Kaimana	PLTMG	10	2018
27	Kaimana II	PLTMG	10	2020
28	MPP Timika	PLTG/MG	10	2018
29	Timika II	PLTMG	30	2018
30	Timika II	PLTMG	10	2020
31	Timika IV	PLTMG	20	2022
32	Merauke	PLTMG	20	2018
33	Merauke II	PLTMG	20	2018
34	Merauke III	PLTMG	20	2018
35	MPP Papua	PLTG/MG	10	2018
36	Raja Ampat	PLTMG	10	2018
	Total		**870**	

(Source: Electric Supply Business Plan by PLN for 2017-2026)

2.4 Optimization

Optimization is a process to decide something effectively according to the objective function. Optimization is used to find the minimum or maximum value from a function wherein the problems are represented by some mathematical

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[1] Abbreviation of Pembangkit Listrik Tenaga Mesin Gas which means gas power plants

[2] Abbreviation of Pembangkit Listrik Tenaga Gas dan Uap which means steam and gas power plants

models. The problem has to be defined in a mathematical model before it will be optimized by some methods. There are some steps to construct a mathematical model. The first thing should be accomplished is to understand the real problem that will be optimized later, then make the abstract of it (Bowo, 2014). Bowo (2014) stated the detail steps are shown below:

1. Understand the problem which will be represented in mathematical model obviously.
2. Construct the mathematical model by using these steps:
   a. Define the variables in the problem, which were decided on our own and called as the decision variables.
   b. Define the parameters in the problem, the parameters are some values which have obvious value and cannot be changed by ourselves.
   c. Define the objective of the problem and construct it into a function consist of variable and parameter, which called the objective function.
   d. Define the constraints which will be the obstacles to solve the objective function. Constraints are some functions consist of variable and parameter, as like as the objective function.
3. Define the value of every decision variable in order to solve the optimization problem. In fact, there are some approaches to solve the problem, for instance, the heuristic approach which will be utilized in this research.
4. The last step is to interpret the result of the optimization solution.
5. In addition, the researcher is also encouraged to do sensitivity analysis also, in order to evaluate the result.

2.5 Vehicle Routing Problem (VRP)

Minimizing cost and operational time is objective function which want to be accomplished by corporates in Vehicle Routing Problem (VRP). VRP is any distribution problem which is demanded to distribute goods to consumer by using some vehicles. The problem is generated when producer wants to assign some vehicles with same capacity to distribute some goods from depot to consumers. Assigning appropriate roles plays important roles in attempt objective of that kind of distribution system. Hereby, a graph to show how VRP works.
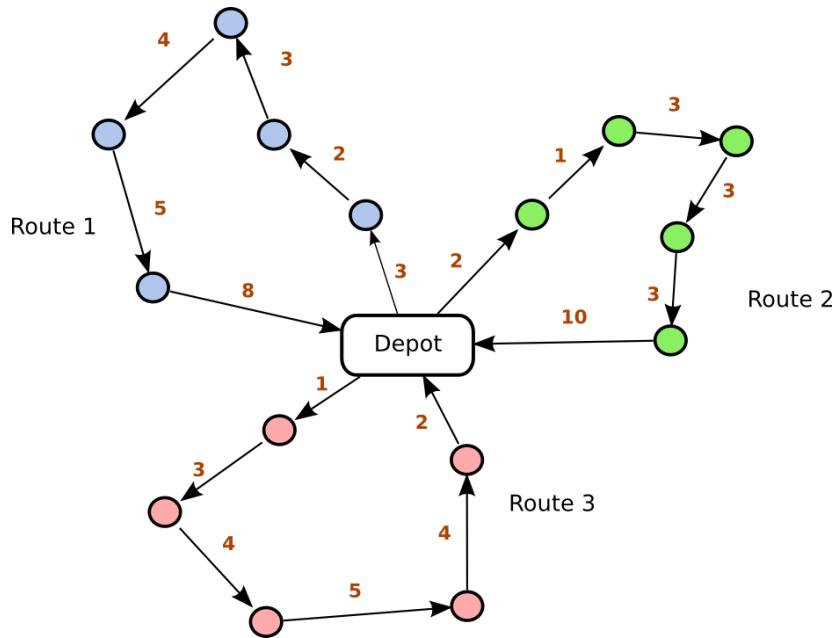
Figure 2.5 VRP Route Model

VRP considered as non-deterministic polynomial hard (NP-Hard) thus it is hard to be solved conventionally. Therefore, Dhoruri *et al,* Rahmat *et* al, dan Bookbinder *et al used* some algorithms to approach the problems such as mathematical modelling, heuristics, metaheuristics in order to solve VRP. However, there are some characteristics of VRP as below (Bookbinder and Reece, 1988):

1. The vehicle trip begins and ends from the depot
2. Number of places must be visited and demand filled exactly once
3. Once the vehicle capacity is already full and cannot serve the next place, the vehicle can return to the depot to refill its capacity and serve the next place.

The purpose of this problem is to minimize the total distance traveled by the vehicle by arranging the order of places to visit along with when the vehicle returns to fill its capacity again.

2.6 Capacitated Vehicle Routing Problem (CVRP)

Capacitated vehicle routing problem is derived from vehicle routing problem which cannot be separated from supply chain management. The main objective of vehicle routing problem is to design the least cost routes for a fleet of vehicles from one depot to a set of points (Kır *et al.* 2017). Along with these lines, since the cost depends on the distance, so in simple term, vehicle routing problem aims to minimize the distance.

Vehicle Routing Problem (VRP) has been researched by many researchers, many methods have been developed until now, either traditionally or heuristically. Kumar and Panneerslvam (2015) said there are many methods to solve VRP based on how the problems can be approached. For instances, Nagata and Bräysy used VRPTW (Vehicle Routing Problem with Time Windows) to minimize the number of routes and the total distance (Nagata and Bräysy, 2009) while Lysgaard and Wøhlk (2014) described branch cut and price method to approach transportation problem by considering capacity.

In addition, there is capacitated vehicle routing problem as well known as CVRP (Capacitated Vehicle Routing Problem). CVRP is one of VRP methods which approaches the problem by considering capacity as the constraint. CVRP has been researched overwhelmingly by some researchers, for instances Dhoruri *et al* (2013), Fukusawa *et al* (2005), Kır *et al* (2017), Kumar *et al* (2015), Lysgaard *et al* (2014), Mester *et al* (2007), Nagata *et al* (2009), and Sarjono (2014) over past decades. Typically, CVRP is used to consider some vessels which each are restricted by the capacity to distribute one kind of product. Moreover, the objective is to minimize distance (Septy and Sobri, 2013).

Antara (2016) referred to CVRP as the method to approach the optimization problem in LNG distribution at Papua. The LNG carrier capacity would be limited in this transportation problem. The discrepancy of ship capacity would influence the results of optimization (Antara, 2016). Antara (2016) used greedy algorithm as the heuristic method as well as Chebbi and Chaouachi (2015). The objective of their research was minimizing time, distance, and cost, once the start and end of the route were at the same point (Chebbi and Chaouachi, 2015).

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Regarding some literature, VRP was solved by considering distance and time as variables. Mirshekarian and Celikbilek (2015) proposed a heuristic method to determine set of feasible routes for a fleet of vehicles within a specified time windows to serve a specified number of customers. Furthermore, current research concerned to optimize route which was focused on green transportation as well Koc and Karaoglan (2016). Koc and Karaoglan (2016) proposed simulated annealing heuristic which based on the exact solution to approach a solution for green vehicle routing problem. Green Vehicle Routing Problem (GVRP) is an interaction between variants of classical routing problems and environmental effects during its operations (Toro *et al*. 2016).

Moreover, recently in the efficient supply chain management, people considered that transportation cost significantly the cost that must be paid by consumers. Thus, in order to require competitive products and fulfill demands, they generate environment friendly organizations by applying some green approaches. For instances, the transportation of products from point A to point B will determine the objective function as minimizing distance, subject to saving fuel, which leads to an environment friendly culture in the organizations.

On the other hand, referring to methods Antara (2016) used linear programming to determine minimum transportation cost while Yalcin and Erginel (2012) used integer programming to approach and solve VRP in their research. Yalcin and Erginel (2012) developed a heuristic method based on integer programming for the vehicle routing problem with backhauls. They divided customers into linehaul and backhaul before solving the problem (Yalcin and Erginel, 2012).

The vehicle routing problem consists of the problems in which a set of routes for a fleet of vehicles based at one or several depots must be determined for a number of geographically dispersed cities or customer (Kır *et al.* 2017). Hence, due to the fact that power plants location in Papua is separated to each other geographically, the problem is classified as a vehicle routing problem.

As stated before, there were many studies from literatures regarding CVRP over past decades, either heuristic or metaheuristic method has studied overwhelmingly. Since it is quite difficult to attempt an optimal solution with

traditional optimization because of the high computational complexity for the large-scale problem, there were many heuristic or metaheuristic approaches developed to solve this problem. In most literature, VRP is commonly defined by limiting vessel capacity, so the VRP typically well-known and has the same meaning as CVRP for some literatures

2.7 Greedy Approach as Heuristics Method

The mathematical model can be used for only small-scale CVRP because it is quite difficult to solve the problems within a reasonable time for large-scale CVRP, due to the complexity. Consequently, this research proposed a heuristic method to solve problems in this case study within a reasonable time. The greedy approach is decided to become the main approach in the heuristic algorithm. The heuristic method is desirable that it can find a solution which is the nearest to the most optimal solution within a reasonable time and simplify the algorithm to solve the problem (Wijharnasir, 2018).

Heuristic algorithm typically is used practically, where the best possible solution may not be chosen but it can find the solution which is closest to the optimal solution. Heuristics is still one kind of an algorithm, though it will not explore every possible state of the problem. The solution will be found based on the constraint. For some cases, there is no need to know the best solution but only the solution which fits with some constraints, thus it is desirable in practical (Mart´ı and Reinelt, 2011)

Greedy algorithm is one of heuristics algorithm. Greedy approach mostly will be used to find a solution within a short time. Greedy approach is accomplished by selecting the local optimum in every step, which was expected during the process, tends to a result that is a global optimum. Yunianto and Setiyanto (2014) stated there were some parameters which had to be defined, such as:

a. Set some parameter solutions which will produce a set of solutions due to the objective function.

b. Selection function. Selcting candidates which most likely attains the optimal solution. The candidate that had been selected before, will not be selected in the following step.

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c. Feasible function. Testing the selected candidate whether prohibited by the available constraint. The feasible candidate will be proposed while the unfeasible candidate will be eliminated.

d. The objective function, a function subject to maximize or minimize the value of the solution.

2.8 Economic Assessment

There are three types of criteria to measure innovation project success, they are technical, economical, and others. Those first two are considered as the well-known criteria to assess the project. In this research, the greedy approach is considered as technical assessment, therefore, the project will be assessed economically.

There are many existing methods to evaluate a project, but they all share a common principle, that is the capital budgeting approach for calculating the economic return of a project as a sequence of discounted cash flows (Chiesa and Frattini, 2009). Probably the most popular and sophisticated is the NPV (Net Present Value) approach. Thus, in this research, NPV approach will be used to assess the project.

The World Bank (1998) in its book entitled The Handbook on Economic Analysis of Investment Operations considered a project to be acceptable if NPV is larger than 0 and IRR is larger than the discount rate. Therefore, for a project which discount rate has not been defined yet, NPV is the appropriate approach to evaluate the project and otherwise.

On the other hand, there is ROI (Return on Investment) and PBP (Payback Period) to evaluate the efficiency of an investment in a project. ROI measures the amount of return on an investment, relative to the investment's cost. ROI determined percentage of return on an investment in a project, hence, it can be used to judge whether the investment is profitable. Meanwhile, PBP is a measure of liquidity and risk exposure which is mostly liked by practitioners (Hajdasiński, 2007). PBP is often used as a first screening device to sort out profitable and unprofitable investment (Femi *et al*. 2008). Thus mostly the payback period is used as a measure of the attractiveness of capital budgeting investment.

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2.9 Paper Review

Table 2.2 Paper Review

No	Author	Theme	Title	Year	Result
1	Aliphya Rausyan Fikr	Shipping Route Problem, Optimization	Study Cluster LNG as a Transportation Mode of LNG from Gas Well Pagerungan to Bali	2011	LNG Carrier Type, Operational Cost, Selling Price Margin of LNG
2	Ludfi Pratiwi Bowo	Vendor-Managed Inventory	Supplier Selection and Distribution Scheduling of CNG using Mathematical Modelling	2014	Selection of supplier, Distribution Scheduling
3	Aldrin Dewabrata	Layout Design of LNG Plant, Optimization, Linear Programming	Design of LNG Receiving Facility based on NFPA 59A, Case Study: Gilimanuk GTPP, Pemaron GTPP, and Pesanggaran GTPP	2014	Layout design of LNG receiving terminal
4	Yuichi Nagata and Oli Bräysy	Vendor-Managed Inventory	A Powerful Route Minimization Heuristic for The Vehicle Routing Problem with Time Windows	2009	The optimized route
5	Jens Lysgaard and Sanne Wøhlk	Capacitated Vehicle Routing Problem (CVRP)	A branch and cut and price algorithm for the cumulative capacitated vehicle routing problem	2014	Minimization of routes
6	Gede Bagus Dwi Suasti Antara	LNG CVRP	Optimization and Economical Analysis of Natural Gas Distribution to Power Plant in Papua Area	2017	The optimized route of LNG distribution by considering transportation cost
7	Olfa Chebbi and Jouhaina Chaouachi	Vehicle Routing Problem	Multi-objective Iterated Greedy Variable Neighborhood Search Algorithm for Solving A Full-Load Automated Guided Vehicle Routing Problem with Battery Constraints	2015	Greedy algorithm to solve VRP

Table 2.3 Paper Review (continued)

No	Author	Theme	Title	Year	Result
8	Gulcin Dinc Yalcin and Nihal Erginel	Vehicle Routing Problem	A Heuristic Based On Integer Programming for The Vehicle Routing Problem with Backhauls	2012	A heuristic based on integer programming
9	Cagri Koc and Ismail Karaoglan	Vehicle Routing Problem	The Green Vehicle Routing Problem: A Heuristic Based Exact Solution Approach	2016	Developed simulated annealing heuristic based on exact solution approach
10	Sadegh Mirshekarian and Can Celikbilek	Vehicle Routing Problem	A Heuristic for The Vehicle Routing Problem with Tight Time Windows and Limited Working Times	2015	A set of feasible routes for a fleet of vehicles within specified time windows
11	Eliasana M. Toro. O, Antonio H. Escobar Z., and Maurico Granada E.	Vehicle Routing Problem	Literature Review on The Vehicle Routing Problem in The Green Transportation Context	2016	Literature review of some vehicle routing problems
12	Raed Husain, T. Assavapokee, and B. Khumawala	Supply Chain Management	Supply Chain Management in The Petroleum Industry: Challenges and Opportunities	2006	Challenges and opportunities in petroleum industry
13	Fukusawa, R., Longo, H., Lysgaard, J., Aragao, M., Reis, M., Uchoa, E., and Werneck, R.	Capacitated Vehicle Routing Problem	Robust Branch and Cut and Price for The Capacitated Vehicle Routing Problem	2005	A method to solve CVRP
14	Kır, S., Yazgan, H. and Tüncel, E	Capacitated Vehicle Routing Problem	A novel heuristic algorithm for capacitated vehicle routing problem	2017	The heuristic method to solve CVRP
15	Kumar, S.N. and Panneerselvam, R	Vehicle Routing Problem	A Time-Dependent Vehicle Routing Problem with Time Windows for E-Commerce Supplier Site Pickups Using Genetic Algorithm	2015	A method to solve VRP in E-Commerce Business

Table 2.4 Paper Review (continued)

No	Author	Theme	Title	Year	Result
16	Mester, D. and Bräysy, O	Capacitated Vehicle Routing Problem	Active-guided evolution strategies for large-scale capacitated vehicle routing problems.	2007	Strategies to solve large-scale CVRP
17	Sarjono, H	Vehicle Routing Problem	Determination of best route to minimize transportation costs using nearest neighbor procedure	2014	A set of routes by considering transportation cost
18	Siswanto, N., Essam, D. and Sarker, R	Inventory Routing Problem	Solving the ship inventory routing and scheduling problem with undedicated compartments	2011	A new heuristic method to solve IRP
19	Alabsi, F. and Naoum, R	Selection Methods	Comparison of Selection Methods and Crossover Operations using Steady State Genetic Based Intrusion Detection System (1053)	2012	A method to do the genetic selection
20	Ardalan, K	Economic Assessment	Payback Period and NPV: Their Different Cash Flows	2012	Comparison between NPV and PBP
21	Hajdasiński, M	Economic Assessment	The Payback Period as a Measure of Profitability and Liquidity	1993	Opinion about PBP as a measuring tool

There were several studies which had been done by some researchers related to LNG industries, capacitated vehicle routing problem, heuristics method, and economical assessment However, there were only a few studies discussed about CVRP in LNG distribution. Hence, this research aims to solve CVRP in the same case study as like as Antara (2016). Antara (2016) considered transportation cost to find a set of adequate routes in LNG distribution to the power plants in Papua. Meanwhile, in this research, the inventory cost will also be considered. Additionally, the updated data on LNG demands is further utilized to solve the problems.

CHAPTER III
RESEARCH METHODOLOGY

This research was developed systematically in purpose to ease researcher and reader to understand. The methodology was divided into some sections in this chapter. Additionally, Figure 3.1 showed the methodology in the flowchart as follows:
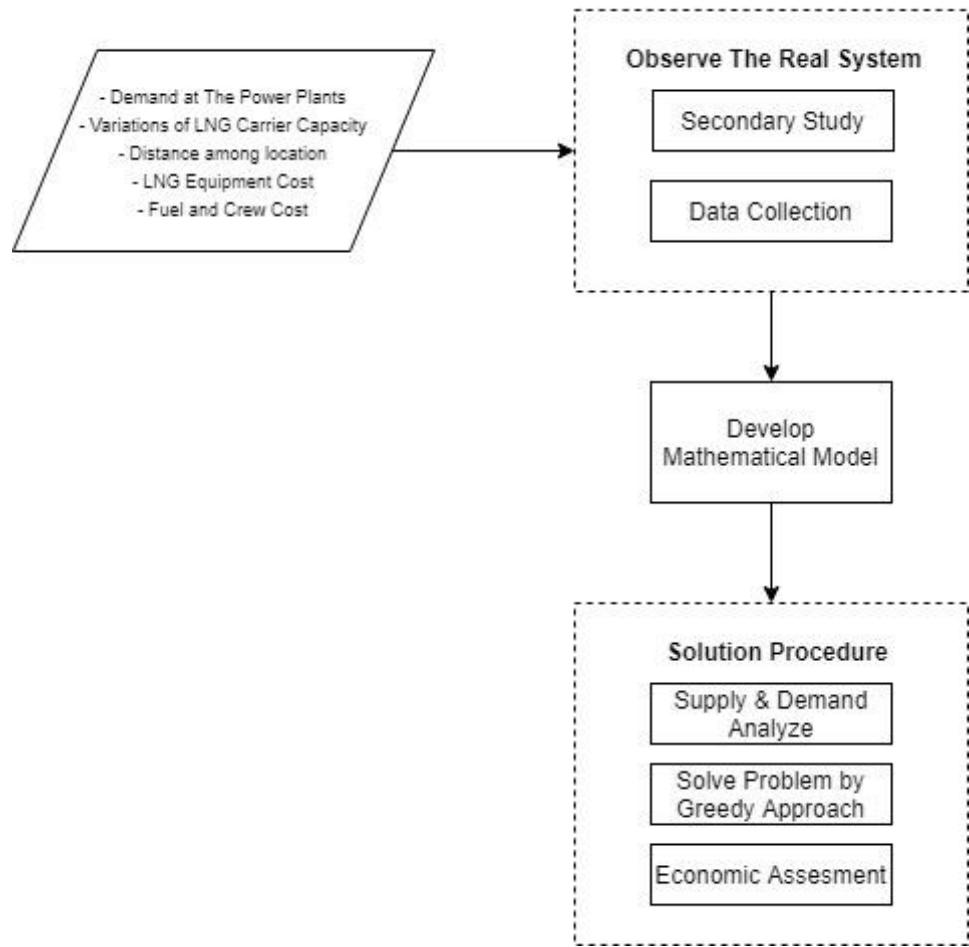
Figure 3.1 Methodology Flowchart

3.1 Observing the Real System

This step was divided into secondary study and data collection. Actually, the field study should be done to observe the real system such as environmental condition, port condition, and so on. However, the latest research had given many references and information which researcher needs, hence the secondary data from

the latest research will be used instead of doing a field study. The latest research done by Antara (2016) was the main reference. Most of the secondary data will be taken from that research. In addition, the most updated data were collected by querying the consultant of this project.

Since the case study was an LNG distribution from a single LNG production terminal to some LNG receiving terminals and the ship capacity limited due to the latest research, it was considered as capacitated vehicle routing problem. Regarding the latest research, there were four kind of ship capacity, 2500 m^3, 7500 m^3, 10000 m^3, and 23000 m^3. Since this research considered the inventory cost, thus, some related data were collected such as storage tank price, vaporizer price, and pipeline.

Data collection including were also collecting some information from books, thesis, proceedings, journal, report of study cases, company annual report, and company website. The collected data were shown below:

a. Power plants data

b. LNG resources data

c. Distance between ports

d. LNG carrier capacity includes the fuel cost

e. Regasification terminal design including the equipment's price

f. Related regulations

Problems were defined in mathematical model to be simplified and identified. There are some steps to construct mathematical model. The parameters, variables, and objective function were defined prior to constraints. The development of this mathematical model referred to a model developed by Kir (2017), with some adjustments in the constraintsto conform the problems in the case study.

3.2 Develop Mathematical Model

The Mathematical model is constructed in order to simplify and represent problems into objective function and constraints. Hence, the problem solving can be occurred decently. However, the mathematical model will be presented by some sets, variables, and parameters as stated in nomenclature.

3.2.1 Objective Functiom

A goal is necessary to be determined in any problem solving, thereby an objective function is stated in Equation (3.1). The objective function represented a goal to maximize profit by increasing revenue and decreasing both transportation and inventory cost.

$$\text{Max } P = \sum_{r \in R} S_r - \sum_{r \in R} T_r - \sum_{r \in R, i=G} I_r \qquad (3.1)$$

3.2.2 Data Analysis

Moreover, constraints should be determined also in order to conform the problems. Thus, constraints will be determined as below. Furthermore, the elucidation of constraints will be profoundly explained later.

$$S_r = d_h m_r \quad \forall h, \forall r \in R \qquad (3.2)$$

$$T_r = T_{gh} x_{gh} \quad \forall g, h_{g \neq h}, \forall r \in R \qquad (3.3)$$

$$I_r = I_{gh} x_{gh} \quad \forall g, h_{g \neq h}, \forall r \in R \qquad (3.4)$$

$$\sum_{l=2, k \neq l}^{N} x_{lk} + x_{1k} = 1 \quad \forall k \qquad (3.5)$$

$$\sum_{l=2, k \neq l}^{N} x_{kl} + x_{k1} = 1 \quad \forall k \qquad (3.6)$$

$$\sum_{h=1, h \neq g}^{N} x_{gh} = \sum_{h=1, h \neq g}^{N} x_{hg} \quad \forall g, h_{g \neq h} \qquad (3.7)$$

$$x_{kk} = 0 \quad \forall k \qquad (3.8)$$

$$x_{lk} + x_{kl} = 1 \quad \forall k, l_{k \neq l} \qquad (3.9)$$

$$\sum_{h=1, h \neq g}^{N} F_{gh} = \sum_{h=1, h \neq g}^{N} F_{hg} + d_h \quad \forall g, h_{g \neq h} \qquad (3.10)$$

$$d_h x_{gh} \leq F_{gh} \quad \forall g, h_{g \neq h} \qquad (3.11)$$

$$F_{gh} \leq (A_{gh} - d_h) x_{gh} \quad \forall g, h_{g \neq h} \qquad (3.12)$$

$$R_s = \{Z_{\delta_{gh}}\} \quad \forall g, h_{g \neq h}, \forall \delta_{gh} = 1 \qquad (3.13)$$

$$R = \{R_s\} \qquad (3.14)$$

$$A_n = d_{ij} + d_{jk} \quad \forall i, j, k_{i \neq j \neq k} \qquad (3.15)$$

$$p(i)=f(ij)\left[\sum_{i=1,j=1,i\neq j}^{n} f(ij)\right]^{-1} \qquad (3.16)$$

The objective function which is defined in Equation (3.1), aims to maximize net revenue during a certain time. The constraints (3.2), (3.3), and (3.4) state the functions to calculate revenue, transportation cost, and inventory cost. The constraints (3.5) and (3.6) determine that there is only one departure from node k. The constraint (3.7) balances incoming arcs and outgoing arcs at the given node. The constraint (3.8) does not allow arc flow from node k to node k. The constraint (3.9) aims to eliminate the trivial sub-tour along the route. The constraint (3.10) provides a balance between LNG flow from g (start nodes) to h (end nodes). The constraint (3.11) and (3.12) state that LNG flow from g to h is greater than or equal to the demand at h and less than or equal to the difference of the ship capacity and the demand at h. The constraint (3.13) defines that R_s are taken from $Z_{\delta ij}$. The constraint (3.14) states that a set of nodes from R shall be member of R_s. Then, the constraint (3.15) defines that the ship capacity was calculated by summing demands at every nodes in a route. Lastly, the constraint (3.16) states equation for roulette wheel selection.

3.2.3 Solution Procedure

The solution was approached by heuristics method. The greedy approach was used as the first step to solve the problem. Afterward, some heuristics steps were developed by combining some methods from some studies. Despite all these steps, LNG supply and demand data were collected and analyzed priorly.

3.2.4 Analyze Supply and Demand

The LNG supply and demand of the power plants in Papua were analyzed before it can be utilized in the optimization process. LNG demand data were collected as power plants load, which were in Megawatt as units. It was converted to MMSCFD (Million Metric Standard Cubic Foot per Day) which is a unit to measure LNG. The result of the calculation was the basic data for the next steps. Hereby, there is LNG conversion table which will be used as a reference to convert some data to the appropriate unit.

Table 3.1 Unit of LNG

TCF (Trillion Cubic Feet)	
A unit for gas reserves, either proved reserves or potential reserves.	
Cubic Meter (m³)	
A volume unit of LNG tank capacity both in LNG carrier and terminals. Sometimes LNG tank capacity using kiloliter (kL) also.	
MMBTU (Million British Thermal Unit)	
A thermal unit which is used for selling and buying LNG. It represents how much energy of LNG either can sell or buy.	
MMSCFD (Million Standard Cubic Feet per Day)	
A unit which is used for volume of gas or fluid flow in piping system.	
BCFD (Billion Cubic Feet per Day)	
A unit which is used for send out capacity of a receiving terminal to consumer.	
TPY (Ton per Year)/TPA (Ton per Annum)	
A unit which is used for production capacity of LNG train or quantity of LNG that store in LNG terminal.	

(Source: Soegiono and Artana, 2006)

Table 3.2 LNG Unit Conversion

1 MTPY LNG	140 MMSCFD Natural Gas
1 Cubic Meter LNG	600 cubic meter Natural Gas
	21.2 MMBTU
1 Million Cubic Meter LNG	460000 tonnes LNG
	21200 cubic feet Gas
Specific Gravity of LNG	0.46
Calorific Value of LNG	100 BTU/Standard cubic feet
Gas Conversion to Energy	
100 MMSCFD	700 MW (typical combined cycle)
100 MMSCFD	500 MW (typical steam cycle)
Gas Conversion to Liquid Products	
100 MMSCFD	730.000 TPY LNG
100 MMSCFD	2100 TPD LNG

(Source: Soegiono and Artana, 2006)

3.2.5 Solve LNG CVRP by using Greedy Approach

This step aims to find a set of adequate routes by using the greedy algorithm to approach the solution. The greedy approach is developed in a heuristic method by combining some selection methods from some studies. The steps were listed as below:

a. Determine power plants demand, which were taken from the first step defined priorly.

b. Determine distance among the nodes, which were production terminal and receiving terminals.

c. Construct the distance in a matrix and determine turn round voyage among the possible route combination.

d. Construct the saving matrix to find a set of feasible combination route to conform the results later.

e. Determine all of the input variables to find transportation cost and inventory cost for all of the combination.

f. Classify all of the combinations into four group regarding the ship capacity.

g. Do the selection method for every group.

h. Find the most adequate route for every group.

i. Compare every solution and select a solution which offerred the cheapest cost as the most adequate route.

Afterward, the selected solution was assessed economically. The payback Period (PBP), Net Present Value (NPV), and Return on Investment (ROI) were calculated to review whether the solution was economically feasible. The detail elucidation will be elaborated in next section.
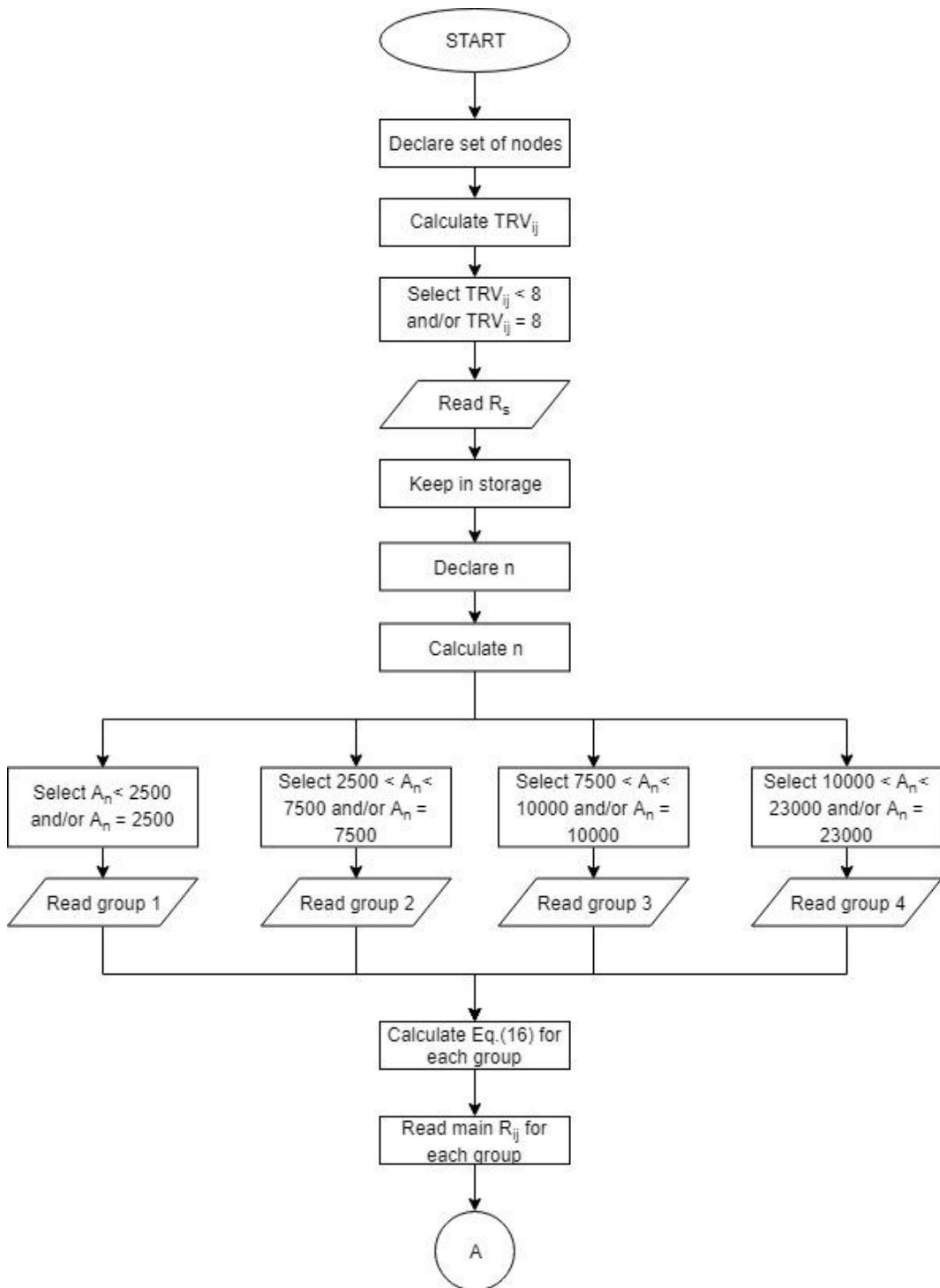
Figure 3.2 Heuristic Flowchart Part 1
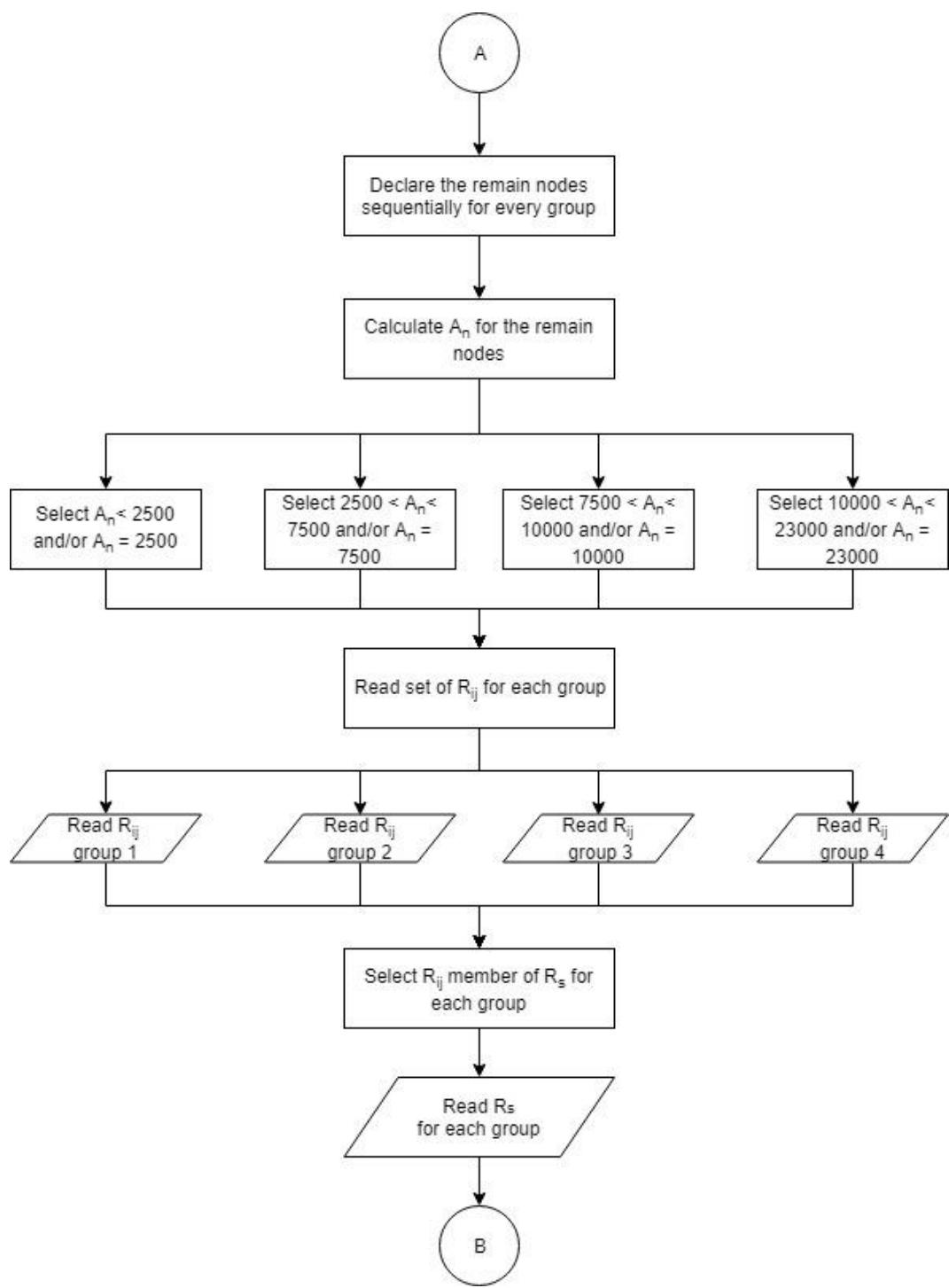
Figure 3.3 Heuristic Flowchart Part 2

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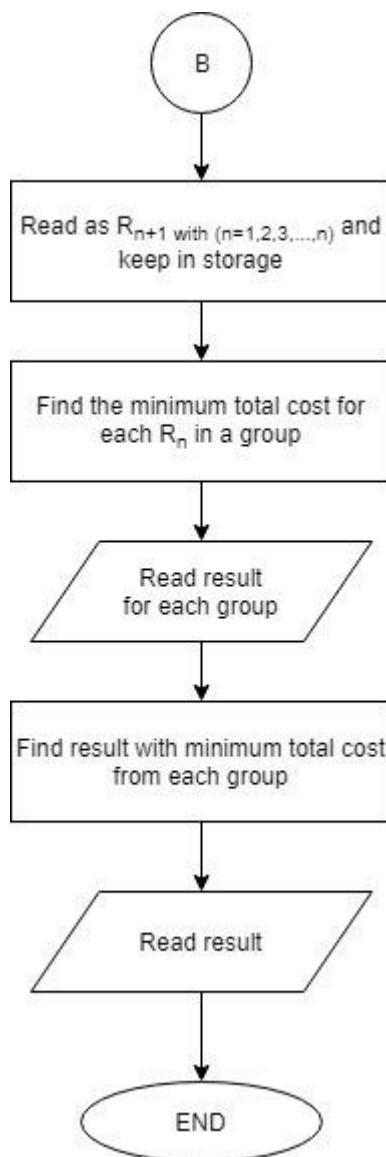
Figure 3.4 Heuristic Flowchart Part 3

3.3 Economic Assessment

Regarding the last section, it was stated that the solutions were assessed from the economic point of view. The assessment was done by considering PBP, NPV, and ROI. PBP indicates time to recover the investment used to acquire the assets. PBP is simply calculated with this formula:

$$PBP = I_i \left(\sum_{t=0}^{n} CF_t \right)^{-1} \tag{3.17}$$

where:

I_i initial investment

CF_t annual net cash flow amount

Along with lines above, in this research the project was assessed by NPV approach which is simply calculated as below:

$$NPV = \sum_{t=0}^{n} CF^{t} [(1+r)^t]^{-1} \tag{3.18}$$

where,

     CF_t net cash flow generated by a project in a year t

     R discount rate

The discount rate later were defined as $r = \{5, 7.5, 10, 12.5, ..., 22.5\}$. In addition, ROI is also calculated by the formula as below:

$$ROI = CF_t(I_i)^{-1} \tag{3.19}$$

Then, the annual cash flow was calculated by subtracting revenue with annual operational cost, depreciation, and tax. The revenue was calculated by defined profit margin $pm = \{3, 3.5, 4, ..., 5\}$, thus the revenue was varied depend on the profit margin. A profit margin used in a case where NPV > 0 would become a lower boundary of the profit in the project. Therefore it can be used as a judgement of the project whether it is profitable.

CHAPTER IV
RESULT AND DISCUSSION

Problems were solved sequentially by following some steps. First, the problems and parameters were configured in causal linkages. Then, the data were analyzed and processed by using some methods and software. This research used Macro Excel from Microsoft Office to process the data. Later, the detail elucidation will be explained profoundly in this section.

4.1 Causal Linkages and Basic Data

Problems in a research mostly were seemed overlapped and overwhelmed with each other, as well as this research. Thus, defining variables and parameters to represent problems was needed by the researcher and the reader to understand. Therefore, the configuration between variables and parameters priorly needed. Consequently, in this research, variables and parameters were casually linked with arrows and labeled with plus (+) and minus (-) as shown in Figure IV.1. The plus sign (+) indicated a positive correlation between one parameter and the others. Otherwise, the minus sign (-) was used. This causal loop diagram eases mathematical model construction that stated in the last section.

However, the optimization principle was to minimize costs and to maximize revenue by determining the optimum route. Hence, the correlations were considered by following this principle. For instance, the plus sign was inserted between demand, ship capacity, and optimum route due to the fact a huge amount of demand will lead to bigger ship capacity as well as ship cost. Additionally, ship cost was an important factor when defining optimum route in transportation problem. Otherwise, the minus sign was inserted between demand and distance since increasing demand will not affect the distance between demand location.
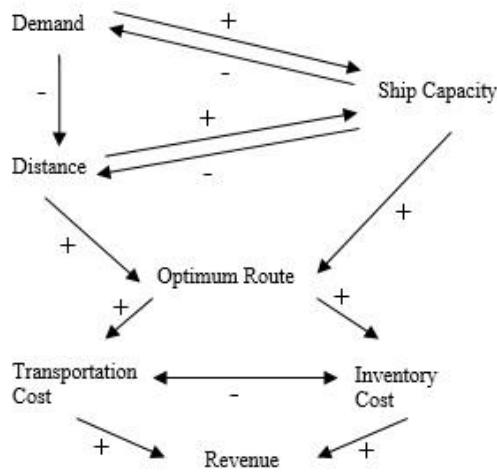
Figure 4.1 Causal loop diagram

4.1.1 Demand at Power Plants

From the Table 2.2, concluded that there were some locations which utilized by more than one power plant. The power plants demand from the same location later were combined in order to minimize node (terminal) location. Consequently, later the LNG regasification terminal was assumed to be connected to some power plants in same location. Thus, Table 4.1 showed power plants demand classification as follows:

Table 4.1 Terminal Location

Code No	Code Name	Location	Capacity	LNG Demands
7	X1.Bi	Biak	95	524.4
1	X2.Bn	Bintuni	10	55.2
-1	X3.Fa	Fakfak	20	110.4
9	X4.Jp	Jayapura	340	1876.8
-2	X5.Ka	Kaimana	20	110.4
4	X6.Mw	Manokwari	60	331.2
-4	X7.Me	Merauke	60	331.2
5	X8.Na	Nabire	40	220.8
3	X9.Ra	Raja Ampat	10	55.2
8	X10.Sa	Sarmi	5	27.6
6	X11.Se	Serui	30	165.6
2	X12.So	Sorong	100	552
-3	X13.Ti	Timika	80	441.6
0	X14.Ta	Tangguh LNG Liq.Plant	N/A	

In addition, code name and code number were inserted in order to ease optimization step. Code number were defined sequentially based on distance between regasification terminal location and Tangguh production terminal location. Positive number indicated terminal locations were located around the northern part of Tangguh, otherwise the negative number. Location of regasification terminal in Papua province map and distance among them were elucidated in the next section.

4.1.2 Distance

Due to simplification of node location, defining distance was much easier. Distance could be defined by using Google Maps from Google Inc. First, nodes was marked in a Papua province map as figure 4.1. Then, distance between two nodes was calculated by drawing a line as like as white line in the Figure 4.2. Distance was calculated in kilometers unit.
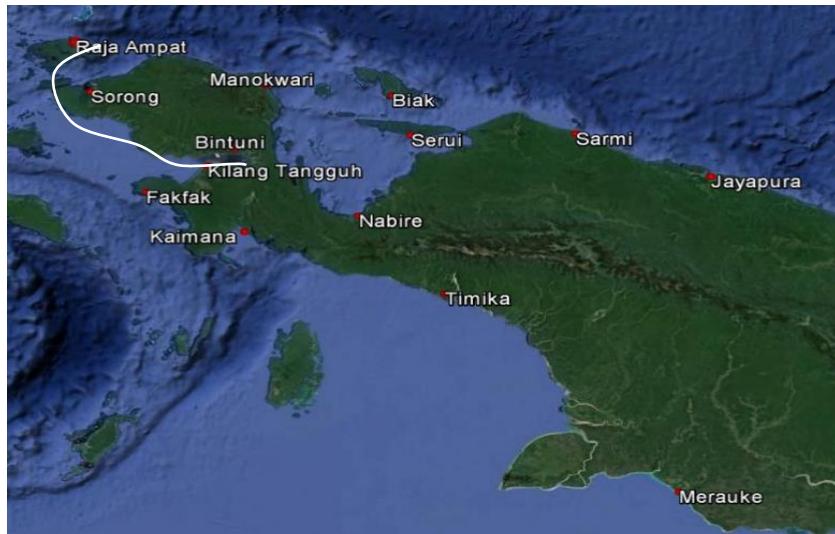
Figure 4.2 Distance between Tangguh LNG production terminal to Raja Ampat

There are 78 combinations by pairing 2 node locations from 14 nodes (including production terminal). Later, all of distance combinations were plotted in a matrix as well as following:

Distance (Km)		X1.Bi	X2.Bn	X3.Fa	X4.Jp	X5.Ka	X6.Mw	X7.Me	X8.Na	X9.Ra	X10.Sa	X11.Se	X12. So	X13. Ti	X14.Ta
		7	1	-1	9	-2	4	-4	5	3	8	6	2	-3	0
X1.Bi	7	-	1,140	1,006	617	1,356	238	2,225	283	604	353	210	619	1,608	1,243
X2.Bn	1		-	286	1,717	631	976	1,516	1,255	693	1,461	1,208	586	892	78
X3.Fa	-1			-	1,590	379	851	1,261	1,128	566	1,338	1,081	458	642	211
X4.Jp	9				-	1,931	825	2,805	872	1,179	289	800	1,197	2,189	1,827
X5.Ka	-2					-	1,189	1,045	1,466	902	1,678	1,426	789	427	560
X6.Mw	4						-	2,076	328	440	563	289	461	1,448	1,087
X7.Me	-4							-	2,350	1,778	2,555	2,299	1,675	762	1,456
X8.Na	5								-	722	611	192	737	1,732	1,356
X9.Ra	3									-	926	675	117	1,165	665
X10.Sa	8										-	536	950	1,938	1,572
X11.Se	6											-	696	1,683	1,319
X12. So	2												-	1,059	517
X13. Ti	-3													-	822
X14.Ta	0														-

Table 4.2 Distance matrix

4.1.3 Ship Capacity

This research used small LNG carriers as the transportation mode. It was decided due to the latest research by Antara (2016), who decided four types of small LNG carrier as transportation modes for this case study. Since this research was developed as the comparison of that latest research, hence, this research used the same ship type. Antara (2016) cited (Yusna and Armita, 2011) who stated LNG distribution character in Indonesia, particularly in Papua was determined as small demands which geographically separated to each other. On the other hand, shallow depth at ports in Papua also becomes consideration to determine appropriate ship capacity.

As stated priorly, this research was used same ship type as Antara (2016), which were Shinju Maru (2500 m^3), Coral Methane (7500 m^3), Norgas (10000 m^3), and Surya Satsuma (23000 m^3). The technical and specification data of these ships will be used later to calculate both transportation cost and inventory cost. Referring to Antara (2016), there are 4 kinds of technical data which significantly affect the optimization process. Hereby, the technical data stated and described as below:

1. Cargo capacity

The larger capacity the larger amount of LNG can be transported from production terminal to demands. In addition, the larger ship capacity leads to the larger economic value. In other words, cost to be paid to transport LNG every volume unit will decrease. However, the larger ship capacity the more expensive charter cost should be paid for the ship and also the larger ship size. Furthermore, the larger ship size is recognized as the deeper ship draught, which means will

require deeper port draught. Cargo capacity will be represented by volume in cubic meter (m^3) and ship dimensions in meter (m).

2. Velocity

The faster ship velocity the shorter time to accomplish turn round voyage (round trip). Therefore, operational time of ship can be decreased. Additionally, the receiving terminal capacity can be decreased as well, since the inventory stock can be decreased due to shorter turn round voyage. Reducing inventory stock leads to reducing inventory cost as well. Velocity will be represented with knot as the unit.

3. Fuel consumption

Antara (2016) stated that fuel consumption significantly affects transportation cost up to 30% of total cost. Hence, fuel consumption will be considered to calculate transportation cost. In other words, the less fuel consumption the more transportation cost can be decreased. Fuel consumption will be represented as ton/day, even though in technical/specification data usually represented in kg/kWh. Later, the value will be converted to an appropriate unit priorly stated.

4. Charter hire/charter cost

Despite of another option, which are building new ship, chartering decided as main option in this research. The LNG carrier, will be chartered during a certain time to specially transport LNG from production terminal to demands. As well as other product, the larger ship size the more cost should be paid to charter. The charter cost will be stated in USD as currency, as well as other cost in this research. As priorly stated, there are 4 ship size will be considered in this research. Therefore, the specification data as shown as below:

Table 4.3 Ship Technical Data

Item	Unit	Value			
Ship Type	-	LNG Carrier			
Ship Capacity	m^3	2,500	7,500	10,000	23,000
LOA	m	86.25	117.8	100	151
Breadth	m	15.1	18.6	20	28
Draft	m	3.8	7.15	7.1	8
Velocity	Knot	13	14	14	15
Chartered Cost	USD/day	18,000	25,000	30,000	40,000
Fuel Consumption	Ton/day	7.9	11	16	19.7

Item	Unit		Value		
Cargo Capacity	m³	2,250	6,750	9,000	20,700

4.1.4 Transportation Cost

Referring to the causal linkages diagram, ship capacity, distance, and demand data were needed to obtain the optimum route. On the other hand, optimum route were obtained by considering optimum transportation and inventory cost. The transportation cost was calculated by referring to Stopford (2002) and Antara (2016). Transportation cost had some variables such as capital cost, voyage cost, operational cost, and cargo handling cost. This research assumed to elude building new ship as an option, thus capital cost and operational cost were represented as charter hire. Whereas, the cargo handling cost was neglected due to assumption for LNG receiving terminal facility utilization.

4.1.5 Voyage Cost

Voyage cost is any cost which should be paid to distribute goods from a port to another port (Antara, 2016). Voyage cost can be calculated by considering fuel cost and port cost. The formula to calculate voyage cost in this research mainly was cited from Antara (2016) by modifying parameters and variables notation to conform the problem in this research.

Parameters and variables

r route r

k ship k

VO_{rk} voyage cost for route r by assigning ship k

BO_{rk} fuel cost for a round trip (turn round voyage)

PO_{rk} port cost for a turn round voyage

TRV_{rk} turn round voyage for route r by assigning ship k

FO_k fuel consumption of ship k

PT_{rk} port time for route r by assigning ship k

SlT_{rk} slack time for route r by assigning ship k

ST_{rk} sea time (time to sail through route r by ship k with certain velocity)

S_r distance for a route r

V_k velocity of ship k

M_k loading capacity of ship k

Q_k pump capacity of ship k

Equations

$$Vo_{rk}=Bo_{rk}+Po_{rk} \qquad (3.20)$$

$$Bo_{rk}= TRV_{rk} \; x \; Fo_k \qquad (3.21)$$

$$TRV_{rk}= ST_{rk}+ Pt_{rk}+ SlT_{rk} \qquad (3.22)$$

$$ST_{rk}=\frac{S_r}{V_k} \qquad (3.23)$$

$$Pt_{rk}=\frac{M_k}{Q_k} \qquad (3.24)$$

These equations above were determined to calculate voyage cost. On the other hand, port cost was taken from a port charge list by PT. Pelabuhan Indonesia IV (2010) since the demand location were located in PT. Pelabuhan Indonesia IV regional. Hereby, the port charge list was cited from Antara (2016).

Table 4.4 Port Charge List

Port Charge		
Berthing Service	IDR 85.36	per GT
Mooring Service	IDR 92.84	per GT
Towing Service		
- flat	IDR 67625.00	vessel/maneuver
- variable	IDR 20.64	GT/ vessel/maneuver
Tug Service		
a. 2001 s.d. 3500 GT		
- flat	IDR 546260.00	vessel/hour
- variable	IDR 10.00	GT/ vessel/hour
b. 3501 s.d. 8000 GT		
- flat	IDR 771456.00	vessel/hour
- variable	IDR 10.00	GT/ vessel/hour
c. 8001 s.d. 14000 GT		
- flat	IDR 1299100.00	vessel/hour
- variable	IDR 10.00	GT/ vessel/hour
d. 14001 s.d. 23000 GT		
- flat	IDR 2860000.00	vessel/hour
- variable	IDR 10.00	GT/ vessel/hour

(Source: Antara, 2016)

4.1.6 Charter Hire

Stopford (2002) generally stated that there are 3 schemes to charter a ship, they are voyage charter, time charter, and bareboat charter. The decision depends on consideration among ship owner and charterer. Voyage charter is a scheme depends on how often ship is sailing. Ship owner owes every cost related to the ship except cargo handling cost. Ship owner is also responsible to manage route, scheduling, and any other else related to transportation. Ship charterer will only pay a certain cost to transport a number of goods from a port to port. In simple term, this scheme as well as freight company.

On the other hand, the time charter scheme happens when ship charterer charters any ship to ship owner during a certain time. The charter cost will be charged for day or month. The charterer will be responsible for fuel cost, port cost, cargo handling cost, and also manage route and scheduling by themselves. In spite of, the charterer does not owe to operational cost. The operational cost will be ship owner's responsibility. In addition, the bareboat charter is a scheme where the owner was only building the ship without owing every particular cost including operational cost (Antara, 2016).

This research was decided to use time charter as the charter hire scheme. Thus, transportation cost calculation did not considered operational cost. Since operational cost assumed will become ship owner's responsibility. After that, the transportation cost was calculated as below:

Parameters and variables

TO_{rk} transportation cost for route r by assigning ship k during a year

VO'_{rk} voyage cost for route r by assigning ship k during a year

C_k charter hire of ship k to be assigned in route r

Equation

$$To_{rk} = Vo'_{rk} + c_{rk} \tag{3.25}$$

4.1.7 Inventory Cost

The inventory cost was composed of capital expenditure (CAPEX) and operational expenditure (OPEX). CAPEX is investment cost which will be paid

once a while in order to procure equipment. OPEX is operational cost which will always be paid in order to run the facility, which in this case study is LNG receiving terminal (Antara, 2016).

There are 4 main systems in LNG receiving terminal, which are berthing system, LNG transfer system, LNG storage system, and regasification system. Every system consist of some main equipment. This research was referred to an equipment−price list created by Antara (2016). Besides, in this research, the inventory cost was diversed among the feasible routes. Antara (2016) optimized the routes by considering transportation cost without inventory cost. Antara (2016) also stated a flat value for inventory cost for every route. On the other hand, this research considered both transportation cost and inventory cost, by differing inventory cost value.

This method was proposed regarding a statement stated by Antara (2016) that every LNG receiving terminal would have different capacity depends on turn round voyage of ship, ship capacity, and LNG demands per day. The more demand demanded by power plants, the more natural gas consumption by power plants. Thus, the more natural gas consumption was demanded by power plants, the more LNG should be supplied and stored in LNG receiving terminal. The LNG receiving terminal must be storing LNG so that the stock during turn round voyage will cope to power plants demands. In other words, the longer turn round voyage the larger capacity of LNG receiving terminal. Furthermore, LNG receiving terminal must be devoted to LNG safety stock, which practically stated as three days.

Besides, turn round voyage was significantly affected by ship capacity. The larger ship capacity, the shorter time to complete a turn round voyage. In addition, the larger receiving terminal capacity the more expensive should be paid to procure, maintain, and operate the equipment. Hence, the different route would significantly affect differentiation of inventory cost. Therefore, this research considered that effect to attempt the optimum route.

The LNG demand practically affected the selection of LNG storage tank and LNG regasification unit (LNG vaporizer). However, in order to simplify this research, the specification of LNG storage tank and LNG vaporizer in receiving terminal would be defined as well as in research done by Antara (2016). Later,

researcher encouraged enhancement of this research by considering selection of receiving terminal equipment. Hereby, Table 4.5 showed an equipment price list created by Antara (2016).

Table 4.5 Equipment Price List

System	Equipment Details	Unit	Price ($)	Req.Equip	Total
LNG TRANSFER SYSTEM	LNG Pump Skid	set	900,000	2	$ 1,800,000
	LNG Metering unit	set	2,300	1	$ 2,300
	Cryogenic Line Pipe	m	770	1000	$ 770,000
	Piping,valve,indicator,insulation,etc.	set	225,768	1	$ 225,768
LNG STORAGE SYSTEM	LNG Storage Tank (ISO Container Tank)	m3	2,000	400	$ 800,000
	LNG Pump (RU Feeder)	set	80,000	2	$ 160,000
	Cryogenic Line Pipe	m	770	1000	$ 770,000
	Piping,valve,indicator,insulation,etc.	set	20,693	1	$ 20,693
REGASIFICATION SYSTEM	LNG Buffer Tank	set	400,000	1	$ 400,000
	VAPORIZER Heat Exchanger (Ambient Air Type)	set	120,000	2	$ 240,000
	Gas Heater (steam)	set	70,000	2	$ 140,000
BOG TREATMENT/ UTILIZATION SYSTEM	BOG Compressor	set	700,000	2	$ 1,400,000
	Piping,valve,indicator,insulation,etc.	set	175,000	1	$ 175,000
GAS TRANSFER SYSTEM	Gas Heater (steam)	set	70,000	2	$ 140,000
	NG Line Pipe	m	100	1000	$ 100,000
	Pigging (Launcher and Receiver)	set	7,000	1	$ 7,000
	NG Metering Unit	set	1,500	1	$ 1,500
	Piping,valve,indicator,insulation,etc.	set	19,650	1	$ 19,650
ELECTRIC GENERATOR	Self-Driven Electric Generator (Diesel) skid	set	1,200,000	1	$ 1,200,000
BUILDING	Control Room	set	20,000	1	$ 20,000
	Office Building	set	50,000	1	$ 50,000
	Parking Area, Muster station, Utilization area, etc.	set	10,000	1	$ 10,000
FIRE FIGHTING	Hydrant	set	2,500	1	$ 2,500
	Fire Alarm, Gas Detector	set	5,000	1	$ 5,000
	Portable Fire Distinguisher	set	450	6	$ 2,700
PURGING SYSTEM	Nitrogen Storage Tank	set	20,000	1	$ 20,000
	Piping,valve,indicator,insulation,etc.	set	2,000	1	$ 2,000
MONITORING & CONTROL SYSTEM	Process Control System (PCS), DCS (Hardware & Software)	set	800,000	1	$ 800,000

4.1.8 Revenue

This case study, as well as other projects, is subject to gain revenue. The revenue will be gained from the defined margin multiply with an amount of natural gas delivered to power plants. On the other hand, it means that the larger margin the more revenue can be gained. Additionally, the revenue significantly affected economical assessment as well as CAPEX and OPEX did. Meanwhile, CAPEX and OPEX were significantly affected by ship routes. Therefore, in order to achieve economical attractiveness of this project, the routes were defined properly. The next section elaborated a proposed heuristic method to define routes in this case study by using greedy approach.

4.2 Heuristic Method

The mathematical model can be used for only a small-scale CVRP because solving more complex problems within a reasonable time is difficult. Consequently, this research proposed a heuristic method to solve the problem in this case study within a reasonable time. The greedy approach was determined to become the main approach in the algorithm. This heuristic method is desirable in finding a solution which is the best approximation of the most optimal solution within a reasonable time and in simplifying the algorithm to solve the problem. It was elaborated in three main steps, nevertheless, there were some steps as below.

4.2.1 Defining and Grouping Route Combinations

Step 1: State Δ_{ij} among every point while calculating $TRV = 2x_{ij} (\Delta_{ij} / v)$

Step 2: Define $\delta_{ij} = \begin{cases} 1, \text{ if } TRV \leq 8 \\ 0, \text{ if } TRV > 8 \end{cases}$

Since Δ_{ij} is a notation for distance, this step represents a step to create distance matrix as determined in section III. In addition, after creating distance matrix, the saving matrix was created in order to conform with feasibility land transport and ship capacity. Referring to the project's consultant, Antara (2016) stated practically the feasible route must have TRV less than equal 8 days. Due to the fact that the more TRV, the larger ship should be utilized and the more BOG (Boiled-Off Gas) could be trapped and treated.

The feasibility land transport was manually decided with self-judgment. Later, the result was validated by statistical test. The result consisted of a set of route pairs that cope with feasibility land transport and TRV constraints. The result was used as a variable in constraint (3.14) to confirm that later the selected route can only be serviced by ship with TRV less than equal 8 days. It was necessary to define whether the route pair combination was rational to be serviced by ship before performing the next step. The result was shown in Table 4.4 below while δ_{ij} as equal as 1 represented as Y in the table and otherwise.

Table 4.6 Saving Matrix

From	To	Savings	Distance	Trip Time (days)	Feasibility for Land Transport	Deciding Rationality
7	1	579.6	1,140	3	N	Y
7	-1	634.8	1,006	3	N	Y
1	-1	165.6	286	1	Y	Y
7	9	2401.2	617	2	N	Y
1	9	1932	1,717	4	N	Y
-1	9	1987.2	1,590	4	N	Y
7	-2	634.8	1,356	4	N	Y
1	-2	165.6	631	2	Y	Y
-1	-2	220.8	379	1	Y	Y
9	-2	1987.2	1,931	5	N	N
7	4	855.6	238	1	N	Y
1	4	386.4	976	3	Y	Y
-1	4	441.6	851	2	Y	Y
9	4	2208	825	2	N	Y
-2	4	441.6	1,189	3	Y	Y
7	-4	855.6	2,225	6	N	N
1	-4	386.4	1,516	4	N	Y
-1	-4	441.6	1,261	3	N	Y
9	-4	2208	2,805	7	N	N
-2	-4	441.6	1,045	3	N	Y
4	-4	662.4	2,076	5	N	N
7	5	745.2	283	1	N	Y
1	5	276	1,255	3	Y	Y
-1	5	331.2	1,128	3	Y	Y
9	5	2097.6	872	2	N	Y
-2	5	331.2	1,466	4	Y	N
4	5	552	328	1	N	Y
-4	5	552	2,350	6	N	N
7	3	579.6	604	2	N	Y
1	3	110.4	693	2	N	Y
-1	3	165.6	566	2	N	Y
9	3	1932	1,179	3	N	Y
-2	3	165.6	902	3	N	Y
4	3	386.4	440	1	N	Y

From	To	Savings	Distance	Trip Time (days)	Feasibility for Land Transport	Deciding Rationality
-4	3	386.4	1,778	5	N	N
5	3	276	722	2	N	Y
7	8	552	353	1	N	Y
1	8	82.8	1,461	4	N	Y
-1	8	138	1,338	4	N	Y
9	8	1904.4	289	1	Y	Y
-2	8	138	1,678	4	N	Y
4	8	358.8	563	2	N	Y
-4	8	358.8	2,555	6	N	N
5	8	248.4	611	2	N	Y
3	8	82.8	926	3	N	Y
7	6	690	210	1	N	Y
1	6	220.8	1,208	3	N	Y
-1	6	276	1,081	3	N	Y
9	6	2042.4	800	2	N	Y
-2	6	276	1,426	4	N	Y
4	6	496.8	289	1	N	Y
-4	6	496.8	2,299	6	N	N
5	6	386.4	192	1	N	Y
3	6	220.8	675	2	N	Y
8	6	193.2	536	2	N	Y
7	2	1076.4	619	2	N	Y
1	2	607.2	586	2	Y	Y
-1	2	662.4	458	2	Y	Y
9	2	2428.8	1,197	3	N	Y
-2	2	662.4	789	2	N	Y
4	2	883.2	461	2	Y	Y
-4	2	883.2	1,675	4	N	Y
5	2	772.8	737	2	N	Y
3	2	607.2	117	1	N	Y
8	2	579.6	950	3	N	Y
6	2	717.6	696	2	N	Y
7	-3	966	1,608	4	N	Y
1	-3	496.8	892	3	N	Y
-1	-3	552	642	2	N	Y
9	-3	2318.4	2,189	5	N	N
-2	-3	552	427	1	Y	Y
4	-3	772.8	1,448	4	N	Y
-4	-3	772.8	762	2	N	Y
5	-3	662.4	1,732	4	Y	N
3	-3	496.8	1,165	3	N	Y
8	-3	469.2	1,938	5	N	N
6	-3	607.2	1,683	4	N	Y
2	-3	993.6	1,059	3	N	Y

Step 3: Calculate $A_n = F_{ij} + d_{ij}$ $\forall i,j_{i \neq j}$, $\forall n = \{1,2,3,4\}$, then T_{ij} and I_{ij} for every R_{ij}.

Step 4: Repeat step 3 till $A_n \leq 2500$ to characterize n as 1, until $A_n \leq 7500$ to characterize n as 2, till $A_n \leq 10000$ to characterize n as 3, and $A_n \leq 23000$ to characterize n as 4.

This case study provided 1 production terminal and 13 receiving terminals, thus there are 8191 possible combinations might be appeared. Route code number was assigned sequentially for every combination to ease later step. Calculate A_n as stated in step 3 in order to classify 8191 combinations into four routes. The possible route which had TRV more than 8 days and could not be occupied with maximum ship capacity, which was 23000 m³, was excluded from the next calculation step.

In this categorization step, transportation cost Equation (3.23), and inventory cost, (see on Table 4.5) were calculated. An example of 2500 m³ group was shown in Table 4.8. In addition, transportation cost was considered for 20 years since this case study assumed to occur in 20 years. On the other hand, investment cost was considered once a while during a project lifetime.

Table 4.7 Feasible routes for 2500 m³ group

Route	Total Consumers	Total Transportation Cost ($/year)	Total Transportation Cost for 20 years ($)	Total Inventory Cost ($)	Total Cost ($)
248	3	$ 6,863,939.64	$ 137,278,792.75	$ 1,651,343,303.40	$ 1,788,622,096.15
164	3	$ 6,864,006.00	$ 137,280,119.90	$ 1,651,075,817.11	$ 1,788,355,937.01
86	2	$ 6,873,312.33	$ 137,466,246.59	$ 1,614,721,220.00	$ 1,752,187,466.58
83	2	$ 6,939,381.90	$ 138,787,638.03	$ 1,610,258,325.83	$ 1,749,045,963.86
159	3	$ 7,099,698.87	$ 141,993,977.41	$ 1,604,432,321.51	$ 1,746,426,298.91
34	2	$ 6,945,127.33	$ 138,902,546.67	$ 1,593,750,600.29	$ 1,732,653,146.96
180	3	$ 6,949,509.51	$ 138,990,190.30	$ 1,581,495,753.97	$ 1,720,485,944.27
8	1	$ 6,965,870.13	$ 139,317,402.68	$ 1,538,140,352.74	$ 1,677,457,755.42
163	3	$ 7,043,467.73	$ 140,869,354.62	$ 1,373,314,993.05	$ 1,514,184,347.67
60	2	$ 6,848,472.65	$ 136,969,453.00	$ 1,227,270,533.84	$ 1,364,239,986.84
203	3	$ 6,864,338.23	$ 137,286,764.63	$ 1,179,106,187.60	$ 1,316,392,952.23
38	2	$ 7,215,767.75	$ 144,315,354.99	$ 1,148,959,106.69	$ 1,293,274,461.68
11	1	$ 6,974,979.58	$ 139,499,591.69	$ 1,137,270,414.21	$ 1,276,770,005.91
43	2	$ 6,896,587.08	$ 137,931,741.66	$ 1,095,629,065.15	$ 1,233,560,806.81
59	2	$ 7,005,022.68	$ 140,100,453.67	$ 1,086,351,417.70	$ 1,226,451,871.37
42	2	$ 7,134,093.54	$ 142,681,870.84	$ 929,298,751.15	$ 1,071,980,621.99
28	2	$ 7,179,786.54	$ 143,595,730.82	$ 889,634,355.07	$ 1,033,230,085.89
26	2	$ 7,473,315.91	$ 149,466,318.22	$ 730,518,222.82	$ 879,984,541.04
82	2	$ 6,893,183.22	$ 137,863,664.46	$ 663,202,469.37	$ 801,066,133.83
33	2	$ 6,897,408.12	$ 137,948,162.41	$ 657,241,346.26	$ 795,189,508.68
32	2	$ 7,135,563.34	$ 142,711,266.84	$ 619,457,302.40	$ 762,168,569.24
5	1	$ 7,337,066.00	$ 146,741,320.04	$ 526,996,920.28	$ 673,738,240.32
3	1	$ 7,872,572.32	$ 157,451,446.41	$ 420,308,101.54	$ 577,759,547.95
9	1	$ 7,252,632.71	$ 145,052,654.21	$ 280,810,483.99	$ 425,863,138.20
2	1	$ 8,344,734.91	$ 166,894,698.13	$ 191,087,938.72	$ 357,982,636.85
10	1	$ 6,919,920.65	$ 138,398,412.97	$ 210,985,250.57	$ 349,383,663.54

4.2.2 Roulette Wheel Principal

This section was profoundly elucidate heuristic steps. This step was developed based on genetic algorithm. Jebari and Madiavi (2013) stated the genetic algorithm are stochastic search methods using the concepts of Mendelian genetics and Darwinian evolution. Such heuristics had been proved to be effective in solving a variety of hard real-world problems in many application domains including economics, engineering, manufacturing, bioinformatics, medicine, computational science, etc. There were some popular methods regarding genetic algorithm, for instances, the roulette wheel selection (RWS), the stochastic universal sampling (SUS), the linear rank selection (LRS), the exponential rank selection (ERS), the tournament selection (TOS), and the truncation selection (TRS).

Generally, in principle genetic algorithm was developed with this algorithm where a population of individuals was selected from the search space, often in a random manner, serves as candidate solutions to optimize the problem. The individuals in this population are evaluated through fitness adaptation function. A selection mechanism is then used to select individuals to be used as parents to those of the next generation. These individuals will then be crossed and mutated to form the new offspring. The next generation is finally formed by an alternative mechanism between parents and their offspring. This process is repeated until a certain satisfaction condition (Jebari and Madiavi, 2013).

This research adapted roulette wheel selection for solving capacitated vehicle routing problem as well as Kır *et al* (2017) did. The detail steps were elaborated in step 5 below:

Step 5: After determining all possible solutions R, classify the result into four groups according to the n value. Select one of solutions among R by using roulette wheel principal determined by the equation below:

$$p(i) = f(ij) \left[\sum_{i=1, j=1, i \neq j}^{n} f(ij) \right]^{-1} \tag{3.26}$$

Where: $f(ij)$ is fitness value of R_{ij}. The selected route R is a set of R_{ij} in each group, which is desired to become the main route for its group.

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Since there are four groups determined (2500 m^3, 7500 m^3, 10000 m^3, and 23000 m^3), so there are four main routes. Hereby the main route for group 2500 m^3 was highlighted with yellow color in Table 4.8.

Table 4.8 Roulette wheel selection for 2500 m³ group

Route	Total Consumers	Total Cost ($)		Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
248	3	$	1,788,622,096.15	1788622096	0.057868375	0.057868375	0.625237735	Y
164	3	$	1,788,355,937.01	1788355937	0.057859763	0.115728138	0.476505251	Y
86	2	$	1,752,187,466.58	1752187467	0.056689583	0.172417721	0.199646531	Y
83	2	$	1,749,045,963.86	1749045964	0.056587944	0.229005665	0.539586522	Y
159	3	$	1,746,426,298.91	1746426299	0.056503188	0.285508854	0.488892371	Y
34	2	$	1,732,653,146.96	1732653147	0.056057577	0.341566431	0.034095089	N
180	3	$	1,720,485,944.27	1720485944	0.055663924	0.397230355	0.135352813	N
8	1	$	1,677,457,755.42	1677457755	0.054271807	0.451502163	0.510651416	Y
163	3	$	1,514,184,347.67	1514184348	0.048989324	0.500491487	0.248763181	N
60	2	$	1,364,239,986.84	1364239987	0.044138083	0.54462957	0.345738653	N
203	3	$	1,316,392,952.23	1316392952	0.042590059	0.587219629	0.387972726	N
38	2	$	1,293,274,461.68	1293274462	0.041842092	0.629061721	0.755147322	Y
11	1	$	1,276,770,005.91	1276770006	0.041308114	0.670369835	0.61209034	N
43	2	$	1,233,560,806.81	1233560807	0.03991014	0.710279975	0.402160056	N
59	2	$	1,226,451,871.37	1226451871	0.039680141	0.749960116	0.553664806	N
42	2	$	1,071,980,621.99	1071980622	0.034682439	0.784642555	0.563168873	N
28	2	$	1,033,230,085.89	1033230086	0.033428719	0.818071274	0.141919975	N
26	2	$	879,984,541.04	879984541	0.028470673	0.846541947	0.188013132	N
82	2	$	801,066,133.83	801066133.8	0.025917378	0.872459325	0.868368291	N
33	2	$	795,189,508.68	795189508.7	0.025727248	0.898186573	0.765893568	N
32	2	$	762,168,569.24	762168569.2	0.024658902	0.922845475	0.47659584	N
5	1	$	673,738,240.32	673738240.3	0.021797862	0.944643336	0.314617065	N
3	1	$	577,759,547.95	577759548	0.018692605	0.963335941	0.362546422	N
9	1	$	425,863,138.20	425863138.2	0.013778208	0.977114149	0.45268098	N
2	1	$	357,982,636.85	357982636.8	0.011582029	0.988696179	0.336083323	N
10	1	$	349,383,663.54	349383663.5	0.011303821	1	0.13304916	N

The random numbers were generated and then sorted ascendingly. The Y indicated that random number value was greater than accumulated normalized fitness value, and N was otherwise. On the other hand, accumulated normalized fitness value was the accumulated value of result in equation (15) (indicated in column normalized value in table IV.7). Then, the selected route R was a set of R_{ij} which last indicated by Y in this table. In other words, R was a set of R_{ij} which had the largest accumulated normalized fitness value as well as greater than the generated random number. The next step was assigning other ships to the remaining routes from the latest step.

Step 6: Determine the second closest point for the remaining nodes, by considering Δ_{ij}. Calculate $A_n = F_{ij} + d_{ij}$ until A_n exceeds 23000 for each group. Repeat this step until every remaining node in each group has satisfied its demand. For example, for group 2500 m³ the ship assigned to route firstly as shown in this table below:

Table 4.9 First combination route for 2500 m³ group

No	No. Route	X14	X3	X5	X13	X7	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	-1	-2												0	2500
2	-	0			-3	-4	1	2	3	4	5	6	7	8	9	0	-

Then, since the remaining routes cannot be occupied by maximum ship capacity, the remaining routes were separated sequentially until conform to ship capacity, which were hopefully cope the maximum ship capacity which was 23000 m³. Besides, in case the route could not cope the maximum ship capacity, the node was decreased in order to cope the 2nd maximum ship capacity (10000 m³), and so forth, until all of the remaining nodes were occupied by ship. It was simply shown in Table 4.10, 4.11, and 4.12.

Table 4.10 Assigning remaining routes

No	No. Route	X14	X3	X5	X13	X7	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity (m³)
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	-1	-2												0	2500
2	76	0			-3	-4										0	10000
3		0					1	2	3	4	5	6	7	8	9	0	-

Table 4.11 Assigning remaining routes

No	No. Route	X14	X3	X5	X13	X	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity (m³)
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	-1	-2												0	2500
2	76	0			-3	-4										0	10000
3	4	0													9	0	23000
4		0					1	2	3	4	5	6	7	8		0	-

Table 4.12 Assigning remaining routes (α_1 in table)

No	No. Route	X14	X3	X5	X13	X7	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity (m³)
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	-1	-2												0	2500
2	76	0			-3	-4										0	10000
3	4	0													9	0	23000
4	1865	0					1	2	3	4	5					0	23000
5	152	0										6	7	8		0	10000

Step 7: Every feasible solution was indicated as R_{ij} which was a member of R while R itself must be a member of R_s. On the other hand, each R_{ij} which could not meet the constraint (3.14) was excluded from the next steps. Step 7 was configured the latest result to meet a constraint related to TRV, which stated above in step 2. This step ensure, every R was feasible and rational to be assigned by ship.

4.2.3 Minimizing LNG Carrier Size

Due to that process, each group had a set of feasible solutions R by maximizing the ship utilization. Nevertheless, to minimize transportation cost and inventory cost, a better solution sought by reducing the ship capacity in these orderly stages.

Stage 1: Every set of the feasible routes in each group was assigned to variable α_1, as shown in table 4.12.

Stage 2: Determine the second closest point of the remaining nodes, by considering Δ_{ij}. Calculate $A_n = F_{ij} + d_{ij}$ until A_n exceeds the smaller ship capacity in the latest result in α_1. Assign the result to α_2, as shown in table 4.13.

Stage 3: Calculating A_n until it exceeds the smaller ship capacity in the latest result in α_3, as shown in Table 4.14

For example, referring to Table IV.11 the route number 1865 consist of node 1,2,3,4,5 were separated into route number 205 consist of node 1,2,3 and route

number 65 consist of node 4 and 5. The smaller ship capacity was aimed to be sought from these steps and indicated by α_2 and α_3, shown in Table 4.11 and 4.12. The smaller ship capacity was expected to minimize total cost.

Table 4.13 α_2 in table

No	No. Route	X14	X3	X5	X13	X7	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity (m³)
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	1	2												0	2500
2	76	0			-3	-4										0	10000
3	4	0													9	0	23000
4	205	0					1	2	3							0	7500
5	65	0								4	5					0	7500
6	152	0										6	7	8		0	10000

Table 4.14 α_3 in table (Combination Route for 2500 m³)

No	No. Route	X14	X3	X5	X13	X7	X2	X12	X9	X6	X8	X11	X1	X10	X4	X14	Ship Capacity (m³)
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	
1	38	0	-1	-2												0	2500
2	76	0			-3	-4										0	10000
3	4	0													9	0	23000
4	205	0					1	2	3							0	7500
5	65	0								4	5					0	7500
6	23	0										6	7			0	7500
7	22	0												8		0	7500

Repeat the stages until there was no A_n with a smaller value for every R_{ij} in a set of R_n. Afterward, find R_{ij} in a set of R_n which offered the cheapest total cost. As there were four distinguished n value in presence, there were four feasible solutions. All the feasible solutions yield the different total costs. Finally, the comparison between those different four total costs lead to the particular solution to this problem. The feasible solution R_n with the cheapest total cost among them was considered as the particular solution.

Referring to the solutions, every vessel was assigned to the particular route and dedicated to meet its demand. Every route was a closed-loop started from Tangguh production terminal which labeled by zero (0). The total cost was the estimated result, by considering both capital and operational cost to fulfill LNG demands for the particular route within 20 years, as an estimated project life. The detail solution was shown in Table 4.15 as below:

Table 4.15 Set of R_n solutions

Vessel	Capacity (m³)	Route	TRV (days)	Total Cost (USD)	
Ship 1	7,500	0-3-11-10-0	8	$	2,838,573,958.3
Ship 2	23000	0-5-13-7-0	8	$	7,743,395,013.0
Ship 3	23000	0-4-0	7	$	15,811,998,849.5
Ship 4	7500	0-2-12-9-0	4	$	4,137,970,938.7
Ship 5	7500	0-6-0	5	$	2,255,544,486.1
Ship 6	2500	0-8-0	6	$	1,677,457,755.4
Ship 7	7500	0-4-0	5	$	3,680,417,512.5
	TOTAL INVESTMENT			$	38,145,358,513.5

Consequently, to the utilization of smaller ship capacity, the ship was easier to berth at the port during uncertain weather. The uncertain weather led to incapabilities of large-size ship's draught to cope with uncertain sea depth. Thus, the small-size ship was adequate to be used in Indonesia, since Indonesia port condition was constantly changing due to the geographical condition. The solution was considered to become more reliable to cope with uncertain weather at some ports in Papua.

4.3 Economic Assessment

In this section, the project was assessed economically. There were many existing methods to evaluate a project (Chiesa and Frattini, 2009). The most popular method is the NPV (Net Present Value) approach. Thus, in this paper, NPV approach was used to assess the project.

In addition, IRR (Internal Rate Return) was recommended to be used in the economic assessment (Chiesa and Frattini, 2009). The appropriate utilization of NPV and IRR depend on the decision context. A project was considered acceptable if NPV > 0 and IRR > the discount rate (Chiesa and Frattini, 2009).

On the other hand, there were ROI (Return on Investment) and PBP (Payback Period) to evaluate the efficiency of an investment in a project. ROI measureed the amount of return on an investment relative to the investment. Hence, it was used to understand whether an investment was profitable.

4.3.1 CAPEX and OPEX

As stated in the literature review, in this case study, CAPEX (Capital Expenditure) is a whole cost which shall be paid once in a while to devote equipment in LNG receiving terminal. This cost included procurement for jetty facilities, LNG offloading facilities, cryogenics pipe, LNG storage tank, LNG pump, LNG vaporizer, BOG compressor, generator, supporting building, and component installation. The price list was taken from the data which provided by Antara (2016). Nevertheless, the total cost was adjusted in order to conform power plant capacity.

Table 4.16 Terminal investment

No	Location	Total Cap (MW)	LNG (m³/day)	Terminal Investment (USD)
1	Biak	95	524.4	25,169,268
2	Bintuni	10	55.2	16,651,268
3	Fak Fak	20	110.4	18,265,268
4	Jayapura	340	1876.8	56,777,268
5	Kaimana	20	110.4	17,465,268
6	Manokwari	60	331.2	21,351,268
7	Merauke	60	331.2	22,951,268
8	Nabire	40	220.8	19,093,268
9	Raja Ampat	10	55.2	16,651,268
10	Sarmi	5	27.6	15,845,268
11	Serui	30	165.6	19,079,268
12	Sorong	100	552.0	25,175,268
13	Timika	80	441.6	25,779,268
TOTAL INVESTMENT				**300,254,478**

On the other hand, OPEX (Operational Expenditure) was a whole cost shall be paid regularly during project lifetime to run the LNG distribution. OPEX consisted of operational cost in LNG receiving terminal and transportation cost to distribute LNG from production terminal to receiving terminal. Antara (2016) stated operational cost consisted of charter hire, fuel cost, port cost, receiving terminal operational cost, electricity and fuel cost for running receiving terminal, maintenance cost, and manning cost. The price list was taken from the latest research by Antara (2016) by adjusting some variables in order to conform the power plant capacity.

Table 4.17 Operational Cost

Loc.	LNG Dem. (m³)	MTPA (ton)	Opt. Cost (USD)	Power&Fuel Cost (USD)	Maint. Cost (USD)	Man. Cost (USD)
Biak	524.4	88,047	880,468	3,521,870	1,320,701	2,641,403
Bintuni	55.2	9,268	92,681	370,723	139,021	278,042
Fakfak	110.4	18,536	185,362	741,446	278,042	556,085
Jayapura	1,876.8	315,115	3,151,147	12,604,589	4,726,721	9,453,442
Kaimana	110.4	18,536	185,362	741,446	278,042	556,085
Manokwari	331.2	55,608	556,085	2,224,339	834,127	1,668,254
Merauke	331.2	55,608	556,085	2,224,339	834,127	1,668,254
Nabire	220.8	37,072	370,723	1,482,893	556,085	1,112,170
Raja Ampat	55.2	9,268	92,681	370,723	139,021	278,042
Sarmi	27.6	4,634	46,340	185,362	69,511	139,021
Serui	165.6	27,804	278,042	1,112,170	417,064	834,127
Sorong	552.0	92,681	926,808	3,707,232	1,390,212	2,780,424
Timika	441.6	74,145	741,446	2,965,786	1,112,170	2,224,339
TOTAL			**4,495,019**	**17,980,075**	**6,742,528**	**13,485,056**

4.3.2 Revenue

Revenue was taken from discrepancy between LNG buying price and LNG selling price. LNG selling price was decided so that the profit was acquired by company. The discrepancy was called as margin. This research used different margin as shown in Table 4.19. Later, margin was multiplied to total gas proceed in this project a year in order to obtain annual cash flow from this project. Annual cash flow was used to calculate PBP, NPV, and ROI as well described in next section.

Table 4.18 Margin Variation

Gas Processing	mmbtu day	110,455	
	mmbtu year	40,316,148	
Margin (USD)	1.50	2.00	2.50
Revenue (USD)	60,474,222	80,632,296	100,790,370
Margin (USD)	3.00	3.50	4.00
Revenue (USD)	120,948,444.00	141,106,518.00	161,264,592.00

4.3.3 *Payback Period* (PBP)

PBP indicated the time to recover the invested money. It was widely used by practitioners (Chiesa and Frattini, 2009). PBP is also used as a measure of the attractiveness of capital budgeting investment. It is simply calculated as stared as Equation (3.16).

4.3.4 Net Present Value (NPV)

In this research, the project was assessed by NPV approach which was simply calculated as Equation (3.17).

4.3.5 Return on Investment (ROI)

In addition, ROI was calculated by using Equation (3.18). The annual cash flow was calculated by subtracting the revenue with the annual operational cost, depreciation, and tax. The revenue was calculated by defining the profit margin pm = {1.5, 2, 2.5, …, 4}. Later, a profit margin used in a case where $NPV > 0$ was utilized as the profitability judgment for the project. Furthermore, the example of PBP and ROI calculation was shown in Table 4.21 and NPV calculation was shown in Table 4.19 and 4.20.

Margin $ 1.50

Table 4.19 Annual cash flow and ROI for margin $ 1.50

Year	Cumulative Investment	Revenue (USD)	Operational Cost (USD)	Depreciation (USD)	Earning Before Tax (USD)	Tax 25% (USD)	Earning After Tax (USD)	Proceeds (USD)	Cumulative Proceeds (USD)	Inv. Before Payback (USD)
0	300,254,478									300,254,478
0	300,254,478									300,254,478
1		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	15,955,884	-284,298,593
2		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	31,911,768	-268,342,709
3		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	47,867,653	-252,386,825
4		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	63,823,537	-236,430,941
5		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	79,779,421	-220,475,056
6		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	95,735,305	-204,519,172
7		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	111,691,190	-188,563,288
8		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	127,647,074	-172,607,404
9		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	143,602,958	-156,651,519
10		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	159,558,842	-140,695,635
11		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	175,514,727	-124,739,751
12		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	191,470,611	-108,783,867
13		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	207,426,495	-92,827,983
14		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	223,382,379	-76,872,098
15		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	239,338,263	-60,916,214
16		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	255,294,148	-44,960,330
17		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	271,250,032	-29,004,446
18		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	287,205,916	-13,048,561
19		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	303,161,800	2,907,323
20		60,474,222	42,702,679	10,508,907	7,262,637	1,815,659	5,446,978	15,955,884	319,117,685	18,863,207
ROI	5.31%									

Table 4.20 Net present value calculation

Year	Investment (USD)	Proceeds (USD)	I 5.0%	NPV (USD)	i 7.5%	NPV (USD)	i 10.0%	NPV (USD)	i 12.5%	NPV (USD)
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		15,955,884	0.9524	15,196,080	0.9302	14,842,683	0.9091	14,505,349	0.8889	14,183,008
2		15,955,884	0.9070	14,472,457	0.8653	13,807,147	0.8264	13,186,681	0.7901	12,607,118
3		15,955,884	0.8638	13,783,293	0.8050	12,843,858	0.7513	11,987,892	0.7023	11,206,327
4		15,955,884	0.8227	13,126,945	0.7488	11,947,775	0.6830	10,898,084	0.6243	9,961,180
5		15,955,884	0.7835	12,501,853	0.6966	11,114,209	0.6209	9,907,349	0.5549	8,854,382
6		15,955,884	0.7462	11,906,526	0.6480	10,338,799	0.5645	9,006,681	0.4933	7,870,562
7		15,955,884	0.7107	11,339,549	0.6028	9,617,487	0.5132	8,187,892	0.4385	6,996,055
8		15,955,884	0.6768	10,799,571	0.5607	8,946,500	0.4665	7,443,538	0.3897	6,218,716
9		15,955,884	0.6446	10,285,305	0.5216	8,322,326	0.4241	6,766,853	0.3464	5,527,747
10		15,955,884	0.6139	9,795,529	0.4852	7,741,698	0.3855	6,151,684	0.3079	4,913,553
11		15,955,884	0.5847	9,329,075	0.4513	7,201,580	0.3505	5,592,440	0.2737	4,367,603
12		15,955,884	0.5568	8,884,833	0.4199	6,699,144	0.3186	5,084,036	0.2433	3,882,314
13		15,955,884	0.5303	8,461,746	0.3906	6,231,762	0.2897	4,621,851	0.2163	3,450,945
14		15,955,884	0.5051	8,058,806	0.3633	5,796,988	0.2633	4,201,683	0.1922	3,067,507
15		15,955,884	0.4810	7,675,053	0.3380	5,392,547	0.2394	3,819,712	0.1709	2,726,673
16		15,955,884	0.4581	7,309,574	0.3144	5,016,322	0.2176	3,472,465	0.1519	2,423,709
17		15,955,884	0.4363	6,961,499	0.2925	4,666,347	0.1978	3,156,787	0.1350	2,154,408
18		15,955,884	0.4155	6,629,999	0.2720	4,340,787	0.1799	2,869,806	0.1200	1,915,030
19		15,955,884	0.3957	6,314,285	0.2531	4,037,942	0.1635	2,608,915	0.1067	1,702,248
20		15,955,884	0.3769	6,013,605	0.2354	3,756,225	0.1486	2,371,741	0.0948	1,513,110
			Total	(101,408,892)	Total	(137,592,354)	Total	(164,413,040)	Total	(184,712,282)

Year	Investment (USD)	Proceeds (USD)	I 15.0%	NPV (USD)	i 17.5%	NPV (USD)	i 20.0%	NPV (USD)	i 22.5%	NPV (USD)
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		15,955,884	0.8696	13,874,682	0.8511	13,579,476	0.8333	13,296,570	0.8163	13,025,212
2		15,955,884	0.7561	12,064,941	0.7243	11,557,001	0.6944	11,080,475	0.6664	10,632,826
3		15,955,884	0.6575	10,491,253	0.6164	9,835,745	0.5787	9,233,729	0.5440	8,679,858
4		15,955,884	0.5718	9,122,829	0.5246	8,370,847	0.4823	7,694,774	0.4441	7,085,598
5		15,955,884	0.4972	7,932,894	0.4465	7,124,125	0.4019	6,412,312	0.3625	5,784,162
6		15,955,884	0.4323	6,898,169	0.3800	6,063,085	0.3349	5,343,593	0.2959	4,721,765
7		15,955,884	0.3759	5,998,408	0.3234	5,160,073	0.2791	4,452,994	0.2416	3,854,502
8		15,955,884	0.3269	5,216,007	0.2752	4,391,551	0.2326	3,710,829	0.1972	3,146,532
9		15,955,884	0.2843	4,535,658	0.2342	3,737,490	0.1938	3,092,357	0.1610	2,568,598
10		15,955,884	0.2472	3,944,051	0.1994	3,180,843	0.1615	2,576,964	0.1314	2,096,814
11		15,955,884	0.2149	3,429,609	0.1697	2,707,100	0.1346	2,147,470	0.1073	1,711,685
12		15,955,884	0.1869	2,982,269	0.1444	2,303,915	0.1122	1,789,559	0.0876	1,397,294
13		15,955,884	0.1625	2,593,277	0.1229	1,960,779	0.0935	1,491,299	0.0715	1,140,648
14		15,955,884	0.1413	2,255,024	0.1046	1,668,748	0.0779	1,242,749	0.0584	931,141
15		15,955,884	0.1229	1,960,890	0.0890	1,420,211	0.0649	1,035,624	0.0476	760,115
16		15,955,884	0.1069	1,705,122	0.0758	1,208,690	0.0541	863,020	0.0389	620,502
17		15,955,884	0.0929	1,482,715	0.0645	1,028,673	0.0451	719,183	0.0317	506,533
18		15,955,884	0.0808	1,289,317	0.0549	875,466	0.0376	599,320	0.0259	413,496
19		15,955,884	0.0703	1,121,145	0.0467	745,077	0.0313	499,433	0.0212	337,548
20		15,955,884	0.0611	974,909	0.0397	634,108	0.0261	416,194	0.0173	275,549
			Total	(200,381,309)	Total	(212,701,473)	Total	(222,556,027)	Total	(230,564,099)

Table 4.21 Net present value calculation

Discount Rate	NPV	Discount Rate	NPV
5.00%	$ (101,408,892.05)	15.00%	$ (200,381,309.16)
7.50%	$ (137,592,353.61)	17.50%	$ (212,701,473.09)
10.00%	$ (164,413,040.42)	20.00%	$ (222,556,027.03)
12.50%	$ (184,712,281.61)	22.50%	$ (230,564,099.45)

It was concluded from the example for margin USD 1.5 that the NPV is less than zero. Thus, this scenario did not attractive to be applied practically. The next section explained the result and conclusion after analyzing every scenario profoundly.

4.3.6 Economic Assessment

In this case study, profit margins were iterated among the defined set. First, USD 1.5 was set as the initial profit margin. However, it led to a result of 19 years for PBP, as shown in Figure 4.5.
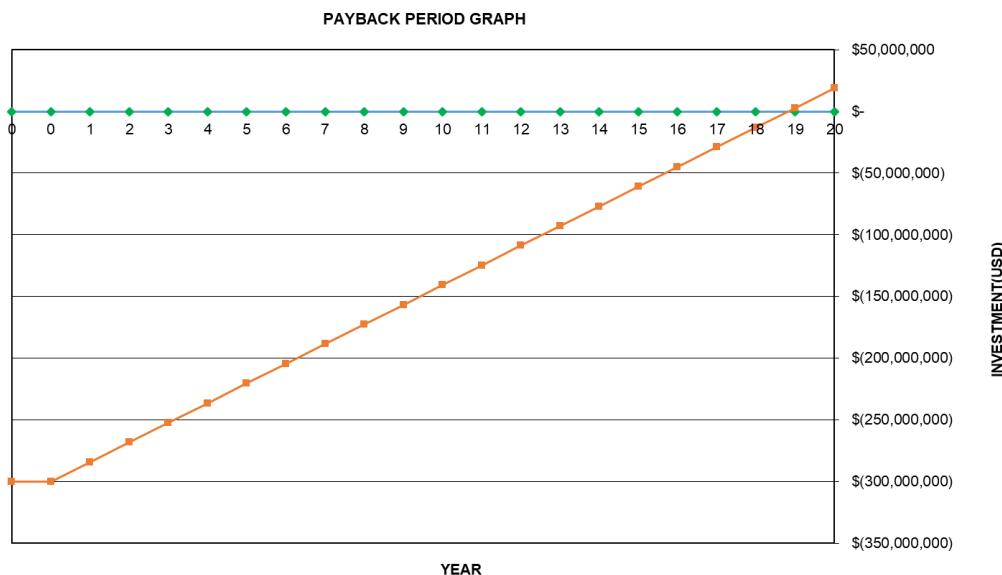
Figure 4.3 Payback Period Graph

Additionally, the NPV < 0 which simply means this first scenario cash flow was unattractive, as shown in Figure 4.4 as follows:
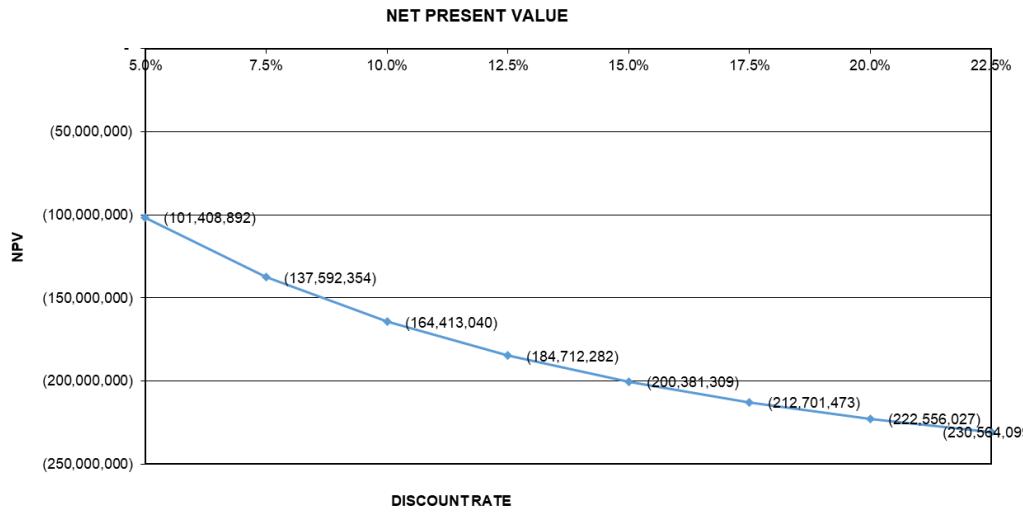
Figure 4.4 Net Present Value for Margin USD 1.50

Later, USD 2.00 was taken for another scenario (shown in appendix). The result showed that by applying this scenario, the payback was achieved after 10 years. Referring to the NPV value, this scenario was more attractive to be applied since NPV > 0, indicated that a feasible condition was acquired. Besides, by iterating other profit margins, the payback period was accelerated. Moreover, the greater profit margin the greater NPV will be achieved, indicated that the project becomes more profitable. Nevertheless, the profit margin was decided by the company in order to accomplish higher profit.

On the other hand, Antara (2016) stated that minimum profit margin to achieve NPV > 0 in order to meet a feasible condition in this case study is USD 4.00. Whereas, by enhancing the method in this research, the minimum profit margin to meet feasible condition was USD 2.00 (refer to Table 4.22), 50% smaller than the earlier research done by Antara (2016).

Table 4.22 Economic Assessment Result

Margin (USD)	PBP (years)	NPV (USD)	ROI
1.5	19	$ (137,592,353.61)	5.31%
2	10	$ 16,533,629.80	10.35%
2.5	7	$ 170,659,613.21	15.38%

3	5	$	324,785,596.62	20.42%
3.5	4	$	478,911,580.02	25.46%
4	4	$	633,037,563.43	30.49%

This research proposed smaller-size ship than the earlier research with smaller value of profit margin to meet feasible solution, indicated that the smaller size ship utilization offers more profit for this case study. Furthermore, referring to Soegiono and Artana (2006), when the small amounts of LNG demand dispersed geographically far from each other (e.g., LNG distribution in Indonesia), utilizing small-size ship will be more efficient. Finally, the economic assessment's result proved this line by offering more profit in this case study than the earlier research.

CHAPTER V
CONCLUSION AND SUGGESTION

5.1 Conclusion

In this paper, a greedy approach as a heuristic method was presented to solve the LNG capacitated vehicle routing problem in LNG distribution to the power plants in Papua, Indonesia. The given solution assigned one ship with 2500 m^3 ship capacity, four ships with 7500 m^3 ship capacity, and two ships with 23000 m^3 ship capacity. The solution offered the utilization of smaller-size ship than the earlier research. It was considered more reliable to cope with uncertain weather in Indonesia. Moreover, the utilization of small-size ships was considered to become more profitable in Indonesia. As shown in the economic assessment section, small-size ships utilization only required a profit margin of USD 2.00 to become a profitable project.

5.2 Suggestion

This research was an enhancement of the latest research by Antara (2016) by modifying the algorithm in order to conform the newest power plant capacity data. Nevertheless, enhancement of heuristic algorithm in this research is required to obtain a better result in a short time for other case studies, particularly LNG distribution in Indonesia. In addition, the newest price list data is also required in order to conform different situation practically nowadays.

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APPENDIXES

Appendix A Distance Matrix

Distance (Km)		X1.Bi	X2.Bn	X3.Fa	X4.Jp	X5.Ka	X6.Mw	X7.Me	X8.Na	X9.Ra	X10.Sa	X11.Se	X12. So	X13. Ti	X14.Ta
		7	1	-1	9	-2	4	-4	5	3	8	6	2	-3	0
X1.Bi	7	-	1,140	1,006	617	1,356	238	2,225	283	604	353	210	619	1,608	1,243
X2.Bn	1		-	286	1,717	631	976	1,516	1,255	693	1,461	1,208	586	892	78
X3.Fa	-1			-	1,590	379	851	1,261	1,128	566	1,338	1,081	458	642	211
X4.Jp	9				-	1,931	825	2,805	872	1,179	289	800	1,197	2,189	1,827
X5.Ka	-2					-	1,189	1,045	1,466	902	1,678	1,426	789	427	560
X6.Mw	4						-	2,076	328	440	563	289	461	1,448	1,087
X7.Me	-4							-	2,350	1,778	2,555	2,299	1,675	762	1,456
X8.Na	5								-	722	611	192	737	1,732	1,356
X9.Ra	3									-	926	675	117	1,165	665
X10.Sa	8										-	536	950	1,938	1,572
X11.Se	6											-	696	1,683	1,319
X12. So	2												-	1,059	517
X13. Ti	-3													-	822
X14.Ta	0														-

Appendix B Feasibility for land transport (self-judgment)

Feasibility for Land Transport															
		X1.Bi	X2.Bn	X3.Fa	X4.Jp	X5.Ka	X6.Mw	X7.Me	X8.Na	X9.Ra	X10.Sa	X11.Se	X12. So	X13. Ti	X14.Ta
		7	1	-1	9	-2	4	-4	5	3	8	6	2	-3	0
X1.Bi	7	-	N	N	N	N	N	N	N	N	N	N	N	N	N
X2.Bn	1		-	Y	N	Y	Y	N	Y	N	N	N	Y	N	Y
X3.Fa	-1			-	N	Y	Y	N	Y	N	N	N	Y	N	Y
X4.Jp	9				-	N	N	N	N	N	Y	N	N	N	N
X5.Ka	-2					-	Y	N	Y	N	N	N	N	Y	Y
X6.Mw	4						-	N	N	N	N	N	Y	N	Y
X7.Me	-4							-	N	N	N	N	N	N	N
X8.Na	5								-	N	N	N	N	Y	Y
X9.Ra	3									-	N	N	N	N	N
X10.Sa	8										-	N	N	N	N
X11.Se	6											-	N	N	N
X12. So	2												-	N	Y
X13. Ti	-3													-	N
X14.Ta	0														-

Appendix C Combination Routes

No. Alt. Rute	Consumer Port Code															Total Consumers	Total Distance	Turn Round Voyage		Total LNG Volume/trip (m³)	Ship Capacity	Total Transportation Cost ($/year)	Total Transportation Cost for 20 years	Total Inventory Cost ($)	Total Cost ($)
	0	7	1	-1	9	-2	4	-4	5	3	8	6	2	-3	0			Hours	Days						
	X14	X1.Bi	X2.B	X3.Fa	X4.Jp	X5.K	X6.M	X7.M	X8.N	X9.R	X10.S	X11.S	X12.S	X13.Ti	X14										
1	1	1													1	1	2,486	127.3	5.3	4353.8	7,500	$ 9,744,53	$ 194,890,737	$ 3,485,526,776	$ 3,680,417,513
2	1		1												1	1	156	30.5	1.3	235.7	2,500	$ 8,344,73	$ 166,894,698	$ 191,087,939	$ 357,982,637
3	1			1											1	1	422	41.5	1.7	522.2	2,500	$ 7,872,57	$ 157,451,446	$ 420,308,102	$ 577,759,548
4	1				1										1	1	3,654	175.8	7.3	19375.6	23,000	$ 15,450,98	$ 309,019,686	$ 15,502,979,163	$ 15,811,998,849
5	1					1									1	1	1,120	70.5	2.9	655.6	2,500	$ 7,337,06	$ 146,741,320	$ 526,996,920	$ 673,738,240
6	1						1								1	1	2,174	114.3	4.8	2570.9	7,500	$ 9,814,78	$ 196,295,590	$ 2,059,248,896	$ 2,255,544,486
7	1							1							1	1	2,912	145.0	6.0	2993.9	7,500	$ 9,668,91	$ 193,378,210	$ 2,397,657,269	$ 2,591,035,479
8	1								1						1	1	2,712	136.6	5.7	1919.5	2,500	$ 6,965,87	$ 139,317,403	$ 1,538,140,353	$ 1,677,457,755
9	1									1					1	1	1,330	79.2	3.3	347.9	2,500	$ 7,252,63	$ 145,052,654	$ 280,810,484	$ 425,863,138
10	1										1				1	1	3,144	154.6	6.4	260.6	2,500	$ 6,919,92	$ 138,398,413	$ 210,985,251	$ 349,383,664
11	1											1			1	1	2,638	133.6	5.6	1418.4	2,500	$ 6,974,98	$ 139,499,592	$ 1,137,270,414	$ 1,276,770,006
12	1												1		1	1	1,034	66.9	2.8	3195.8	7,500	$ 10,302,64	$ 206,052,842	$ 2,559,156,628	$ 2,765,209,470
13	1													1	1	1	1,644	92.3	3.8	3022.8	7,500	$ 9,979,32	$ 199,586,428	$ 2,420,782,758	$ 2,620,369,187
14	1	1	1												1	2	2,461	138.2	5.8	5076.8	7,500	$ 9,695,40	$ 193,908,067	$ 4,063,936,997	$ 4,257,845,064
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
8188	1	1	1		1	1	1	1	1	1	1	1	1	1	1	12	14,102	741.7	30.9	159083.9	-	$ -	$ -	$ 127,269,667,211	$ 127,269,667,211
8189	1	1		1	1	1	1	1	1	1	1	1	1	1	1	12	14,108	742.0	30.9	161004.8	-	$ -	$ -	$ 128,806,362,822	$ 128,806,362,822
8190	1		1	1	1	1	1	1	1	1	1	1	1	1	1	12	14,261	748.3	31.2	146224.3	-	$ -	$ -	$ 116,981,956,362	$ 116,981,956,362
8191	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	16,566	856.1	35.7	185707.0	-	$ -	$ -	$ 148,568,148,686	$ 148,568,148,686

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Appendix D Roulette Wheel Selection 7500 m³

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
129	608	4	$ 5,591,940,040.93	5591940041	0.007732838	0.007732838	0.892518777	Y
169	1637	5	$ 5,589,979,522.21	5589979522	0.007730127	0.015462965	0.300449352	Y
151	722	4	$ 5,529,124,387.74	5529124388	0.007645973	0.023108939	0.054005295	Y
111	315	3	$ 5,521,545,191.90	5521545192	0.007635492	0.030744431	0.924636983	Y
173	1688	5	$ 5,504,035,861.83	5504035862	0.00761128	0.038355711	0.444835039	Y
34	74	2	$ 5,469,904,291.37	5469904291	0.007564081	0.045919791	0.310227889	Y
123	370	3	$ 5,448,494,642.59	5448494643	0.007534474	0.053454266	0.409262946	Y
104	298	3	$ 5,444,371,522.65	5444371523	0.007528773	0.060983038	0.20719432	Y
146	694	4	$ 5,438,237,879.70	5438237880	0.007520291	0.068503329	0.906197393	Y
143	682	4	$ 5,427,412,369.11	5427412369	0.00750532	0.076008649	0.946870803	Y
122	369	3	$ 5,420,861,085.54	5420861086	0.007496261	0.08350491	0.876716252	Y
168	1078	4	$ 5,411,981,067.33	5411981067	0.007483981	0.090988891	0.313457691	Y
82	209	3	$ 5,410,806,584.82	5410806585	0.007482357	0.098471248	0.352208238	Y
162	838	4	$ 5,403,495,247.00	5403495247	0.007472247	0.105943495	0.794577375	Y
128	607	4	$ 5,403,197,171.81	5403197172	0.007471834	0.113415329	0.527798083	Y
114	329	3	$ 5,398,658,828.47	5398658828	0.007465559	0.120880888	0.530583849	Y
81	208	3	$ 5,375,271,716.36	5375271716	0.007433218	0.128314105	0.986917794	Y
90	231	3	$ 5,362,700,933.02	5362700933	0.007415834	0.135729939	0.035736418	N
133	614	4	$ 5,332,605,378.40	5332605378	0.007374216	0.143104156	0.803195486	Y
12	23	2	$ 5,327,573,025.81	5327573026	0.007367257	0.150471413	0.363479899	Y
88	228	3	$ 5,317,281,917.22	5317281917	0.007353026	0.157824439	0.665842348	Y
41	89	2	$ 5,295,149,396.56	5295149397	0.00732242	0.165146859	0.35436909	Y
156	801	4	$ 5,289,971,817.61	5289971818	0.00731526	0.172462119	0.326453145	Y
59	148	3	$ 5,281,659,214.00	5281659214	0.007303765	0.179765884	0.550413614	Y
140	635	4	$ 5,271,358,285.30	5271358285	0.00728952	0.187055405	0.858049713	Y
164	867	4	$ 5,262,177,579.16	5262177579	0.007276825	0.194332229	0.198596727	Y
9	17	2	$ 5,256,128,867.08	5256128867	0.00726846	0.20160069	0.152040174	N
55	99	3	$ 5,238,051,445.77	5238051446	0.007243462	0.208844152	0.142862196	N
172	1646	5	$ 5,221,233,412.57	5221233413	0.007220205	0.216064357	0.537669884	Y
176	2048	5	$ 5,219,287,739.05	5219287739	0.007217514	0.223281871	0.485779268	Y
126	379	4	$ 5,164,531,916.73	5164531917	0.007141795	0.230423666	0.929634795	Y
153	744	4	$ 5,162,847,016.62	5162847017	0.007139465	0.237563131	0.309382132	Y
110	314	3	$ 5,149,519,713.25	5149519713	0.007121035	0.244684167	0.738895727	Y
118	348	3	$ 5,132,033,378.29	5132033378	0.007096854	0.251781021	0.208656218	N
76	194	3	$ 5,125,737,160.93	5125737161	0.007088148	0.258869169	0.433599523	Y
127	383	4	$ 5,122,009,230.62	5122009231	0.007082992	0.265952161	0.906750762	Y
116	334	3	$ 5,092,055,378.27	5092055378	0.007041571	0.272993732	0.222470845	N
171	1643	5	$ 5,079,715,790.85	5079715791	0.007024507	0.280018239	0.477884754	Y
69	183	3	$ 5,069,342,810.85	5069342811	0.007010162	0.287028401	0.159882455	N
166	1003	4	$ 5,019,227,873.12	5019227873	0.006940861	0.293969262	0.032577289	N
158	813	4	$ 5,009,880,105.27	5009880105	0.006927934	0.300897196	0.08801339	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
58	125	3	$ 4,988,530,974.34	4988530974	0.006898411	0.307795607	0.293033861	N
113	328	3	$ 4,978,978,739.59	4978978740	0.006885202	0.31468081	0.772480154	Y
105	302	3	$ 4,963,824,198.82	4963824199	0.006864246	0.321545055	0.844253956	Y
100	251	3	$ 4,947,126,228.84	4947126229	0.006841155	0.32838621	0.769705478	Y
135	618	4	$ 4,932,518,285.76	4932518286	0.006820954	0.335207164	0.999637332	Y
71	186	3	$ 4,925,333,451.56	4925333452	0.006811018	0.342018182	0.625673849	Y
138	630	4	$ 4,917,393,789.66	4917393790	0.006800039	0.348818221	0.565871715	Y
142	681	4	$ 4,917,393,789.66	4917393790	0.006800039	0.355618261	0.910498802	Y
94	238	3	$ 4,872,535,242.09	4872535242	0.006738006	0.362356267	0.961837822	Y
93	234	3	$ 4,868,341,113.26	4868341113	0.006732206	0.369088473	0.114887437	N
150	718	4	$ 4,849,730,009.80	4849730010	0.00670647	0.375794943	0.633113866	Y
117	337	3	$ 4,835,521,092.71	4835521093	0.006686821	0.382481764	0.270810504	N
130	609	4	$ 4,830,608,874.46	4830608874	0.006680028	0.389161792	0.886906098	Y
84	223	3	$ 4,764,251,316.44	4764251316	0.006588265	0.395750058	0.34793882	N
157	812	4	$ 4,746,883,762.90	4746883763	0.006564249	0.402314306	0.043065573	N
154	747	4	$ 4,724,612,383.39	4724612383	0.00653345	0.408847757	0.573460462	Y
39	87	2	$ 4,719,978,045.86	4719978046	0.006527042	0.415374799	0.342079848	N
175	1838	5	$ 4,695,851,405.94	4695851406	0.006493678	0.421868477	0.137428686	N
40	88	2	$ 4,695,556,707.46	4695556707	0.006493271	0.428361748	0.966004275	Y
8	15	2	$ 4,643,770,686.43	4643770686	0.006421658	0.434783406	0.365975066	N
163	863	4	$ 4,626,099,138.32	4626099138	0.006397221	0.441180627	0.74983855	Y
108	309	3	$ 4,613,141,639.88	4613141640	0.006379303	0.44755993	0.047455892	N
11	22	2	$ 4,602,767,822.09	4602767822	0.006364957	0.453924887	0.340308904	N
83	222	3	$ 4,592,795,983.90	4592795984	0.006351168	0.460276054	0.664382392	Y
103	297	3	$ 4,592,442,135.88	4592442136	0.006350678	0.466626733	0.174034947	N
89	229	3	$ 4,533,841,946.04	4533841946	0.006269643	0.472896375	0.667705694	Y
145	693	4	$ 4,511,108,013.08	4511108013	0.006238205	0.479134581	0.992532901	Y
80	206	3	$ 4,510,517,850.92	4510517851	0.006237389	0.485371969	0.729049509	Y
99	250	3	$ 4,472,074,045.03	4472074045	0.006184227	0.491556196	0.556024815	Y
120	359	3	$ 4,448,297,234.85	4448297235	0.006151347	0.497707543	0.153494136	N
74	189	3	$ 4,437,394,105.87	4437394106	0.006136269	0.503843813	0.461926751	N
75	193	3	$ 4,426,947,279.24	4426947279	0.006121823	0.509965636	0.518981509	Y
63	166	3	$ 4,400,967,459.55	4400967460	0.006085897	0.516051532	0.669018155	Y
134	617	4	$ 4,396,962,016.91	4396962017	0.006080358	0.52213189	0.755843891	Y
66	178	3	$ 4,388,829,836.73	4388829837	0.006069112	0.528201002	0.360204807	N
161	821	4	$ 4,376,685,707.69	4376685708	0.006052319	0.534253321	0.248636279	N
56	104	3	$ 4,368,783,700.67	4368783701	0.006041391	0.540294712	0.472005941	N
57	108	3	$ 4,337,194,491.93	4337194492	0.005997708	0.54629242	0.816402687	Y
144	692	4	$ 4,313,445,327.65	4313445328	0.005964866	0.552257287	0.427308657	N
174	1698	5	$ 4,306,287,677.36	4306287677	0.005954968	0.558212255	0.021952523	N
29	65	2	$ 4,300,388,786.32	4300388786	0.005946811	0.564159066	0.349902423	N
61	161	3	$ 4,300,365,588.54	4300365589	0.005946779	0.570105845	0.356936845	N
10	21	2	$ 4,298,598,269.10	4298598269	0.005944335	0.57605018	0.73665678	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
27	62	2	$ 4,294,858,524.85	4294858525	0.005939164	0.581989344	0.861699989	Y
70	184	3	$ 4,272,052,380.06	4272052380	0.005907626	0.587896969	0.763525855	Y
132	612	4	$ 4,268,315,689.46	4268315689	0.005902459	0.593799428	0.932813344	Y
160	818	4	$ 4,267,096,016.90	4267096017	0.005900772	0.5997002	0.799493267	Y
7	14	2	$ 4,257,845,064.17	4257845064	0.005887979	0.605588179	0.428204972	N
33	73	2	$ 4,256,004,202.55	4256004203	0.005885434	0.611473613	0.271948225	N
65	177	3	$ 4,234,542,436.62	4234542437	0.005855755	0.617329368	0.264208009	N
53	94	3	$ 4,172,968,919.78	4172968920	0.005770608	0.623099976	0.057228401	N
64	167	3	$ 4,163,296,358.67	4163296359	0.005757232	0.628857208	0.825576762	Y
115	333	3	$ 4,155,422,828.01	4155422828	0.005746344	0.634603553	0.204315705	N
92	233	3	$ 4,147,349,312.43	4147349312	0.00573518	0.640338732	0.501350852	N
102	296	3	$ 4,144,737,310.04	4144737310	0.005731568	0.6460703	0.481432828	N
97	245	3	$ 4,141,995,477.02	4141995477	0.005727776	0.651798076	0.006489477	N
79	205	3	$ 4,137,970,938.69	4137970939	0.005722211	0.657520287	0.49469041	N
137	629	4	$ 4,120,495,545.93	4120495546	0.005698045	0.663218332	0.556787523	N
85	224	3	$ 4,045,824,370.17	4045824370	0.005594786	0.668813118	0.980683848	Y
121	362	3	$ 4,039,365,137.25	4039365137	0.005585853	0.674398971	0.868427313	Y
152	743	4	$ 4,031,824,899.44	4031824899	0.005575426	0.679974398	0.674826605	N
54	98	3	$ 4,000,950,672.03	4000950672	0.005532732	0.685507129	0.13220068	N
170	1642	5	$ 3,971,803,621.16	3971803621	0.005492426	0.690999555	0.667150532	N
136	628	4	$ 3,897,058,856.62	3897058857	0.005389065	0.69638862	0.643628203	N
167	1013	4	$ 3,878,174,221.44	3878174221	0.00536295	0.701751569	0.68222375	N
149	701	4	$ 3,877,678,634.96	3877678635	0.005362265	0.707113834	0.988463129	Y
31	68	2	$ 3,837,844,282.62	3837844283	0.005307179	0.712421013	0.914799103	Y
148	698	4	$ 3,821,279,956.02	3821279956	0.005284273	0.717705287	0.537951334	N
37	85	2	$ 3,808,398,192.01	3808398192	0.00526646	0.722971747	0.107005114	N
60	160	3	$ 3,766,571,139.58	3766571140	0.005208619	0.728180366	0.161609485	N
107	308	3	$ 3,718,166,143.00	3718166143	0.005141682	0.733322048	0.342557531	N
78	200	3	$ 3,699,731,043.40	3699731043	0.005116189	0.738438236	0.268631869	N
1	1	1	$ 3,680,417,512.54	3680417513	0.005089481	0.743527718	0.797634743	Y
73	188	3	$ 3,677,650,270.15	3677650270	0.005085654	0.748613372	0.09922849	N
21	45	2	$ 3,675,835,258.12	3675835258	0.005083145	0.753696517	0.498543225	N
91	232	3	$ 3,674,161,280.74	3674161281	0.00508083	0.758777346	0.382711091	N
32	72	2	$ 3,669,889,637.21	3669889637	0.005074923	0.763852269	0.177507718	N
24	57	2	$ 3,655,938,024.31	3655938024	0.00505563	0.768907898	0.304493415	N
67	179	3	$ 3,627,714,150.01	3627714150	0.0050166	0.773924499	0.064273111	N
17	40	2	$ 3,574,960,948.47	3574960948	0.00494365	0.778868149	0.876217195	Y
28	63	2	$ 3,568,935,591.92	3568935592	0.004935318	0.783803467	0.178351962	N
106	307	3	$ 3,564,796,599.81	3564796600	0.004929594	0.788733061	0.66464225	N
165	873	4	$ 3,538,807,416.59	3538807417	0.004893655	0.793626716	0.927757865	Y
141	637	4	$ 3,538,312,173.61	3538312174	0.00489297	0.798519686	0.178052557	N
87	227	3	$ 3,523,213,068.78	3523213069	0.00487209	0.803391776	0.010433127	N
23	56	2	$ 3,518,960,969.76	3518960970	0.00486621	0.808257987	0.654187152	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
86	92	3	$ 3,516,263,637.69	3516263638	0.00486248	0.813120467	0.92444853	Y
36	84	2	$ 3,480,506,522.44	3480506522	0.004813033	0.8179335	0.378906847	N
22	46	2	$ 3,467,274,537.42	3467274537	0.004794735	0.822728236	0.644474823	N
139	634	4	$ 3,458,135,593.65	3458135594	0.004782098	0.827510333	0.803840987	N
43	35	2	$ 3,382,317,417.82	3382317418	0.004677252	0.832187585	0.861519543	Y
96	244	3	$ 3,377,931,164.06	3377931164	0.004671187	0.836858772	0.791546117	N
119	358	3	$ 3,329,504,822.92	3329504823	0.00460422	0.841462992	0.65048419	N
72	187	3	$ 3,282,885,450.73	3282885451	0.004539752	0.846002744	0.53975632	N
62	162	3	$ 3,263,709,731.24	3263709731	0.004513235	0.850515979	0.99798148	Y
15	36	2	$ 3,220,361,135.87	3220361136	0.00445329	0.854969269	0.552646105	N
14	30	2	$ 3,217,424,600.93	3217424601	0.004449229	0.859418499	0.46971997	N
131	611	4	$ 3,206,247,389.83	3206247390	0.004433773	0.863852272	0.128007679	N
159	817	4	$ 3,204,990,237.04	3204990237	0.004432034	0.868284306	0.236653847	N
95	243	3	$ 3,198,741,097.94	3198741098	0.004423393	0.872707699	0.139208232	N
112	316	3	$ 3,127,092,236.63	3127092237	0.004324313	0.877032012	0.041769067	N
35	79	2	$ 3,119,999,672.81	3119999673	0.004314505	0.881346517	0.385558528	N
109	313	3	$ 3,102,799,333.20	3102799333	0.004290719	0.885637236	0.779176355	N
68	182	3	$ 3,101,885,808.97	3101885809	0.004289456	0.889926692	0.010018816	N
16	39	2	$ 3,101,266,681.39	3101266681	0.0042886	0.894215292	0.493586143	N
30	67	2	$ 3,086,552,033.09	3086552033	0.004268252	0.898483544	0.792296777	N
155	753	4	$ 3,021,495,592.30	3021495592	0.004178288	0.902661832	0.907567963	Y
25	58	2	$ 2,937,089,933.66	2937089934	0.004061567	0.9067234	0.387735854	N
77	199	3	$ 2,885,451,938.14	2885451938	0.00399016	0.910713559	0.879728294	N
101	252	3	$ 2,838,573,958.31	2838573958	0.003925334	0.914638893	0.921782686	Y
98	249	3	$ 2,790,130,062.76	2790130063	0.003858343	0.918497237	0.089518739	N
50	165	3	$ 2,786,937,493.17	2786937493	0.003853928	0.922351165	0.699228432	N
51	198	3	$ 2,766,871,341.02	2766871341	0.00382618	0.926177345	0.839943933	N
5	12	1	$ 2,765,209,470.37	2765209470	0.003823882	0.930001227	0.642948274	N
38	66	2	$ 2,761,136,950.74	2761136951	0.00381825	0.933819477	0.570417901	N
42	29	2	$ 2,734,063,799.05	2734063799	0.003780812	0.937600289	0.675800187	N
125	610	4	$ 2,711,662,595.66	2711662596	0.003749834	0.941350123	0.604077332	N
147	697	4	$ 2,697,951,582.60	2697951583	0.003730874	0.945080997	0.13748435	N
19	41	2	$ 2,623,790,944.86	2623790945	0.003628321	0.948709317	0.65959105	N
4	13	1	$ 2,620,369,186.91	2620369187	0.003623589	0.952332906	0.463599507	N
2	7	1	$ 2,591,035,478.73	2591035479	0.003583025	0.955915931	0.060918825	N
46	226	3	$ 2,506,842,957.09	2506842957	0.003466599	0.959382529	0.024652723	N
124	633	4	$ 2,464,703,613.71	2464703614	0.003408326	0.962790855	0.066299599	N
13	61	2	$ 2,450,643,177.98	2450643178	0.003388882	0.966179738	0.499090198	N
47	368	3	$ 2,371,992,700.07	2371992700	0.00328012	0.969459858	0.318468709	N
49	204	3	$ 2,355,279,398.98	2355279399	0.003257008	0.972716866	0.78607964	N
48	207	3	$ 2,354,203,622.36	2354203622	0.003255521	0.975972387	0.490053331	N
6	78	2	$ 2,304,983,269.64	2304983270	0.003187456	0.979159843	0.323533637	N
3	6	1	$ 2,255,544,486.11	2255544486	0.003119089	0.982278932	0.476673368	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	Selection
18	77	2	$ 2,237,306,685.14	2237306685	0.003093869	0.985372801	0.896859614	N
20	31	2	$ 2,216,831,744.71	2216831745	0.003065555	0.988438356	0.249141143	N
26	44	2	$ 2,187,265,587.21	2187265587	0.00302467	0.991463026	0.077145143	N
52	225	3	$ 2,124,725,626.85	2124725627	0.002938186	0.994401212	0.186205464	N
44	312	3	$ 2,024,492,377.82	2024492378	0.002799578	0.99720079	0.638084958	N
45	181	3	$ 2,024,226,342.45	2024226342	0.00279921	1	0.66903058	N

Appendix E Roulette Wheel Selection 10000 m³

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
158	2013	5	$ 7,434,135,385.03	7434135385	0.006910391	0.006910391	0.192501411	Y
102	734	4	$ 7,423,651,510.99	7423651511	0.006900646	0.013811037	0.717298855	Y
103	745	4	$ 7,420,579,281.75	7420579282	0.00689779	0.020708827	0.027680283	Y
113	808	4	$ 7,414,473,324.30	7414473324	0.006892114	0.027600942	0.209054286	Y
108	759	4	$ 7,410,023,756.81	7410023757	0.006887978	0.03448892	0.756099921	Y
138	1177	4	$ 7,407,295,424.88	7407295425	0.006885442	0.041374362	0.524340974	Y
126	876	4	$ 7,391,313,561.36	7391313561	0.006870586	0.048244948	0.542810542	Y
72	407	4	$ 7,386,368,116.24	7386368116	0.006865989	0.055110937	0.553004084	Y
90	640	4	$ 7,382,777,905.53	7382777906	0.006862652	0.061973589	0.699354142	Y
33	191	3	$ 7,367,862,083.32	7367862083	0.006848787	0.068822376	0.287428948	Y
58	344	3	$ 7,364,860,723.74	7364860724	0.006845997	0.075668373	0.775200021	Y
109	800	4	$ 7,349,748,191.15	7349748191	0.006831949	0.082500322	0.638782312	Y
128	974	4	$ 7,348,181,786.32	7348181786	0.006830493	0.089330816	0.257768772	Y
80	532	4	$ 7,334,910,406.81	7334910407	0.006818157	0.096148972	0.345391759	Y
71	401	4	$ 7,333,918,857.86	7333918858	0.006817235	0.102966207	0.983949414	Y
81	588	4	$ 7,331,599,905.88	7331599906	0.006815079	0.109781287	0.900998653	Y
107	757	4	$ 7,325,986,492.53	7325986493	0.006809862	0.116591148	0.623830832	Y
148	1664	5	$ 7,313,009,244.11	7313009244	0.006797799	0.123388947	0.785571933	Y
142	1632	5	$ 7,301,881,662.20	7301881662	0.006787455	0.130176402	0.259055569	Y
79	469	4	$ 7,293,251,121.92	7293251122	0.006779432	0.136955834	0.42301179	Y
69	385	4	$ 7,284,981,764.32	7284981764	0.006771746	0.14372758	0.705243452	Y
76	427	4	$ 7,276,089,282.83	7276089283	0.00676348	0.150491059	0.812531691	Y
145	1644	5	$ 7,272,933,897.98	7272933898	0.006760547	0.157251606	0.412130338	Y
154	1829	5	$ 7,267,450,171.81	7267450172	0.006755449	0.164007055	0.239809702	Y
160	2042	5	$ 7,263,031,344.94	7263031345	0.006751342	0.170758397	0.528457983	Y
25	129	3	$ 7,253,414,903.64	7253414904	0.006742403	0.1775008	0.847696001	Y
63	363	3	$ 7,252,033,581.92	7252033582	0.006741119	0.184241918	0.111099817	N
73	418	4	$ 7,233,004,693.78	7233004694	0.00672343	0.190965349	0.388965039	Y
54	319	3	$ 7,224,934,801.85	7224934802	0.006715929	0.197681278	0.031432344	N
119	835	4	$ 7,214,544,244.47	7214544244	0.006706271	0.204387548	0.060017345	N
36	197	3	$ 7,200,925,106.77	7200925107	0.006693611	0.006693611	0.656262166	Y
62	361	3	$ 7,152,565,359.37	7152565359	0.006648658	0.006648658	0.388366555	Y
11	91	2	$ 7,125,865,631.03	7125865631	0.006623839	0.006623839	0.651306497	Y
34	192	3	$ 7,125,751,993.06	7125751993	0.006623734	0.006623734	0.569841539	Y
28	144	3	$ 7,122,476,111.25	7122476111	0.006620689	0.006620689	0.579534955	Y
24	127	3	$ 7,109,444,061.07	7109444061	0.006608575	0.006608575	0.23641247	Y
135	1038	4	$ 7,108,691,510.91	7108691511	0.006607875	0.006607875	0.410239452	Y
139	1105	5	$ 7,089,980,036.58	7089980037	0.006590482	0.006590482	0.718052482	Y
146	1658	5	$ 7,089,201,490.18	7089201490	0.006589758	0.006589758	0.26205799	Y
51	304	3	$ 7,061,127,974.76	7061127975	0.006563663	0.006563663	0.941974018	Y
22	112	3	$ 7,054,636,663.33	7054636663	0.006557629	0.006557629	0.037505403	Y
156	1873	5	$ 7,046,325,487.97	7046325488	0.006549903	0.006549903	0.234881798	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
57	343	3	$ 7,035,950,492.79	7035950493	0.006540259	0.006540259	0.232213133	Y
41	235	3	$ 7,031,206,434.90	7031206435	0.006535849	0.006535849	0.029216018	Y
149	1667	5	$ 7,025,839,422.91	7025839423	0.00653086	0.00653086	0.686558963	Y
130	979	4	$ 6,993,478,991.02	6993478991	0.00650078	0.00650078	0.94637154	Y
17	105	3	$ 6,988,039,033.26	6988039033	0.006495723	0.006495723	0.843080131	Y
38	202	3	$ 6,976,108,010.35	6976108010	0.006484632	0.006484632	0.643690841	Y
91	680	4	$ 6,960,160,796.88	6960160797	0.006469809	0.006469809	0.418232836	Y
125	875	4	$ 6,957,799,282.48	6957799282	0.006467614	0.006467614	0.58656867	Y
89	639	4	$ 6,956,922,049.04	6956922049	0.006466798	0.006466798	0.670924569	Y
21	111	3	$ 6,953,016,332.01	6953016332	0.006463168	0.006463168	0.780286757	Y
44	246	3	$ 6,951,341,266.79	6951341267	0.006461611	0.006461611	0.541995278	Y
43	240	3	$ 6,949,510,923.23	6949510923	0.006459909	0.006459909	0.539607629	Y
106	756	4	$ 6,937,904,121.61	6937904122	0.00644912	0.00644912	0.667836968	Y
161	2113	5	$ 6,908,817,961.51	6908817962	0.006422083	0.006422083	0.678031975	Y
152	1803	5	$ 6,904,011,205.56	6904011206	0.006417615	0.006417615	0.189830918	Y
48	256	3	$ 6,886,898,653.84	6886898654	0.006401708	0.006401708	0.283301118	Y
16	102	3	$ 6,870,439,156.77	6870439157	0.006386408	0.006386408	0.29742347	Y
141	1627	5	$ 6,863,861,339.41	6863861339	0.006380294	0.006380294	0.546844881	Y
3	64	2	$ 6,863,677,299.58	6863677300	0.006380123	0.006380123	0.442669571	Y
18	107	3	$ 6,862,277,223.29	6862277223	0.006378821	0.006378821	0.264480951	Y
116	820	4	$ 6,858,067,811.84	6858067812	0.006374908	0.006374908	0.25335435	Y
127	973	4	$ 6,843,200,740.32	6843200740	0.006361089	0.006361089	0.612013674	Y
67	375	3	$ 6,835,946,510.41	6835946510	0.006354345	0.006354345	0.538772869	Y
144	1639	5	$ 6,834,150,214.32	6834150214	0.006352676	0.006352676	0.537222671	Y
75	424	4	$ 6,831,968,924.70	6831968925	0.006350648	0.006350648	0.730868363	Y
94	688	4	$ 6,817,502,747.07	6817502747	0.006337201	0.006337201	0.317031363	Y
132	993	4	$ 6,817,502,747.07	6817502747	0.006337201	0.006337201	0.844970698	Y
30	150	3	$ 6,817,482,477.05	6817482477	0.006337182	0.006337182	0.749185068	Y
56	335	3	$ 6,811,048,332.08	6811048332	0.006331201	0.006331201	0.196119635	Y
124	874	4	$ 6,794,426,119.26	6794426119	0.00631575	0.00631575	0.427068537	Y
88	638	4	$ 6,793,397,090.90	6793397091	0.006314794	0.006314794	0.252958608	Y
111	803	4	$ 6,766,886,599.59	6766886600	0.006290151	0.006290151	0.137311093	Y
155	1832	5	$ 6,747,799,832.69	6747799833	0.006272409	0.006272409	0.322339885	Y
99	715	4	$ 6,741,421,195.29	6741421195	0.00626648	0.00626648	0.155960994	Y
86	624	4	$ 6,723,985,220.38	6723985220	0.006250272	0.006250272	0.787050127	Y
122	853	4	$ 6,721,085,532.89	6721085533	0.006247577	0.006247577	0.590375332	Y
131	982	4	$ 6,698,163,860.06	6698163860	0.00622627	0.00622627	0.756069519	Y
150	1689	5	$ 6,694,270,877.14	6694270877	0.006222651	0.006222651	0.771811136	Y
118	834	4	$ 6,693,267,011.73	6693267012	0.006221718	0.006221718	0.681741006	Y
61	360	3	$ 6,668,317,564.14	6668317564	0.006198526	0.006198526	0.163996986	Y
26	132	3	$ 6,657,001,944.86	6657001945	0.006188008	0.006188008	0.774541175	Y
78	468	4	$ 6,655,895,102.06	6655895102	0.006186979	0.006186979	0.300557072	Y
68	384	4	$ 6,654,904,167.02	6654904167	0.006186058	0.006186058	0.474943347	Y
66	374	3	$ 6,652,522,167.08	6652522167	0.006183844	0.006183844	0.950512385	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
32	190	3	$ 6,644,151,603.11	6644151603	0.006176063	0.006176063	0.315193234	Y
15	101	3	$ 6,633,795,778.29	6633795778	0.006166437	0.006166437	0.19944146	Y
137	1176	4	$ 6,622,595,240.30	6622595240	0.006156025	0.006156025	0.934426908	Y
5	70	2	$ 6,619,993,475.39	6619993475	0.006153607	0.006153607	0.331138254	Y
60	352	3	$ 6,597,192,421.74	6597192422	0.006132412	0.006132412	0.206272022	Y
12	95	3	$ 6,592,956,675.42	6592956675	0.006128475	0.006128475	0.186693588	Y
159	2038	5	$ 6,588,366,473.00	6588366473	0.006124208	0.006124208	0.62512361	Y
53	318	3	$ 6,570,921,783.86	6570921784	0.006107992	0.006107992	0.214620662	Y
52	317	3	$ 6,543,738,135.15	6543738135	0.006082724	0.006082724	0.640010519	Y
37	201	3	$ 6,525,518,540.17	6525518540	0.006065788	0.006065788	0.733664111	Y
31	152	3	$ 6,520,234,701.60	6520234702	0.006060876	0.006060876	0.565959313	Y
27	143	3	$ 6,488,520,241.37	6488520241	0.006031396	0.006031396	0.586085234	Y
96	700	4	$ 6,458,164,870.18	6458164870	0.006003179	0.006003179	0.204285382	Y
59	349	3	$ 6,444,976,163.04	6444976163	0.005990919	0.005990919	0.03160751	Y
35	195	3	$ 6,432,770,881.49	6432770881	0.005979574	0.005979574	0.37366357	Y
47	255	3	$ 6,431,860,824.29	6431860824	0.005978728	0.005978728	0.19071904	Y
13	97	3	$ 6,428,887,167.58	6428887168	0.005975964	0.005975964	0.145256113	Y
65	372	3	$ 6,419,823,248.41	6419823248	0.005967539	0.005967539	0.117769285	Y
23	126	3	$ 6,387,806,048.50	6387806049	0.005937777	0.005937777	0.610795208	Y
92	683	4	$ 6,374,004,244.98	6374004245	0.005924948	0.005924948	0.07643377	Y
1	18	2	$ 6,371,405,901.25	6371405901	0.005922532	0.005922532	0.501671458	Y
40	211	3	$ 6,370,425,763.78	6370425764	0.005921621	0.005921621	0.332241657	Y
105	755	4	$ 6,369,031,201.72	6369031202	0.005920325	0.005920325	0.791033408	Y
120	839	4	$ 6,364,856,827.11	6364856827	0.005916445	0.005916445	0.829288519	Y
147	1663	5	$ 6,356,948,709.10	6356948709	0.005909094	0.005909094	0.93895698	Y
112	807	4	$ 6,342,838,708.22	6342838708	0.005895978	0.005895978	0.93587118	Y
20	110	3	$ 6,342,761,005.55	6342761006	0.005895906	0.005895906	0.638347693	Y
115	819	4	$ 6,328,983,506.72	6328983507	0.005883099	0.005883099	0.029034183	Y
104	754	4	$ 6,303,564,357.47	6303564357	0.00585947	0.00585947	0.835072425	Y
133	1004	4	$ 6,294,639,676.51	6294639677	0.005851174	0.005851174	0.092997059	Y
83	616	4	$ 6,283,387,454.46	6283387454	0.005840715	0.005840715	0.166808063	Y
7	76	2	$ 6,281,926,968.41	6281926968	0.005839357	0.005839357	0.244267304	Y
157	1903	5	$ 6,269,461,572.73	6269461573	0.00582777	0.00582777	0.430352912	Y
136	1048	4	$ 6,249,717,530.98	6249717531	0.005809417	0.005809417	0.508080491	Y
82	613	4	$ 6,241,068,446.14	6241068446	0.005801377	0.005801377	0.171226943	Y
9	81	2	$ 6,215,014,202.52	6215014203	0.005777159	0.005777159	0.902998538	Y
140	1626	5	$ 6,209,285,341.45	6209285341	0.005771833	0.005771833	0.377057422	Y
151	1692	5	$ 6,200,804,351.83	6200804352	0.00576395	0.00576395	0.505919353	Y
162	3302	6	$ 6,181,712,118.14	6181712118	0.005746203	0.005746203	0.324195581	Y
6	71	2	$ 6,174,266,868.62	6174266869	0.005739282	0.005739282	0.679298476	Y
98	714	4	$ 6,170,308,975.42	6170308975	0.005735603	0.005735603	0.020297506	Y
117	833	4	$ 6,162,561,033.56	6162561034	0.005728401	0.005728401	0.335690717	Y
77	445	4	$ 6,160,518,181.89	6160518182	0.005726502	0.005726502	0.409669902	Y
74	423	4	$ 6,157,237,310.21	6157237310	0.005723452	0.005723452	0.930430392	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
101	733	4	$ 6,118,035,464.15	6118035464	0.005687012	0.005687012	0.626455007	Y
121	842	4	$ 6,095,802,257.24	6095802257	0.005666345	0.005666345	0.927082177	Y
64	371	3	$ 6,070,770,858.88	6070770859	0.005643077	0.005643077	0.717560017	Y
95	699	4	$ 6,050,428,064.96	6050428065	0.005624168	0.005624168	0.061086839	Y
49	295	3	$ 6,043,013,554.59	6043013555	0.005617276	0.005617276	0.757379929	Y
55	330	3	$ 6,024,023,107.93	6024023108	0.005599623	0.005599623	0.925688968	Y
46	254	3	$ 6,019,207,325.96	6019207326	0.005595147	0.005595147	0.967465573	Y
39	210	3	$ 6,013,223,214.36	6013223214	0.005589584	0.005589584	0.458846458	Y
153	1828	5	$ 5,997,356,405.76	5997356406	0.005574835	0.005574835	0.500027773	Y
29	149	3	$ 5,971,747,061.43	5971747061	0.00555103	0.00555103	0.052333517	Y
4	69	2	$ 5,956,705,612.35	5956705612	0.005537048	0.005537048	0.978879766	Y
129	978	4	$ 5,952,148,418.66	5952148419	0.005532812	0.005532812	0.977509521	Y
143	1638	5	$ 5,947,737,655.17	5947737655	0.005528712	0.005528712	0.271096585	Y
110	802	4	$ 5,934,284,664.79	5934284665	0.005516207	0.005516207	0.844564074	Y
14	100	3	$ 5,916,250,222.07	5916250222	0.005499443	0.005499443	0.662325237	Y
114	814	4	$ 5,914,318,783.05	5914318783	0.005497648	0.005497648	0.356152866	Y
2	20	2	$ 5,904,008,871.01	5904008871	0.005488064	0.005488064	0.082657502	Y
45	253	3	$ 5,887,487,240.51	5887487241	0.005472706	0.005472706	0.770210731	Y
93	687	4	$ 5,879,024,387.04	5879024387	0.00546484	0.00546484	0.700472587	Y
70	400	4	$ 5,875,055,081.75	5875055082	0.00546115	0.00546115	0.690323849	Y
100	719	4	$ 5,848,089,764.00	5848089764	0.005436084	0.005436084	0.290912679	Y
50	303	3	$ 5,841,197,242.95	5841197243	0.005429678	0.005429678	0.673559799	Y
87	636	4	$ 5,835,405,398.28	5835405398	0.005424294	0.005424294	0.612862752	Y
8	80	2	$ 5,823,673,321.70	5823673322	0.005413388	0.005413388	0.830262085	Y
134	1007	4	$ 5,810,880,191.30	5810880191	0.005401496	0.005401496	0.206098484	Y
85	623	4	$ 5,780,675,411.41	5780675411	0.00537342	0.00537342	0.884759304	Y
123	864	4	$ 5,770,764,895.78	5770764896	0.005364207	0.005364207	0.777411121	Y
19	109	3	$ 5,757,795,059.05	5757795059	0.005352151	0.005352151	0.41404256	Y
42	239	3	$ 5,754,963,769.89	5754963770	0.005349519	0.005349519	0.170669882	Y
84	619	4	$ 5,749,489,162.41	5749489162	0.00534443	0.00534443	0.110167781	Y
97	713	4	$ 5,700,138,894.18	5700138894	0.005298557	0.005298557	0.625817851	Y
10	90	2	$ 5,645,397,068.97	5645397069	0.005247672	0.005247672	0.786509323	Y

Appendix F Roulette Wheel Selection 23000 m³

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
838	1872	5	$ 16,871,415,883.37	16871415883	0.000990809	0.000990809	0.490033398	Y
888	2627	6	$ 16,861,512,347.14	16861512347	0.000990227	0.001981036	0.265893012	Y
775	1536	5	$ 16,855,892,074.45	16855892074	0.000989897	0.002970934	0.574697506	Y
296	5164	7	$ 16,852,492,080.28	16852492080	0.000989698	0.003960631	0.030335583	Y
24	3624	6	$ 16,851,654,775.29	16851654775	0.000989648	0.00495028	0.731191356	Y
632	2625	6	$ 16,847,176,420.75	16847176421	0.000989385	0.005939665	0.787264151	Y
843	2911	6	$ 16,844,652,935.51	16844652936	0.000989237	0.006928902	0.5152141	Y
299	1855	5	$ 16,843,650,826.96	16843650827	0.000989178	0.007918081	0.769884909	Y
780	4229	7	$ 16,827,222,501.42	16827222501	0.000988214	0.008906294	0.895699787	Y
736	5168	7	$ 16,819,838,063.31	16819838063	0.00098778	0.009894074	0.131671251	Y
979	597	4	$ 16,812,515,227.34	16812515227	0.00098735	0.010881424	0.727071414	Y
46	3312	6	$ 16,800,531,293.53	16800531294	0.000986646	0.01186807	0.424389993	Y
352	1345	5	$ 16,796,878,532.74	16796878533	0.000986432	0.012854502	0.739045378	Y
178	5178	7	$ 16,793,417,896.92	16793417897	0.000986228	0.01384073	0.055636904	Y
413	3576	6	$ 16,787,436,643.58	16787436644	0.000985877	0.014826607	0.368876459	Y
136	2474	6	$ 16,780,293,037.94	16780293038	0.000985458	0.015812065	0.448999236	Y
263	2821	6	$ 16,775,605,547.32	16775605547	0.000985182	0.016797247	0.57969244	Y
264	2426	6	$ 16,773,810,938.24	16773810938	0.000985077	0.017782324	0.504005351	Y
137	2895	6	$ 16,773,572,330.10	16773572330	0.000985063	0.018767387	0.832097278	Y
902	1305	5	$ 16,767,122,344.84	16767122345	0.000984684	0.019752071	0.086071412	Y
484	2442	6	$ 16,748,764,566.86	16748764567	0.000983606	0.020735677	0.574494065	Y
704	4188	7	$ 16,747,787,219.08	16747787219	0.000983549	0.021719225	0.431422566	Y
485	2844	6	$ 16,744,870,283.46	16744870283	0.000983377	0.022702602	0.998213513	Y
861	2092	5	$ 16,712,008,949.85	16712008950	0.000981447	0.02368405	0.144076501	Y
273	2465	6	$ 16,694,848,506.11	16694848506	0.00098044	0.024664489	0.099885238	Y
1088	1471	5	$ 16,689,269,842.64	16689269843	0.000980112	0.025644602	0.395980904	Y
759	2666	6	$ 16,676,797,004.54	16676797005	0.00097938	0.026623981	0.977595412	Y
439	3783	6	$ 16,674,805,206.66	16674805207	0.000979263	0.027603244	0.353826489	Y
503	5166	7	$ 16,657,078,097.16	16657078097	0.000978221	0.028581465	0.316993538	Y
325	2007	5	$ 16,654,878,350.23	16654878350	0.000978092	0.029559557	0.036348991	Y
190	2294	5	$ 16,654,536,896.05	16654536896	0.000978072	0.03053763	0.397896674	Y
967	2671	6	$ 16,651,722,299.47	16651722299	0.000977907	0.031515537	0.912631012	Y
192	5658	7	$ 16,650,797,873.91	16650797874	0.000977853	0.032493389	0.414925414	Y
1	2324	5	$ 16,632,940,197.77	16632940198	0.000976804	0.033470193	0.049495209	Y
564	862	4	$ 16,626,532,047.03	16626532047	0.000976428	0.034446621	0.356045236	Y
826	1490	5	$ 16,623,075,324.47	16623075324	0.000976225	0.035422846	0.406477738	Y
9	5643	7	$ 16,622,517,781.64	16622517782	0.000976192	0.036399037	0.762817703	Y
566	2696	6	$ 16,622,212,175.09	16622212175	0.000976174	0.037375211	0.792911633	Y
94	5205	7	$ 16,617,277,332.71	16617277333	0.000975884	0.038351095	0.191677842	Y
384	5237	7	$ 16,615,075,019.45	16615075019	0.000975755	0.03932685	0.331054972	Y
1164	2453	6	$ 16,600,809,867.15	16600809867	0.000974917	0.040301767	0.754826915	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
284	5428	7	$ 16,587,015,714.73	16587015715	0.000974107	0.041275874	0.95194695	Y
334	1504	5	$ 16,577,904,403.30	16577904403	0.000973572	0.042249446	0.441771422	Y
96	2292	5	$ 16,577,463,397.91	16577463398	0.000973546	0.043222992	0.23299099	Y
36	5449	7	$ 16,574,495,248.50	16574495249	0.000973372	0.044196364	0.92672846	Y
98	1817	5	$ 16,567,840,330.56	16567840331	0.000972981	0.045169344	0.345260126	Y
778	2022	5	$ 16,559,411,380.21	16559411380	0.000972486	0.04614183	0.390588553	Y
290	1203	5	$ 16,555,029,366.29	16555029366	0.000972228	0.047114059	0.364820927	Y
242	1575	5	$ 16,545,061,893.72	16545061894	0.000971643	0.048085702	0.744629154	Y
779	596	4	$ 16,544,635,727.10	16544635727	0.000971618	0.04905732	0.921670089	Y
101	1031	4	$ 16,537,508,482.67	16537508483	0.0009712	0.050028519	0.173912834	Y
463	4187	7	$ 16,537,190,931.92	16537190932	0.000971181	0.0509997	0.462878795	Y
1105	1321	5	$ 16,518,558,420.71	16518558421	0.000970087	0.051969787	0.491982933	Y
11	3321	6	$ 16,515,249,387.00	16515249387	0.000969892	0.052939679	0.65267727	Y
469	1580	5	$ 16,512,710,486.34	16512710486	0.000969743	0.053909423	0.402899161	Y
12	3840	6	$ 16,509,597,163.41	16509597163	0.00096956	0.054878983	0.293672028	Y
20	1792	5	$ 16,503,285,143.34	16503285143	0.00096919	0.055848173	0.237356804	Y
42	3288	6	$ 16,500,157,436.23	16500157436	0.000969006	0.056817179	0.886804396	Y
300	3310	6	$ 16,497,445,636.33	16497445636	0.000968847	0.05778602 5	0.157256352	Y
590	2047	5	$ 16,497,318,207.97	16497318208	0.000968839	0.058754865	0.547361854	Y
43	3807	6	$ 16,494,199,947.39	16494199947	0.000968656	0.059723521	0.622990014	Y
301	3827	6	$ 16,492,061,987.33	16492061987	0.000968531	0.060692051	0.567270136	Y
346	1890	5	$ 16,489,935,080.19	16489935080	0.000968406	0.061660457	0.793968145	Y
350	4251	7	$ 16,474,951,069.38	16474951069	0.000967526	0.062627983	0.685869294	Y
1177	2867	6	$ 16,474,303,833.48	16474303833	0.000967488	0.06359547	0.168364405	Y
1046	1513	5	$ 16,470,061,214.10	16470061214	0.000967239	0.064562709	0.577837619	Y
852	1185	5	$ 16,468,594,439.68	16468594440	0.000967152	0.065529861	0.107868265	Y
172	1484	5	$ 16,467,932,986.42	16467932986	0.000967114	0.066496975	0.633721852	Y
173	4739	7	$ 16,465,957,163.32	16465957163	0.000966998	0.067463972	0.648939382	Y
260	3556	6	$ 16,448,304,683.13	16448304683	0.000965961	0.068429933	0.162037961	Y
856	1212	5	$ 16,446,836,899.41	16446836899	0.000965875	0.069395808	0.523093726	Y
262	4457	7	$ 16,427,073,325.99	16427073326	0.000964714	0.070360522	0.965418672	Y
214	2098	5	$ 16,426,005,773.13	16426005773	0.000964651	0.071325173	0.002172366	N
135	3623	6	$ 16,425,865,244.01	16425865244	0.000964643	0.072289816	0.914893125	Y
655	5242	7	$ 16,417,539,179.38	16417539179	0.000964154	0.07325397	0.444629335	Y
1123	2495	6	$ 16,414,961,196.62	16414961197	0.000964003	0.074217973	0.761694656	Y
311	4033	6	$ 16,389,773,334.20	16389773334	0.000962523	0.075180497	0.656772228	Y
491	1073	4	$ 16,388,797,620.93	16388797621	0.000962466	0.076142963	0.931632196	Y
47	1889	5	$ 16,385,607,403.80	16385607404	0.000962279	0.077105241	0.821993505	Y
608	4227	7	$ 16,381,828,252.01	16381828252	0.000962057	0.078067298	0.528643494	Y
432	3885	6	$ 16,370,162,592.97	16370162593	0.000961372	0.07902867	0.480832483	Y
433	3381	6	$ 16,368,291,806.34	16368291806	0.000961262	0.079989932	0.822362467	Y
666	2091	5	$ 16,367,313,098.28	16367313098	0.000961204	0.080951137	0.997290497	Y
115	2096	5	$ 16,364,154,265.14	16364154265	0.000961019	0.081912155	0.4997619	Y

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436	4083	6	$ 16,362,679,449.30	16362679449	0.000960932	0.082873088	0.987316347	Y
116	1677	5	$ 16,360,946,644.62	16360946645	0.000960831	0.083833918	0.371051026	Y
715	2846	6	$ 16,360,669,437.84	16360669438	0.000960814	0.084794733	0.640745254	Y
320	1225	5	$ 16,343,273,702.26	16343273702	0.000959793	0.085754525	0.889974813	Y
883	1350	5	$ 16,333,699,037.94	16333699038	0.00095923	0.086713756	0.407302538	Y
29	2254	5	$ 16,332,043,049.58	16332043050	0.000959133	0.087672889	0.871373131	Y
617	4255	7	$ 16,324,258,713.62	16324258714	0.000958676	0.088631565	0.583474943	Y
443	2634	6	$ 16,323,393,069.76	16323393070	0.000958625	0.08959019	0.448233252	Y
66	1850	5	$ 16,302,689,198.14	16302689198	0.000957409	0.090547599	0.538885384	Y
383	2026	5	$ 16,288,342,447.47	16288342447	0.000956567	0.091504166	0.684158621	Y
571	4038	6	$ 16,287,306,529.98	16287306530	0.000956506	0.092460672	0.894913694	Y
1075	1201	5	$ 16,281,484,812.38	16281484812	0.000956164	0.093416836	0.51304488	Y
1025	1538	5	$ 16,280,935,026.78	16280935027	0.000956132	0.094372968	0.726678418	Y
232	2611	6	$ 16,279,803,975.34	16279803975	0.000956065	0.095329033	0.341813856	Y
889	1341	5	$ 16,272,779,602.61	16272779603	0.000955653	0.096284686	0.489854644	Y
845	2701	6	$ 16,262,092,669.91	16262092670	0.000955025	0.097239711	0.359323531	Y
198	1344	5	$ 16,244,479,568.65	16244479569	0.000953991	0.098193702	0.857968765	Y
392	3531	6	$ 16,238,700,164.14	16238700164	0.000953651	0.099147353	0.110441668	Y
286	3061	6	$ 16,232,270,093.72	16232270094	0.000953274	0.100100627	0.074725265	N
522	742	4	$ 16,232,267,923.39	16232267923	0.000953274	0.1010539	0.934457937	Y
394	3136	6	$ 16,229,537,049.89	16229537050	0.000953113	0.102007014	0.842800489	Y
738	1812	5	$ 16,224,800,457.06	16224800457	0.000952835	0.102959849	0.159489757	Y
287	3360	6	$ 16,221,731,967.99	16221731968	0.000952655	0.103912504	0.941725214	Y
124	2685	6	$ 16,221,275,067.59	16221275068	0.000952628	0.104865132	0.671316707	Y
3	3258	6	$ 16,219,776,051.72	16219776052	0.00095254	0.105817672	0.824463143	Y
125	2036	5	$ 16,216,604,843.16	16216604843	0.000952354	0.106770026	0.7545227	Y
4	3765	6	$ 16,214,429,259.01	16214429259	0.000952226	0.107722252	0.641784876	Y
291	3602	6	$ 16,209,437,505.58	16209437506	0.000951933	0.108674184	0.751436073	Y
35	2005	5	$ 16,202,887,606.64	16202887607	0.000951548	0.109625733	0.61632593	Y
159	5247	7	$ 16,202,415,722.60	16202415723	0.000951521	0.110577253	0.522800109	Y
240	3781	6	$ 16,197,329,464.51	16197329465	0.000951222	0.111528475	0.621320135	Y
907	1121	5	$ 16,187,928,665.85	16187928666	0.00095067	0.112479145	0.867125959	Y
526	5174	7	$ 16,187,859,942.95	16187859943	0.000950666	0.11342981	0.247374454	Y
294	1797	5	$ 16,183,246,851.35	16183246851	0.000950395	0.114380205	0.198808367	Y
854	3342	6	$ 16,176,590,314.38	16176590314	0.000950004	0.115330209	0.182473526	Y
528	3065	6	$ 16,176,574,742.05	16176574742	0.000950003	0.116280212	0.293213921	Y
345	2323	5	$ 16,156,646,284.06	16156646284	0.000948833	0.117229045	0.736953471	Y
645	3372	6	$ 16,153,712,932.93	16153712933	0.00094866	0.118177705	0.68588832	Y
102	5173	7	$ 16,146,223,272.99	16146223273	0.00094822	0.119125925	0.303890057	Y
37	5182	7	$ 16,143,134,140.10	16143134140	0.000948039	0.120073964	0.955812997	Y
349	1301	5	$ 16,138,701,579.30	16138701579	0.000947779	0.121021743	0.486367853	Y
867	1882	5	$ 16,129,752,683.49	16129752683	0.000947253	0.121968996	0.607691933	Y
355	3857	6	$ 16,120,599,004.43	16120599004	0.000946716	0.122915712	0.940453832	Y

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171	5448	7	$ 16,120,319,679.42	16120319679	0.000946699	0.123862411	0.828569127	Y
809	1300	5	$ 16,118,298,402.71	16118298403	0.000946581	0.124808992	0.545725208	Y
753	2284	5	$ 16,115,550,109.63	16115550110	0.000946419	0.125755411	0.733790448	Y
755	4301	7	$ 16,106,942,093.08	16106942093	0.000945914	0.126701325	0.886349636	Y
536	1837	5	$ 16,102,297,514.74	16102297515	0.000945641	0.127646966	0.038640094	N
490	4192	7	$ 16,068,807,563.64	16068807564	0.000943674	0.12859064	0.968675999	Y
21	2059	5	$ 16,064,617,450.29	16064617450	0.000943428	0.129534068	0.109758532	N
609	1311	5	$ 16,061,627,830.11	16061627830	0.000943252	0.13047732	0.743412728	Y
266	2471	6	$ 16,058,155,608.70	16058155609	0.000943049	0.131420369	0.600378867	Y
494	571	4	$ 16,046,852,970.87	16046852971	0.000942385	0.132362753	0.483261519	Y
931	2432	6	$ 16,046,321,990.06	16046321990	0.000942354	0.133305107	0.694415758	Y
180	3287	6	$ 16,036,726,997.61	16036726998	0.00094179	0.134246897	0.836868885	Y
181	3806	6	$ 16,030,159,410.84	16030159411	0.000941404	0.135188301	0.378916023	Y
314	2440	6	$ 16,028,535,498.94	16028535499	0.000941309	0.13612961	0.578896761	Y
834	1230	5	$ 16,028,024,231.03	16028024231	0.000941279	0.137070889	0.014500873	N
45	3318	6	$ 16,027,169,021.74	16027169022	0.000941229	0.138012118	0.42244243	Y
315	2842	6	$ 16,023,266,571.91	16023266572	0.000941	0.138953118	0.304155134	Y
62	2110	5	$ 16,017,742,601.42	16017742601	0.000940675	0.139893793	0.21062735	Y
183	3852	6	$ 16,017,024,252.44	16017024252	0.000940633	0.140834426	0.052995749	N
557	2314	5	$ 16,012,582,596.85	16012582597	0.000940372	0.141774798	0.323284638	Y
272	3575	6	$ 16,008,328,518.53	16008328519	0.000940122	0.142714921	0.25008415	Y
680	3111	6	$ 16,004,832,561.43	16004832561	0.000939917	0.143654838	0.048873298	N
682	2636	6	$ 16,002,847,514.12	16002847514	0.0009398	0.144594638	0.801189066	Y
1106	1480	5	$ 15,983,502,822.41	15983502822	0.000938664	0.145533302	0.213850967	Y
5	2263	5	$ 15,967,260,295.34	15967260295	0.000937711	0.146471013	0.570595639	Y
1179	2657	6	$ 15,958,169,369.97	15958169370	0.000937177	0.14740819	0.774059512	Y
784	2122	5	$ 15,952,709,069.50	15952709070	0.000936856	0.148345045	0.038448443	N
847	1576	5	$ 15,944,049,584.72	15944049585	0.000936347	0.149281393	0.246700429	Y
1216	1540	5	$ 15,941,253,669.74	15941253670	0.000936183	0.150217576	0.249278616	Y
949	2832	6	$ 15,935,368,137.85	15935368138	0.000935838	0.151153414	0.961013347	Y
453	831	4	$ 15,925,650,758.42	15925650758	0.000935267	0.152088681	0.479062931	Y
696	1339	5	$ 15,923,620,837.73	15923620838	0.000935148	0.153023828	0.51716349	Y
148	4487	7	$ 15,922,834,593.12	15922834593	0.000935102	0.15395893	0.552326289	Y
520	2486	5	$ 15,917,611,148.67	15917611149	0.000934795	0.154893725	0.231432345	Y
194	1888	5	$ 15,910,446,331.03	15910446331	0.000934374	0.155828099	0.609755385	Y
455	2497	6	$ 15,908,835,355.92	15908835356	0.000934279	0.156762378	0.253626154	Y
1183	2462	6	$ 15,907,684,852.60	15907684853	0.000934212	0.15769659	0.63485511	Y
6	5433	7	$ 15,900,191,713.50	15900191714	0.000933772	0.158630362	0.981192447	Y
336	5204	7	$ 15,900,171,433.66	15900171434	0.000933771	0.159564132	0.50187394	Y
859	2458	6	$ 15,870,388,100.30	15870388100	0.000932021	0.160496154	0.658938601	Y
1130	2421	6	$ 15,862,248,420.33	15862248420	0.000931543	0.161427697	0.181257092	Y
153	1066	4	$ 15,855,901,454.69	15855901455	0.000931171	0.162358868	0.702112257	Y
964	2428	6	$ 15,848,347,220.53	15848347221	0.000930727	0.163289595	0.703540965	Y

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123	4043	6	$ 15,847,331,338.75	15847331339	0.000930667	0.164220262	0.585882383	Y
531	5177	7	$ 15,840,585,051.96	15840585052	0.000930271	0.165150534	0.628095624	Y
1012	2460	6	$ 15,839,585,198.48	15839585198	0.000930213	0.166080746	0.186220787	Y
156	2425	6	$ 15,839,582,010.85	15839582011	0.000930212	0.167010959	0.683922791	Y
1061	1546	5	$ 15,839,345,452.55	15839345453	0.000930198	0.167941157	0.427354737	Y
126	5208	7	$ 15,837,800,124.69	15837800125	0.000930108	0.168871265	0.68400339	Y
158	2820	6	$ 15,833,167,143.69	15833167144	0.000929836	0.1698011	0.70472271	Y
32	3555	6	$ 15,832,763,424.47	15832763424	0.000929812	0.170730912	0.654101339	Y
344	1816	5	$ 15,831,985,951.28	15831985951	0.000929766	0.171660678	0.366059448	Y
921	1478	5	$ 15,828,370,301.91	15828370302	0.000929554	0.172590232	0.802930029	Y
651	2483	6	$ 15,827,826,933.96	15827826934	0.000929522	0.173519754	0.757903674	Y
1276	4	1	$ 15,827,449,833.81	15827449834	0.0009295	0.174449254	0.081644545	N
758	1476	5	$ 15,800,821,083.78	15800821084	0.000927936	0.17537719	0.178169669	Y
99	1886	5	$ 15,786,407,883.38	15786407883	0.00092709	0.17630428	0.557468094	Y
542	2121	5	$ 15,764,218,324.57	15764218325	0.000925786	0.177230066	0.343365624	Y
935	1047	4	$ 15,753,749,890.01	15753749890	0.000925172	0.178155238	0.585716605	Y
360	2291	5	$ 15,749,442,050.02	15749442050	0.000924919	0.179080157	0.044576272	N
669	1881	5	$ 15,746,230,017.73	15746230018	0.00092473	0.180004887	0.569905179	Y
305	4217	7	$ 15,743,583,665.59	15743583666	0.000924575	0.180929461	0.112137283	N
724	3853	6	$ 15,732,887,247.35	15732887247	0.000923946	0.181853408	0.197633795	Y
1146	2807	6	$ 15,729,563,414.77	15729563415	0.000923751	0.182777159	0.548461958	Y
10	5251	7	$ 15,727,763,531.95	15727763532	0.000923646	0.183700805	0.247444747	Y
614	2057	5	$ 15,720,540,556.55	15720540557	0.000923221	0.184624026	0.670246178	Y
496	4195	7	$ 15,718,092,677.36	15718092677	0.000923078	0.185547104	0.649058627	Y
174	1224	5	$ 15,716,237,801.95	15716237802	0.000922969	0.186470072	0.231435146	Y
265	3789	6	$ 15,711,763,614.40	15711763614	0.000922706	0.187392778	0.91497627	Y
369	1030	4	$ 15,705,690,656.20	15705690656	0.000922349	0.188315128	0.506060281	Y
438	3633	6	$ 15,704,295,288.52	15704295289	0.000922267	0.189237395	0.957009387	Y
556	1110	5	$ 15,700,617,492.94	15700617493	0.000922051	0.190159446	0.822778714	Y
894	1221	5	$ 15,696,332,100.50	15696332101	0.0009218	0.191081246	0.512844882	Y
372	1515	5	$ 15,693,242,492.78	15693242493	0.000921618	0.192002864	0.589843731	Y
216	3529	6	$ 15,687,010,208.33	15687010208	0.000921252	0.192924117	3.41414E-05	N
567	1501	5	$ 15,678,170,293.47	15678170293	0.000920733	0.19384485	0.985889407	Y
318	1181	5	$ 15,670,007,669.08	15670007669	0.000920254	0.194765103	0.601773606	Y
570	1191	5	$ 15,666,946,723.88	15666946724	0.000920074	0.195685177	0.275827752	Y
44	3359	6	$ 15,650,491,858.11	15650491858	0.000919108	0.196604285	0.430914798	Y
109	2303	5	$ 15,648,941,326.29	15648941326	0.000919017	0.197523302	0.42593777	Y
691	2866	6	$ 15,642,876,579.95	15642876580	0.00091866	0.198441962	0.823332859	Y
110	1826	5	$ 15,641,304,357.60	15641304358	0.000918568	0.19936053	0.497692771	Y
906	2622	6	$ 15,637,368,698.62	15637368699	0.000918337	0.200278867	0.612671621	Y
14	3588	6	$ 15,623,623,549.87	15623623550	0.00091753	0.201196397	0.963283205	Y
387	1676	5	$ 15,605,431,586.10	15605431586	0.000916461	0.202112858	0.047436368	N
866	1544	5	$ 15,565,208,034.87	15565208035	0.000914099	0.203026957	0.760192158	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
85	5267	7	$ 15,557,296,371.23	15557296371	0.000913635	0.203940592	0.356171702	Y
750	5163	7	$ 15,544,144,940.10	15544144940	0.000912862	0.204853454	0.27809551	Y
1066	1549	5	$ 15,540,955,105.01	15540955105	0.000912675	0.205766129	0.029690148	N
285	2632	6	$ 15,540,408,694.82	15540408695	0.000912643	0.206678772	0.365669346	Y
27	2260	5	$ 15,537,276,820.95	15537276821	0.000912459	0.20759123	0.228619303	Y
195	1492	5	$ 15,536,626,079.04	15536626079	0.000912421	0.208503651	0.456921894	Y
28	1795	5	$ 15,530,402,947.72	15530402948	0.000912055	0.209415706	0.610567129	Y
817	1366	5	$ 15,517,596,148.62	15517596149	0.000911303	0.210327009	0.432766977	Y
406	2095	5	$ 15,515,865,615.68	15515865616	0.000911201	0.211238211	0.821344844	Y
474	514	4	$ 15,512,617,392.41	15512617392	0.000911011	0.212149221	0.538890087	Y
65	1652	5	$ 15,512,150,886.72	15512150887	0.000910983	0.213060205	0.855656139	Y
238	2109	5	$ 15,506,555,766.88	15506555767	0.000910655	0.213970859	0.332160694	Y
1104	2597	6	$ 15,492,403,031.82	15492403032	0.000909824	0.214880683	0.577697501	Y
657	1574	5	$ 15,487,680,408.88	15487680409	0.000909546	0.215790229	0.570900285	Y
658	3380	6	$ 15,487,512,447.52	15487512448	0.000909536	0.216699765	0.281870704	Y
154	3554	6	$ 15,485,691,158.69	15485691159	0.000909429	0.217609195	0.9968237	Y
347	5172	7	$ 15,468,691,207.97	15468691208	0.000908431	0.218517626	0.164743989	N
348	1483	5	$ 15,467,275,539.47	15467275539	0.000908348	0.219425974	0.60787953	Y
416	2035	5	$ 15,461,424,135.85	15461424136	0.000908004	0.220333978	0.659210184	Y
2	3513	6	$ 15,455,953,913.09	15455953913	0.000907683	0.221241661	0.07832057	N
353	1117	5	$ 15,448,377,080.08	15448377080	0.000907238	0.222148899	0.909433481	Y
128	2107	5	$ 15,445,800,251.94	15445800252	0.000907087	0.223055986	0.363671622	Y
129	1686	5	$ 15,444,272,893.77	15444272894	0.000906997	0.223962983	0.212429021	N
357	3605	6	$ 15,434,481,591.40	15434481591	0.000906422	0.224869405	0.806167424	Y
358	543	4	$ 15,424,475,757.45	15424475757	0.000905834	0.225775239	0.859186471	Y
51	2370	5	$ 15,400,528,094.86	15400528095	0.000904428	0.226679667	0.016910307	N
52	5203	7	$ 15,391,801,974.60	15391801975	0.000903916	0.227583582	0.533045107	Y
431	3778	6	$ 15,387,510,883.38	15387510883	0.000903664	0.228487246	0.718786083	Y
53	1900	5	$ 15,384,986,111.69	15384986112	0.000903515	0.229390761	0.022238523	N
434	3266	6	$ 15,383,998,584.57	15383998585	0.000903457	0.230294218	0.285017556	Y
54	5185	7	$ 15,373,434,196.16	15373434196	0.000902837	0.231197055	0.272095266	Y
786	1503	5	$ 15,365,857,292.74	15365857293	0.000902392	0.232099447	0.313750203	Y
104	6750	8	$ 15,365,056,459.87	15365056460	0.000902345	0.233001792	0.197270964	N
787	1912	5	$ 15,361,887,650.81	15361887651	0.000902159	0.233903951	0.998585279	Y
505	5246	7	$ 15,361,423,653.24	15361423653	0.000902132	0.234806082	0.440330601	Y
1056	1505	5	$ 15,348,199,390.02	15348199390	0.000901355	0.235707437	0.582020853	Y
954	552	4	$ 15,343,855,401.28	15343855401	0.0009011	0.236608537	0.789891854	Y
270	3792	6	$ 15,335,667,193.01	15335667193	0.000900619	0.237509156	0.839275997	Y
80	2058	5	$ 15,335,121,297.98	15335121298	0.000900587	0.238409743	0.187937263	N
573	2322	5	$ 15,326,274,975.86	15326274976	0.000900067	0.23930981	0.611019608	Y
957	2441	6	$ 15,324,594,122.57	15324594123	0.000899969	0.240209779	0.01355196	N
1134	2487	6	$ 15,323,544,335.88	15323544336	0.000899907	0.241109686	0.119100268	N
217	1352	5	$ 15,323,342,470.90	15323342471	0.000899895	0.242009581	0.563854206	Y

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574	1847	5	$ 15,322,610,232.01	15322610232	0.000899852	0.242909433	0.557835291	Y
958	2843	6	$ 15,320,395,946.98	15320395947	0.000899722	0.243809155	0.440712727	Y
915	3782	6	$ 15,319,761,873.06	15319761873	0.000899685	0.24470884	0.184517515	N
575	1364	5	$ 15,318,945,490.42	15318945490	0.000899637	0.245608477	0.901150686	Y
377	1304	5	$ 15,314,371,325.93	15314371326	0.000899368	0.246507845	0.734318948	Y
741	4186	7	$ 15,311,756,471.20	15311756471	0.000899215	0.24740706	0.067733401	N
322	4191	7	$ 15,308,434,160.06	15308434160	0.00089902	0.248306079	0.133443703	N
698	1219	5	$ 15,308,269,975.69	15308269976	0.00089901	0.249205089	0.528648816	Y
184	3358	6	$ 15,283,743,164.12	15283743164	0.00089757	0.250102659	0.431401917	Y
640	1320	5	$ 15,277,875,853.46	15277875853	0.000897225	0.250999884	0.602999642	Y
138	2610	6	$ 15,276,130,811.45	15276130811	0.000897123	0.251897006	0.953447605	Y
185	3600	6	$ 15,274,350,360.33	15274350360	0.000897018	0.252794024	0.378793998	Y
454	711	4	$ 15,261,378,407.36	15261378407	0.000896256	0.25369028	0.661372691	Y
872	2802	6	$ 15,256,460,234.26	15256460234	0.000895967	0.254586247	0.215128124	N
459	2706	6	$ 15,250,532,648.18	15250532648	0.000895619	0.255481867	0.368836525	Y
393	1343	5	$ 15,238,779,521.16	15238779521	0.000894929	0.256376796	0.043157195	N
467	4261	7	$ 15,227,548,691.80	15227548692	0.000894269	0.257271065	0.97078516	Y
234	3537	6	$ 15,202,931,295.27	15202931295	0.000892824	0.258163889	0.14203409	N
23	1849	5	$ 15,202,711,314.42	15202711314	0.000892811	0.2590567	0.345700373	Y
656	3780	6	$ 15,189,799,814.63	15189799815	0.000892053	0.259948752	0.994797036	Y
149	3819	6	$ 15,166,164,040.90	15166164041	0.000890664	0.260839417	0.491525736	Y
535	3851	6	$ 15,157,038,769.98	15157038770	0.000890129	0.261729545	0.531040571	Y
948	1579	5	$ 15,144,761,792.92	15144761793	0.000889408	0.262618953	0.126048514	N
412	4042	6	$ 15,142,421,857.07	15142421857	0.00088927	0.263508223	0.444619946	Y
90	1025	4	$ 15,132,104,637.23	15132104637	0.000888664	0.264396887	0.894922861	Y
417	5207	7	$ 15,131,962,925.07	15131962925	0.000888656	0.265285543	0.489302318	Y
152	992	4	$ 15,125,195,701.83	15125195702	0.000888259	0.266173802	0.911011999	Y
728	3601	6	$ 15,124,880,398.43	15124880398	0.00088824	0.267062042	0.981344772	Y
547	1911	5	$ 15,123,106,873.30	15123106873	0.000888136	0.267950177	0.395278255	Y
359	2348	5	$ 15,088,669,624.50	15088669625	0.000886113	0.268836291	0.57586674	Y
162	2470	6	$ 15,079,108,106.34	15079108106	0.000885552	0.269721843	0.470344457	Y
621	2801	6	$ 15,078,748,700.49	15078748700	0.000885531	0.270607374	0.325104043	Y
499	1065	4	$ 15,066,452,659.47	15066452659	0.000884809	0.271492182	0.963858518	Y
364	1885	5	$ 15,060,112,729.07	15060112729	0.000884436	0.272376619	0.843776848	Y
437	2056	5	$ 15,049,803,874.98	15049803875	0.000883831	0.27326045	0.874010605	Y
688	2494	6	$ 15,049,518,512.47	15049518512	0.000883814	0.274144264	0.181292443	N
50	967	4	$ 15,049,364,827.50	15049364828	0.000883805	0.275028069	0.045580132	N
30	2067	5	$ 15,049,006,416.25	15049006416	0.000883784	0.275911853	0.607010971	Y
71	2034	5	$ 15,045,894,877.68	15045894878	0.000883601	0.276795455	0.599530934	Y
961	1057	4	$ 15,037,776,632.12	15037776632	0.000883125	0.277678579	0.114128901	N
1256	1331	5	$ 15,037,745,604.96	15037745605	0.000883123	0.278561702	0.488569172	Y
694	2656	6	$ 15,027,073,843.01	15027073843	0.000882496	0.279444198	0.562975754	Y
510	2865	6	$ 15,025,754,355.52	15025754356	0.000882419	0.280326617	0.696501455	Y

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917	2633	6	$ 15,015,744,057.91	15015744058	0.000881831	0.281208448	0.503102432	Y
373	2302	5	$ 15,011,398,315.54	15011398316	0.000881576	0.282090023	0.209943334	N
211	2369	5	$ 15,008,363,523.09	15008363523	0.000881397	0.282971421	0.884205162	Y
374	1825	5	$ 15,002,999,316.01	15002999316	0.000881082	0.283852503	0.27233104	N
868	3530	6	$ 15,000,488,734.87	15000488735	0.000880935	0.284733438	0.996795893	Y
316	5266	7	$ 14,998,971,807.44	14998971807	0.000880846	0.285614283	0.103586597	N
212	5202	7	$ 14,997,130,145.08	14997130145	0.000880738	0.286495021	0.026601664	N
215	1899	5	$ 14,991,144,026.59	14991144027	0.000880386	0.287375407	0.936046044	Y
376	3071	6	$ 14,991,092,913.18	14991092913	0.000880383	0.28825579	0.637052101	Y
638	3335	6	$ 14,987,134,768.67	14987134769	0.000880151	0.289135941	0.739390395	Y
516	1657	5	$ 14,983,763,887.84	14983763888	0.000879953	0.290015893	0.445142756	Y
1018	525	4	$ 14,982,825,191.17	14982825191	0.000879898	0.290895791	0.426231974	Y
378	4220	7	$ 14,980,866,325.32	14980866325	0.000879782	0.291775573	0.030875848	N
78	1064	4	$ 14,958,422,758.33	14958422758	0.000878464	0.292654038	0.55798784	Y
79	1070	4	$ 14,958,422,758.33	14958422758	0.000878464	0.293532502	0.775563221	Y
815	3856	6	$ 14,949,854,616.65	14949854617	0.000877961	0.294410464	0.471679042	Y
819	1246	5	$ 14,932,506,913.56	14932506914	0.000876942	0.295287406	0.388335588	Y
388	3526	6	$ 14,932,300,336.94	14932300337	0.00087693	0.296164336	0.1538751	N
457	565	4	$ 14,927,982,890.63	14927982891	0.000876677	0.297041013	0.470101378	Y
757	2439	6	$ 14,926,397,550.70	14926397551	0.000876584	0.297917597	0.574795333	Y
821	2592	6	$ 14,924,549,415.43	14924549415	0.000876475	0.298794072	0.986126322	Y
182	852	4	$ 14,922,067,822.81	14922067823	0.000876329	0.299670401	0.367746046	Y
760	2841	6	$ 14,920,672,199.54	14920672200	0.000876247	0.300546649	0.856653056	Y
593	2127	5	$ 14,920,366,504.24	14920366504	0.00087623	0.301422878	0.088252545	N
600	1512	5	$ 14,884,484,011.11	14884484011	0.000874122	0.302297001	0.879886173	Y
601	1200	5	$ 14,880,895,774.60	14880895775	0.000873912	0.303170912	0.964454384	Y
1230	1373	5	$ 14,875,571,545.88	14875571546	0.000873599	0.304044511	0.282998351	N
112	1897	5	$ 14,866,445,662.69	14866445663	0.000873063	0.304917574	0.68526253	Y
1231	1535	5	$ 14,866,262,633.44	14866262633	0.000873052	0.305790626	0.378843878	Y
767	2869	6	$ 14,865,327,480.28	14865327480	0.000872997	0.306663623	0.824441251	Y
338	1489	5	$ 14,851,511,972.42	14851511972	0.000872186	0.307535809	0.443890206	Y
339	1184	5	$ 14,843,303,806.21	14843303806	0.000871704	0.308407513	0.27092282	N
479	3379	6	$ 14,838,350,380.40	14838350380	0.000871413	0.309278926	0.924291479	Y
292	4291	7	$ 14,827,560,640.71	14827560641	0.000870779	0.310149705	0.900029006	Y
235	3540	6	$ 14,823,509,711.20	14823509711	0.000870541	0.311020247	0.314660219	Y
1006	1672	5	$ 14,817,087,825.36	14817087825	0.000870164	0.311890411	0.344442603	Y
676	357	3	$ 14,813,556,272.89	14813556273	0.000869957	0.312760368	0.795151923	Y
196	1563	5	$ 14,811,971,777.66	14811971778	0.000869864	0.313630231	0.558702872	Y
548	2277	5	$ 14,806,407,027.37	14806407027	0.000869537	0.314499768	0.965024497	Y
197	4216	7	$ 14,799,485,127.49	14799485127	0.00086913	0.315368899	0.348247149	Y
781	1697	5	$ 14,798,700,903.63	14798700904	0.000869084	0.316237983	0.201747172	N
615	3528	6	$ 14,796,415,014.24	14796415014	0.00086895	0.317106934	0.895218341	Y
199	1232	5	$ 14,795,172,228.92	14795172229	0.000868877	0.317975811	0.825186186	Y

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420	2106	5	$ 14,787,988,749.53	14787988750	0.000868455	0.318844266	0.582165156	Y
421	1685	5	$ 14,786,309,009.00	14786309009	0.000868357	0.319712623	0.832105781	Y
354	1223	5	$ 14,775,997,242.90	14775997243	0.000867751	0.320580374	0.961143904	Y
1189	541	4	$ 14,772,387,076.01	14772387076	0.000867539	0.321447913	0.749043009	Y
244	3861	6	$ 14,771,852,705.99	14771852706	0.000867508	0.322315421	0.840363584	Y
914	987	4	$ 14,766,652,341.06	14766652341	0.000867202	0.323182623	0.471004849	Y
426	972	4	$ 14,757,901,308.00	14757901308	0.000866688	0.324049311	0.435016266	Y
13	2004	5	$ 14,754,106,094.75	14754106095	0.000866466	0.324915777	0.868137252	Y
690	3788	6	$ 14,743,449,306.66	14743449307	0.00086584	0.325781617	0.224062454	N
160	3787	6	$ 14,716,053,468.09	14716053468	0.000864231	0.326645847	0.246057983	N
1246	1137	5	$ 14,708,015,231.58	14708015232	0.000863759	0.327509606	0.851814854	Y
1076	461	4	$ 14,703,677,645.22	14703677645	0.000863504	0.32837311	0.925656894	Y
67	3796	6	$ 14,702,704,048.99	14702704049	0.000863447	0.329236557	0.99540489	Y
804	2118	5	$ 14,701,373,415.39	14701373415	0.000863369	0.330099926	0.098393459	N
259	4062	6	$ 14,699,846,626.27	14699846626	0.000863279	0.330963279	0.492203623	Y
1020	2088	5	$ 14,699,625,970.29	14699625970	0.000863266	0.331826471	0.111565752	N
15	5181	7	$ 14,695,915,017.07	14695915017	0.000863048	0.332689519	0.31075614	N
578	1244	5	$ 14,683,489,700.90	14683489701	0.000862318	0.333551837	0.303200835	N
581	2591	6	$ 14,672,799,535.45	14672799535	0.000861691	0.334413528	0.635410398	Y
701	1012	4	$ 14,668,652,991.64	14668652992	0.000861447	0.335274975	0.317909462	N
751	1056	4	$ 14,662,690,854.48	14662690854	0.000861097	0.336136072	0.890137915	Y
937	2915	6	$ 14,645,245,788.25	14645245788	0.000860072	0.336996144	0.019164535	N
938	2496	6	$ 14,643,261,271.14	14643261271	0.000859956	0.3378561	0.738629928	Y
380	1349	5	$ 14,633,178,403.30	14633178403	0.000859364	0.338715464	0.130693714	N
644	2806	6	$ 14,633,155,347.05	14633155347	0.000859362	0.339574827	0.24112378	N
381	1120	5	$ 14,631,536,826.79	14631536827	0.000859267	0.340434094	0.932076621	Y
986	561	4	$ 14,619,654,484.15	14619654484	0.00085857	0.341292664	0.104396517	N
271	2033	5	$ 14,613,891,167.91	14613891168	0.000858231	0.342150895	0.587261011	Y
458	1318	5	$ 14,603,220,132.06	14603220132	0.000857604	0.343008499	0.513347837	Y
133	3567	6	$ 14,596,442,858.22	14596442858	0.000857206	0.343865706	0.541958511	Y
16	3317	6	$ 14,595,210,617.81	14595210618	0.000857134	0.34472284	0.438758432	Y
991	570	4	$ 14,593,360,939.44	14593360939	0.000857025	0.345579865	0.770716904	Y
75	2064	5	$ 14,592,853,752.75	14592853753	0.000856996	0.346436861	0.316977528	N
76	1655	5	$ 14,591,479,121.33	14591479121	0.000856915	0.347293776	0.773455924	Y
390	1846	5	$ 14,590,497,559.44	14590497559	0.000856857	0.348150633	0.052915519	N
466	3275	6	$ 14,581,236,414.58	14581236415	0.000856313	0.349006946	0.151874758	N
995	2485	5	$ 14,574,979,830.29	14574979830	0.000855946	0.349862892	0.560667634	Y
1094	1310	5	$ 14,567,074,673.73	14567074674	0.000855482	0.350718374	0.622527754	Y
397	3333	6	$ 14,565,729,676.78	14565729677	0.000855403	0.351573777	0.989159848	Y
844	1514	5	$ 14,563,973,361.49	14563973361	0.0008553	0.352429076	0.59157485	Y
720	2631	6	$ 14,554,738,437.23	14554738437	0.000854757	0.353283833	0.632039902	Y
1259	1211	5	$ 14,552,102,831.08	14552102831	0.000854602	0.354138436	0.612293003	Y
228	3285	6	$ 14,547,630,968.12	14547630968	0.00085434	0.354992776	0.347330932	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
82	1848	5	$ 14,533,744,814.38	14533744814	0.000853524	0.3558463	0.662315271	Y
281	1063	4	$ 14,516,979,748.66	14516979749	0.00085254	0.35669884	0.157474901	N
282	1069	4	$ 14,516,979,748.66	14516979749	0.00085254	0.35755138	0.087899065	N
540	3599	6	$ 14,511,963,477.25	14511963477	0.000852245	0.358403625	0.16733476	N
231	3101	6	$ 14,510,978,862.02	14510978862	0.000852187	0.359255812	0.481632682	Y
616	1375	5	$ 14,483,316,043.30	14483316043	0.000850563	0.360106375	0.938013369	Y
487	3818	6	$ 14,480,456,400.34	14480456400	0.000850395	0.36095677	0.428353083	Y
1334	1426	4	$ 14,461,626,964.27	14461626964	0.000849289	0.361806059	0.238345815	N
17	4047	6	$ 14,457,851,548.39	14457851548	0.000849067	0.362655126	0.337014553	N
1022	416	4	$ 14,427,513,330.72	14427513331	0.000847286	0.363502412	0.693310328	Y
19	2334	5	$ 14,426,458,363.56	14426458364	0.000847224	0.364349636	0.222778776	N
243	1303	5	$ 14,425,592,460.22	14425592460	0.000847173	0.365196809	0.276789828	N
200	3822	6	$ 14,422,711,265.42	14422711265	0.000847004	0.366043812	0.493165504	Y
501	991	4	$ 14,421,964,511.63	14421964512	0.00084696	0.366890772	0.626539631	Y
697	3791	6	$ 14,414,287,898.33	14414287898	0.000846509	0.367737281	0.190442983	N
1029	1336	5	$ 14,411,155,473.11	14411155473	0.000846325	0.368583606	0.903576012	Y
60	1824	5	$ 14,408,820,130.03	14408820130	0.000846188	0.369429794	0.388542068	Y
61	2301	5	$ 14,408,820,130.03	14408820130	0.000846188	0.370275982	0.060625667	N
1033	1116	5	$ 14,403,065,559.30	14403065559	0.00084585	0.371121832	0.619569404	Y
506	2492	6	$ 14,396,474,443.33	14396474443	0.000845463	0.371967295	0.303100609	N
151	1061	4	$ 14,393,572,863.93	14393572864	0.000845292	0.372812587	0.148610849	N
810	1361	5	$ 14,393,217,973.36	14393217973	0.000845272	0.373657859	0.127466774	N
812	1127	5	$ 14,389,477,691.85	14389477692	0.000845052	0.374502911	0.861795833	Y
1234	1253	5	$ 14,385,028,316.73	14385028317	0.000844791	0.375347701	0.279860732	N
1267	1340	5	$ 14,384,564,262.04	14384564262	0.000844763	0.376192465	0.226101239	N
1120	1306	5	$ 14,376,097,497.16	14376097497	0.000844266	0.377036731	0.284854446	N
513	2655	6	$ 14,372,959,725.75	14372959726	0.000844082	0.377880813	0.451369711	Y
579	2379	5	$ 14,371,258,911.74	14371258912	0.000843982	0.378724795	0.016965265	N
155	732	4	$ 14,368,908,036.39	14368908036	0.000843844	0.379568639	0.729042569	Y
818	3604	6	$ 14,361,261,109.37	14361261109	0.000843395	0.380412034	0.393263396	Y
1161	1338	5	$ 14,360,218,798.61	14360218799	0.000843334	0.381255367	0.564102056	Y
87	3257	6	$ 14,359,048,880.32	14359048880	0.000843265	0.382098632	0.840850067	Y
1236	1299	5	$ 14,358,018,874.34	14358018874	0.000843204	0.382941837	0.314921557	N
642	3536	6	$ 14,351,472,548.97	14351472549	0.00084282	0.383784657	0.793529776	Y
943	520	4	$ 14,348,750,079.46	14348750079	0.00084266	0.384627317	0.80943597	Y
446	2831	6	$ 14,332,633,067.15	14332633067	0.000841714	0.38546903	0.145905494	N
261	564	4	$ 14,331,044,427.63	14331044428	0.00084162	0.386310651	0.303272765	N
375	1896	5	$ 14,325,966,844.47	14325966844	0.000841322	0.387151973	0.914473108	Y
653	2809	6	$ 14,300,553,739.28	14300553739	0.00083983	0.387991803	0.714271037	Y
210	2306	5	$ 14,291,810,235.16	14291810235	0.000839316	0.388831119	0.378898428	N
25	3865	6	$ 14,290,251,144.58	14290251145	0.000839225	0.389670344	0.339592899	N
1057	1190	5	$ 14,289,808,571.93	14289808572	0.000839199	0.390509542	0.864612076	Y
321	2275	5	$ 14,286,747,535.47	14286747535	0.000839019	0.391348561	0.618641751	Y

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No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
597	1917	5	$ 14,281,937,732.36	14281937732	0.000838736	0.392187298	0.233966775	N
716	450	4	$ 14,280,058,818.93	14280058819	0.000838626	0.393025924	0.890698347	Y
897	1087	4	$ 14,275,996,633.59	14275996634	0.000838388	0.393864311	0.812111906	Y
770	2659	6	$ 14,268,938,007.90	14268938008	0.000837973	0.394702284	0.688943849	Y
461	521	4	$ 14,268,904,151.81	14268904152	0.000837971	0.395540255	0.422639977	Y
721	531	4	$ 14,254,944,210.35	14254944210	0.000837151	0.396377407	0.553655203	Y
777	559	4	$ 14,239,948,577.64	14239948578	0.000836271	0.397213677	0.075297143	N
176	1001	4	$ 14,239,781,846.82	14239781847	0.000836261	0.398049938	0.529560785	Y
72	1684	5	$ 14,236,419,250.09	14236419250	0.000836063	0.398886001	0.98125179	Y
73	2105	5	$ 14,231,073,547.15	14231073547	0.000835749	0.39972175	0.298657644	N
606	2596	6	$ 14,228,538,156.68	14228538157	0.0008356	0.400557351	0.513538452	Y
913	3265	6	$ 14,212,691,390.97	14212691391	0.00083467	0.401392021	0.269504326	N
1148	2482	6	$ 14,203,832,324.84	14203832325	0.00083415	0.40222617	0.700883059	Y
538	851	4	$ 14,198,577,806.47	14198577806	0.000833841	0.403060011	0.026294502	N
31	1857	5	$ 14,197,112,092.95	14197112093	0.000833755	0.403893766	0.570222084	Y
1071	1500	5	$ 14,194,756,256.93	14194756257	0.000833617	0.404727383	0.207972241	N
546	326	3	$ 14,181,929,997.60	14181929998	0.000832863	0.405560246	0.749337221	Y
230	2346	5	$ 14,163,758,707.89	14163758708	0.000831796	0.406392042	0.772050121	Y
342	1229	5	$ 14,158,399,320.56	14158399321	0.000831481	0.407223523	0.178166255	N
139	3881	6	$ 14,151,484,425.62	14151484426	0.000831075	0.408054599	0.596147353	Y
1026	1878	5	$ 14,151,305,471.55	14151305472	0.000831065	0.408885664	0.261513177	N
414	1510	5	$ 14,146,392,055.15	14146392055	0.000830776	0.40971644	0.172682223	N
140	3535	6	$ 14,145,833,671.07	14145833671	0.000830743	0.410547183	0.474739593	Y
415	1198	5	$ 14,144,788,734.62	14144788735	0.000830682	0.411377865	0.709893714	Y
873	2417	6	$ 14,125,631,376.63	14125631377	0.000829557	0.412207422	0.087532381	N
57	970	4	$ 14,116,682,891.56	14116682892	0.000829032	0.413036454	0.8273473	Y
932	3777	6	$ 14,115,376,956.00	14115376956	0.000828955	0.413865409	0.721399509	Y
807	1908	5	$ 14,115,214,126.95	14115214127	0.000828945	0.414694354	0.05937114	N
425	3341	6	$ 14,107,771,399.87	14107771400	0.000828508	0.415522862	0.876833756	Y
1086	1186	5	$ 14,105,773,371.90	14105773372	0.000828391	0.416351253	0.314084031	N
111	827	4	$ 14,104,995,908.92	14104995909	0.000828345	0.417179598	0.034008379	N
237	1823	5	$ 14,093,778,149.34	14093778149	0.000827686	0.418007285	0.42355383	Y
239	2300	5	$ 14,093,778,149.34	14093778149	0.000827686	0.418834971	0.935958239	Y
942	2705	6	$ 14,082,939,337.43	14082939337	0.00082705	0.419662021	0.470274066	Y
820	2126	5	$ 14,071,247,957.86	14071247958	0.000826363	0.420488384	0.667506913	Y
508	3786	6	$ 14,070,000,687.20	14070000687	0.00082629	0.421314674	0.775282844	Y
822	2347	5	$ 14,063,920,307.12	14063920307	0.000825933	0.422140607	0.555108553	Y
824	1707	5	$ 14,058,424,577.38	14058424577	0.00082561	0.422966217	0.660487287	Y
59	3544	6	$ 14,058,032,841.19	14058032841	0.000825587	0.423791804	0.569064699	Y
247	3609	6	$ 14,054,934,812.07	14054934812	0.000825405	0.42461721	0.067964334	N
514	457	4	$ 14,050,592,669.00	14050592669	0.00082515	0.42544236	0.759118264	Y
201	861	4	$ 14,046,822,627.07	14046822627	0.000824929	0.426267289	0.370679109	N
40	1024	4	$ 14,029,627,737.23	14029627737	0.000823919	0.427091208	0.886860927	Y

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444	3566	6	$ 14,027,606,514.60	14027606515	0.0008238	0.427915008	0.513261418	Y
1215	1475	5	$ 14,025,866,931.46	14025866931	0.000823698	0.428738706	0.062480152	N
7	1794	5	$ 14,019,995,584.04	14019995584	0.000823353	0.429562059	0.366564147	N
8	2259	5	$ 14,019,995,584.04	14019995584	0.000823353	0.430385413	0.637064657	Y
646	3539	6	$ 14,018,985,448.32	14018985448	0.000823294	0.431208707	0.002850477	N
1059	1363	5	$ 14,002,488,138.73	14002488139	0.000822325	0.432031032	0.93535867	Y
84	1075	4	$ 13,999,993,121.62	13999993122	0.000822179	0.432853211	0.078544834	N
594	2012	5	$ 13,986,809,396.83	13986809397	0.000821404	0.433674615	0.562386532	Y
86	3817	6	$ 13,986,394,091.85	13986394092	0.00082138	0.434495995	0.86956741	Y
165	5628	7	$ 13,969,125,654.63	13969125655	0.000820366	0.435316361	0.359802748	N
88	3799	6	$ 13,969,021,154.78	13969021155	0.00082036	0.436136721	0.920367498	Y
774	1534	5	$ 13,967,772,127.94	13967772128	0.000820286	0.436957007	0.115446853	N
659	3860	6	$ 13,962,304,733.93	13962304734	0.000819965	0.437776973	0.944773275	Y
1263	2457	6	$ 13,954,959,645.88	13954959646	0.000819534	0.438596507	0.891969886	Y
605	1584	5	$ 13,938,104,347.22	13938104347	0.000818544	0.439415051	0.253237573	N
729	1022	4	$ 13,928,645,231.31	13928645231	0.000817989	0.440233039	0.24250927	N
470	2805	6	$ 13,918,584,199.48	13918584199	0.000817398	0.441050437	0.182391154	N
675	1086	4	$ 13,914,514,840.45	13914514840	0.000817159	0.441867596	0.036923148	N
1270	1220	5	$ 13,905,648,047.54	13905648048	0.000816638	0.442684234	0.631510923	Y
274	1683	5	$ 13,901,707,950.09	13901707950	0.000816407	0.443500641	0.03134753	N
920	2800	6	$ 13,897,494,714.84	13897494715	0.000816159	0.4443168	0.094573356	N
275	2104	5	$ 13,895,752,383.41	13895752383	0.000816057	0.445132857	0.489537093	Y
858	3307	6	$ 13,893,394,854.84	13893394855	0.000815918	0.445948775	0.95883854	Y
218	1183	5	$ 13,892,912,062.16	13892912062	0.00081589	0.446764665	0.165572935	N
219	1488	5	$ 13,892,912,062.16	13892912062	0.00081589	0.447580555	0.808474343	Y
611	2599	6	$ 13,892,610,917.26	13892610917	0.000815872	0.448396428	0.33602359	N
68	3348	6	$ 13,890,560,192.10	13890560192	0.000815752	0.44921218	0.042898423	N
1116	1319	5	$ 13,885,348,294.05	13885348294	0.000815446	0.450027626	0.899191505	Y
177	3570	6	$ 13,867,539,898.91	13867539899	0.0008144	0.450842026	0.404377181	N
404	2621	6	$ 13,867,140,967.97	13867140968	0.000814377	0.451656402	0.739854281	Y
1035	1216	5	$ 13,863,981,437.56	13863981438	0.000814191	0.452470594	0.500364502	Y
924	586	4	$ 13,862,295,522.31	13862295522	0.000814092	0.453284686	0.31240335	N
1240	1365	5	$ 13,854,089,662.55	13854089663	0.00081361	0.454098296	0.530883502	Y
620	1255	5	$ 13,850,772,394.33	13850772394	0.000813415	0.454911711	0.238512284	N
1126	1122	5	$ 13,844,904,894.24	13844904894	0.000813071	0.455724782	0.06491172	N
1165	1218	5	$ 13,842,472,064.54	13842472065	0.000812928	0.45653771	0.750630568	Y
624	2875	6	$ 13,837,189,061.77	13837189062	0.000812618	0.457350328	0.336187243	N
341	2283	5	$ 13,825,452,950.42	13825452950	0.000811928	0.458162256	0.165781247	N
813	1241	5	$ 13,808,128,681.68	13808128682	0.000810911	0.458973167	0.882638661	Y
77	1854	5	$ 13,789,413,737.38	13789413737	0.000809812	0.459782979	0.069779033	N
633	3330	6	$ 13,785,126,704.96	13785126705	0.00080956	0.460592539	0.493535728	Y
887	3525	6	$ 13,781,654,451.32	13781654451	0.000809356	0.461401895	0.685424318	Y
504	731	4	$ 13,763,353,209.28	13763353209	0.000808281	0.462210177	0.775328044	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
430	3344	6	$ 13,754,453,300.92	13754453301	0.000807759	0.463017936	0.670422202	Y
577	3821	6	$ 13,748,294,203.97	13748294204	0.000807397	0.463825333	0.96692141	Y
298	3273	6	$ 13,748,223,035.33	13748223035	0.000807393	0.464632726	0.657503166	Y
245	1119	5	$ 13,705,766,390.90	13705766391	0.0008049	0.465437625	0.368060957	N
517	1060	4	$ 13,705,638,208.23	13705638208	0.000804892	0.466242517	0.835627997	Y
248	1348	5	$ 13,699,963,518.69	13699963519	0.000804559	0.467047076	0.296875515	N
652	3284	6	$ 13,697,797,625.87	13697797626	0.000804432	0.467851508	0.669298784	Y
1149	2287	5	$ 13,693,246,658.38	13693246658	0.000804164	0.468655672	0.643104807	Y
719	405	4	$ 13,672,344,128.46	13672344128	0.000802937	0.469458609	0.816576751	Y
848	1372	5	$ 13,655,666,025.03	13655666025	0.000801957	0.470260566	0.705470401	Y
1112	3334	6	$ 13,645,177,898.17	13645177898	0.000801341	0.471061908	0.842470777	Y
850	1136	5	$ 13,643,110,537.58	13643110538	0.00080122	0.471863128	0.811011561	Y
313	1074	4	$ 13,639,799,869.32	13639799869	0.000801026	0.472664153	0.749871909	Y
1159	2493	6	$ 13,638,473,543.75	13638473544	0.000800948	0.473465101	0.950319939	Y
529	1000	4	$ 13,633,495,414.22	13633495414	0.000800655	0.474265756	0.126337008	N
460	3880	6	$ 13,624,552,506.21	13624552506	0.00080013	0.475065886	0.177547412	N
319	3816	6	$ 13,623,160,799.85	13623160800	0.000800048	0.475865935	0.201342869	N
464	3534	6	$ 13,616,727,263.69	13616727264	0.000799671	0.476665605	0.362521385	N
674	584	4	$ 13,612,445,167.75	13612445168	0.000799419	0.477465025	0.458440276	N
1082	1511	5	$ 13,609,058,616.14	13609058616	0.00079922	0.478264245	0.929476157	Y
533	2834	6	$ 13,605,959,596.02	13605959596	0.000799038	0.479063283	0.673899057	Y
268	3371	6	$ 13,605,540,001.01	13605540001	0.000799014	0.479862297	0.884181426	Y
1083	1199	5	$ 13,605,166,814.01	13605166814	0.000798992	0.480661288	0.671131038	Y
678	832	4	$ 13,604,048,391.42	13604048391	0.000798926	0.481460214	0.63782071	Y
468	412	4	$ 13,602,917,305.67	13602917306	0.00079886	0.482259074	0.785877605	Y
1034	2276	5	$ 13,600,392,160.69	13600392161	0.000798711	0.483057785	0.68572365	Y
795	2081	5	$ 13,600,192,735.53	13600192736	0.0007987	0.483856485	0.919046067	Y
1084	2452	6	$ 13,595,266,090.20	13595266090	0.00079841	0.484654895	0.360469698	N
864	2437	6	$ 13,590,937,540.38	13590937540	0.000798156	0.485453051	0.665135786	Y
63	1895	5	$ 13,589,753,916.74	13589753917	0.000798087	0.486251137	0.015012356	N
18	3613	6	$ 13,587,815,332.21	13587815332	0.000797973	0.48704911	0.57237573	Y
871	3332	6	$ 13,571,207,836.71	13571207837	0.000796997	0.487846107	0.561808901	Y
539	2272	5	$ 13,566,022,041.39	13566022041	0.000796693	0.4886428	0.426145803	N
398	3300	6	$ 13,559,628,187.09	13559628187	0.000796317	0.489439118	0.162872596	N
875	2590	6	$ 13,556,859,025.23	13556859025	0.000796155	0.490235272	0.680082969	Y
544	1802	5	$ 13,556,403,220.32	13556403220	0.000796128	0.4910314	0.557492418	Y
988	1470	5	$ 13,533,042,831.20	13533042831	0.000794756	0.491826156	0.032211109	N
941	1317	5	$ 13,532,701,161.74	13532701162	0.000794736	0.492620892	0.467195135	N
175	1072	4	$ 13,513,968,323.51	13513968324	0.000793636	0.493414528	0.154656197	N
946	3274	6	$ 13,510,560,089.56	13510560090	0.000793436	0.494207964	0.680644376	Y
1301	551	4	$ 13,509,803,585.32	13509803585	0.000793391	0.495001355	0.759103066	Y
744	540	4	$ 13,509,187,139.56	13509187140	0.000793355	0.49579471	0.257877876	N
559	2916	5	$ 13,498,690,709.64	13498690710	0.000792739	0.496587449	0.925780182	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
179	741	4	$ 13,491,977,655.84	13491977656	0.000792344	0.497379793	0.883196097	Y
823	1916	5	$ 13,487,840,098.40	13487840098	0.000792101	0.498171895	0.668580226	Y
493	524	4	$ 13,482,410,478.06	13482410478	0.000791783	0.498963677	0.818684982	Y
829	2451	6	$ 13,473,641,762.82	13473641763	0.000791268	0.499754945	0.992998532	Y
635	2125	5	$ 13,467,783,865.27	13467783865	0.000790924	0.500545868	0.727052882	Y
636	1706	5	$ 13,466,142,660.72	13466142661	0.000790827	0.501336695	0.611660078	Y
1064	1243	5	$ 13,464,938,518.48	13464938518	0.000790756	0.502127452	0.699937843	Y
422	2905	6	$ 13,461,906,397.22	13461906397	0.000790578	0.50291803	0.700576563	Y
637	2345	5	$ 13,461,219,050.77	13461219051	0.000790538	0.503708568	0.321738872	N
423	2595	6	$ 13,452,745,076.80	13452745077	0.00079004	0.504498609	0.041083128	N
289	572	4	$ 13,452,023,917.32	13452023917	0.000789998	0.505288607	0.770945978	Y
641	2424	6	$ 13,444,662,632.40	13444662632	0.000789566	0.506078173	0.142224416	N
507	563	4	$ 13,435,460,579.29	13435460579	0.000789025	0.506867198	0.481897441	N
293	2830	6	$ 13,434,360,790.08	13434360790	0.000788961	0.507656159	0.667230818	Y
765	2274	5	$ 13,428,318,631.77	13428318632	0.000788606	0.508444764	0.49628324	N
901	2420	6	$ 13,425,928,648.39	13425928648	0.000788466	0.50923323	0.784633288	Y
582	860	4	$ 13,420,279,803.16	13420279803	0.000788134	0.510021364	0.331357252	N
295	5162	7	$ 13,418,276,021.37	13418276021	0.000788016	0.51080938	0.764979426	Y
106	1023	4	$ 13,411,760,608.77	13411760609	0.000787633	0.511597013	0.722807051	Y
959	872	4	$ 13,410,143,036.75	13410143037	0.000787538	0.512384552	0.182847914	N
1156	847	4	$ 13,403,490,905.88	13403490906	0.000787148	0.5131717	0.571878482	Y
141	3629	6	$ 13,395,739,021.57	13395739022	0.000786693	0.513958392	0.981681156	Y
142	5418	7	$ 13,390,276,381.59	13390276382	0.000786372	0.514744764	0.285822491	N
241	1894	5	$ 13,371,851,696.57	13371851697	0.00078529	0.515530054	0.529019345	Y
1241	1245	5	$ 13,366,833,004.39	13366833004	0.000784995	0.516315049	0.790109205	Y
81	3565	6	$ 13,355,281,699.15	13355281699	0.000784317	0.517099366	0.023310953	N
664	3608	6	$ 13,342,909,670.61	13342909671	0.00078359	0.517882956	0.630436775	Y
83	3547	6	$ 13,338,901,906.81	13338901907	0.000783355	0.51866631	0.004715393	N
923	2350	5	$ 13,329,236,871.42	13329236871	0.000782787	0.519449097	0.145660689	N
113	707	4	$ 13,328,680,630.16	13328680630	0.000782754	0.520231852	0.487742606	N
604	1533	5	$ 13,323,954,500.75	13323954501	0.000782477	0.521014329	0.223821936	N
730	1469	5	$ 13,313,382,367.16	13313382367	0.000781856	0.521796185	0.344865402	N
530	3569	6	$ 13,309,987,711.77	13309987712	0.000781657	0.522577841	0.176551254	N
977	2491	6	$ 13,307,252,619.08	13307252619	0.000781496	0.523359338	0.489446261	N
33	3795	6	$ 13,301,355,901.84	13301355902	0.00078115	0.524140487	0.716004407	Y
1048	2317	5	$ 13,291,855,771.26	13291855771	0.000780592	0.524921079	0.765913877	Y
534	460	4	$ 13,274,269,509.18	13274269509	0.000779559	0.525700638	0.442390582	N
206	3279	6	$ 13,256,715,622.67	13256715623	0.000778528	0.526479166	0.087182602	N
1098	1374	5	$ 13,249,369,017.16	13249369017	0.000778097	0.527257263	0.290839466	N
207	2313	5	$ 13,243,092,995.30	13243092995	0.000777728	0.528034991	0.952734994	Y
1317	477	4	$ 13,242,062,515.23	13242062515	0.000777668	0.528812659	0.774994244	Y
689	1092	4	$ 13,241,447,995.42	13241447995	0.000777632	0.52959029	0.289539228	N
543	1021	4	$ 13,241,406,007.47	13241406007	0.000777629	0.530367919	0.434993008	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
884	1537	5	$ 13,238,569,444.59	13238569445	0.000777462	0.531145382	0.942454228	Y
163	5212	7	$ 13,233,935,791.68	13233935792	0.00077719	0.531922572	0.8950875	Y
121	830	4	$ 13,224,832,194.40	13224832194	0.000776656	0.532699228	0.682032758	Y
552	2079	5	$ 13,211,534,858.70	13211534859	0.000775875	0.533475103	0.223534616	N
38	1654	5	$ 13,211,499,885.59	13211499886	0.000775873	0.534250975	0.021053385	N
626	2665	6	$ 13,209,998,157.77	13209998158	0.000775785	0.53502676	0.117751546	N
39	2063	5	$ 13,206,765,170.53	13206765171	0.000775595	0.535802355	0.733684747	Y
333	2031	5	$ 13,195,136,826.14	13195136826	0.000774912	0.536577267	0.712762667	Y
891	1509	5	$ 13,192,930,167.87	13192930168	0.000774782	0.537352049	0.106585781	N
892	1197	5	$ 13,191,174,822.72	13191174823	0.000774679	0.538126728	0.253706249	N
276	3339	6	$ 13,181,041,727.68	13181041728	0.000774084	0.538900812	0.820125153	Y
91	3351	6	$ 13,176,366,181.10	13176366181	0.000773809	0.539674621	0.375537735	N
221	1228	5	$ 13,163,380,951.27	13163380951	0.000773047	0.540447668	0.038996145	N
495	2624	6	$ 13,155,011,611.97	13155011612	0.000772555	0.541220224	0.327164996	N
900	3340	6	$ 13,152,402,980.98	13152402981	0.000772402	0.541992626	0.930902701	Y
1113	1053	4	$ 13,131,266,189.40	13131266189	0.000771161	0.542763787	0.002946107	N
288	3564	6	$ 13,109,006,696.63	13109006697	0.000769854	0.54353364	0.732932756	Y
849	1252	5	$ 13,077,990,363.25	13077990363	0.000768032	0.544301673	0.409818168	N
918	1083	4	$ 13,073,723,161.62	13073723162	0.000767782	0.545069454	0.233884551	N
1166	141	3	$ 13,064,596,177.66	13064596178	0.000767246	0.5458367	0.017468635	N
855	2456	6	$ 13,055,515,532.48	13055515532	0.000766712	0.546603412	0.757151744	Y
49	1032	4	$ 13,052,992,837.75	13052992838	0.000766564	0.547369976	0.185816279	N
103	999	4	$ 13,051,854,014.72	13051854015	0.000766497	0.548136473	0.527084383	N
1302	593	4	$ 13,049,904,418.94	13049904419	0.000766383	0.548902856	0.536441861	N
660	1370	5	$ 13,048,238,268.69	13048238269	0.000766285	0.549669141	0.402842771	N
661	1134	5	$ 13,046,635,320.86	13046635321	0.000766191	0.550435321	0.965631433	Y
236	347	3	$ 13,042,682,636.65	13042682637	0.000765959	0.55120129	0.963808826	Y
981	467	4	$ 13,022,722,049.97	13022722050	0.000764786	0.551966077	0.249656058	N
1174	456	4	$ 13,011,895,586.57	13011895587	0.000764151	0.552730227	0.253138094	N
797	1871	5	$ 13,009,452,313.12	13009452313	0.000764007	0.553494234	0.02702295	N
527	1071	4	$ 13,007,184,142.85	13007184143	0.000763874	0.554258108	0.034200159	N
799	2282	5	$ 13,006,094,106.72	13006094107	0.00076381	0.555021918	0.169663133	N
143	2003	5	$ 13,005,343,980.87	13005343981	0.000763766	0.555785684	0.172767933	N
733	3272	6	$ 13,003,204,247.13	13003204247	0.00076364	0.556549324	0.057529993	N
308	2355	5	$ 12,989,074,850.01	12989074850	0.00076281	0.557312134	0.668810019	Y
681	712	4	$ 12,987,467,757.96	12987467758	0.000762716	0.55807485	0.194856406	N
532	740	4	$ 12,982,756,383.32	12982756383	0.000762439	0.55883729	0.601523601	Y
465	3628	6	$ 12,966,633,597.29	12966633597	0.000761492	0.559598782	0.82076442	Y
692	3370	6	$ 12,932,686,613.43	12932686613	0.000759499	0.560358281	0.534234818	N
1185	530	4	$ 12,910,730,752.68	12910730753	0.000758209	0.561116491	0.861755209	Y
1238	1126	5	$ 12,908,794,120.05	12908794120	0.000758096	0.561874586	0.454822866	N
267	2620	6	$ 12,907,639,679.58	12907639680	0.000758028	0.562632614	0.40007001	N
326	3374	6	$ 12,902,794,401.67	12902794402	0.000757743	0.563390358	0.801916721	Y

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754	1474	5	$ 12,891,761,051.59	12891761052	0.000757095	0.564147453	0.220610223	N
1310	560	4	$ 12,889,062,596.17	12889062596	0.000756937	0.56490439	0.763048999	Y
1158	727	4	$ 12,885,202,226.38	12885202226	0.00075671	0.5656611	0.462128692	N
117	859	4	$ 12,884,286,190.13	12884286190	0.000756656	0.566417757	0.280644462	N
700	2419	6	$ 12,876,585,466.05	12876585466	0.000756204	0.567173961	0.926676811	Y
1118	556	4	$ 12,854,565,048.76	12854565049	0.000754911	0.567928872	0.965262984	Y
962	752	4	$ 12,854,319,642.58	12854319643	0.000754897	0.568683769	0.070678659	N
764	2305	5	$ 12,854,018,943.68	12854018944	0.000754879	0.569438648	0.408838788	N
492	569	4	$ 12,847,807,408.31	12847807408	0.000754514	0.570193162	0.798567969	Y
1080	2011	5	$ 12,847,728,710.53	12847728711	0.00075451	0.570947671	0.621459803	Y
639	1915	5	$ 12,846,925,808.21	12846925808	0.000754462	0.571702134	0.433786528	N
908	3343	6	$ 12,846,023,006.86	12846023007	0.000754409	0.572456543	0.440007898	N
1213	558	4	$ 12,834,191,478.91	12834191479	0.000753715	0.573210258	0.487508235	N
711	595	4	$ 12,825,575,808.97	12825575809	0.000753209	0.573963466	0.666314695	Y
498	415	4	$ 12,823,990,158.32	12823990158	0.000753115	0.574716582	0.142786577	N
576	538	4	$ 12,817,872,661.09	12817872661	0.000752756	0.575469338	0.306278575	N
220	2281	5	$ 12,813,275,209.17	12813275209	0.000752486	0.576221824	0.936605713	Y
1085	1583	5	$ 12,809,272,128.82	12809272129	0.000752251	0.576974075	0.622534315	Y
1249	1360	5	$ 12,805,700,626.06	12805700626	0.000752041	0.577726116	0.865050892	Y
222	3298	6	$ 12,805,140,886.08	12805140886	0.000752008	0.578478125	0.718097668	Y
648	2481	6	$ 12,798,280,335.38	12798280335	0.000751606	0.579229731	0.684451249	Y
424	2695	6	$ 12,796,115,443.97	12796115444	0.000751478	0.579981209	0.335854107	N
1319	432	4	$ 12,793,432,858.04	12793432858	0.000751321	0.58073253	0.200228719	N
583	1811	5	$ 12,791,784,988.27	12791784988	0.000751224	0.581483754	0.909919079	Y
511	5211	7	$ 12,786,382,988.25	12786382988	0.000750907	0.582234661	0.260872891	N
922	581	4	$ 12,777,641,962.26	12777641962	0.000750394	0.582985054	0.352287122	N
585	2087	5	$ 12,776,518,402.94	12776518403	0.000750328	0.583735382	0.692792804	Y
1043	1295	5	$ 12,769,715,595.28	12769715595	0.000749928	0.58448531	0.17996619	N
351	998	4	$ 12,768,868,413.61	12768868414	0.000749878	0.585235188	0.107315393	N
863	2459	6	$ 12,745,694,996.00	12745694996	0.000748517	0.585983706	0.693305741	Y
1294	519	4	$ 12,737,730,489.35	12737730489	0.00074805	0.586731755	0.75718978	Y
1203	526	4	$ 12,733,701,704.79	12733701705	0.000747813	0.587479569	0.649173839	Y
598	3270	6	$ 12,724,478,098.92	12724478099	0.000747271	0.58822684	0.778150593	Y
363	5165	7	$ 12,720,476,117.18	12720476117	0.000747036	0.588973876	0.949561539	Y
95	2290	5	$ 12,714,745,945.29	12714745945	0.0007467	0.589720576	0.961463108	Y
1102	1254	5	$ 12,714,048,519.31	12714048519	0.000746659	0.590467235	0.294499765	N
874	3299	6	$ 12,713,794,567.56	12713794568	0.000746644	0.591213879	0.892714696	Y
989	882	4	$ 12,710,399,044.59	12710399045	0.000746445	0.591960324	0.734155301	Y
603	2312	5	$ 12,706,292,852.37	12706292852	0.000746203	0.592706527	0.676147291	Y
100	1029	4	$ 12,684,310,440.43	12684310440	0.000744912	0.59345144	0.700822035	Y
304	1821	5	$ 12,681,011,347.72	12681011348	0.000744719	0.594196158	0.907171746	Y
814	130	3	$ 12,659,039,697.83	12659039698	0.000743428	0.594939587	0.314504839	N
1324	1115	5	$ 12,656,325,286.89	12656325287	0.000743269	0.595682856	0.291190604	N

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22	969	4	$ 12,651,002,357.17	12651002357	0.000742956	0.596425812	0.233379621	N
74	5191	7	$ 12,627,763,099.00	12627763099	0.000741592	0.597167404	0.14126971	N
472	4226	7	$ 12,620,485,560.56	12620485561	0.000741164	0.597908568	0.209053215	N
832	2431	6	$ 12,606,099,330.22	12606099330	0.000740319	0.598648887	0.211019723	N
26	3543	6	$ 12,595,442,653.17	12595442653	0.000739694	0.599388581	0.71381116	Y
396	858	4	$ 12,581,030,540.68	12581030541	0.000738847	0.600127428	0.708889108	Y
323	523	4	$ 12,576,693,776.24	12576693776	0.000738592	0.60086602	0.754992261	Y
762	1477	5	$ 12,573,794,861.77	12573794862	0.000738422	0.601604443	0.927797343	Y
553	1869	5	$ 12,570,809,190.50	12570809190	0.000738247	0.602342689	0.850436383	Y
561	1499	5	$ 12,554,435,907.23	12554435907	0.000737285	0.603079975	0.579505148	N
1028	2053	5	$ 12,552,290,790.24	12552290790	0.000737159	0.603817134	0.74334171	Y
114	2094	5	$ 12,552,258,965.01	12552258965	0.000737157	0.604554292	0.892039689	Y
707	3338	6	$ 12,547,927,397.96	12547927398	0.000736903	0.605291195	0.184202506	N
1037	1801	5	$ 12,534,740,889.93	12534740890	0.000736129	0.606027323	0.27608272	N
1327	1335	5	$ 12,532,457,153.86	12532457154	0.000735995	0.606763318	0.031887571	N
1133	3329	6	$ 12,530,774,227.35	12530774227	0.000735896	0.607499214	0.931248624	Y
337	1681	5	$ 12,503,742,132.29	12503742132	0.000734308	0.608233522	0.343825141	N
1176	411	4	$ 12,499,415,964.52	12499415965	0.000734054	0.608967576	0.253321932	N
164	3369	6	$ 12,494,771,686.91	12494771687	0.000733781	0.609701357	0.605048264	N
277	5236	7	$ 12,477,683,859.77	12477683860	0.000732778	0.610434135	0.239153392	N
1235	462	4	$ 12,474,989,810.34	12474989810	0.00073262	0.611166755	0.835296279	Y
982	422	4	$ 12,472,019,483.52	12472019484	0.000732445	0.6118992	0.431581117	N
654	346	3	$ 12,471,467,763.41	12471467763	0.000732413	0.612631613	0.997779507	Y
788	2076	5	$ 12,464,809,884.12	12464809884	0.000732022	0.613363635	0.840224706	Y
790	1662	5	$ 12,461,604,496.36	12461604496	0.000731834	0.614095469	0.891848734	Y
122	710	4	$ 12,455,853,872.84	12455853873	0.000731496	0.614826964	0.774473368	Y
34	3347	6	$ 12,452,603,577.34	12452603577	0.000731305	0.615558269	0.295152678	N
1142	583	4	$ 12,452,361,689.95	12452361690	0.000731291	0.61628956	0.567760135	N
1055	2271	5	$ 12,452,257,798.47	12452257798	0.000731285	0.617020845	0.680066521	Y
592	2090	5	$ 12,441,313,264.95	12441313265	0.000730642	0.617751487	0.849603857	Y
435	2019	5	$ 12,435,443,316.86	12435443317	0.000730297	0.618481784	0.822705867	Y
665	1250	5	$ 12,433,035,902.74	12433035903	0.000730156	0.61921194	0.115092036	N
1062	1651	5	$ 12,417,159,341.66	12417159342	0.000729223	0.619941163	0.319066871	N
672	2455	6	$ 12,410,003,846.57	12410003847	0.000728803	0.620669967	0.594942714	N
131	1793	5	$ 12,404,436,566.31	12404436566	0.000728476	0.621398443	0.177190218	N
361	459	4	$ 12,393,932,132.52	12393932133	0.000727859	0.622126302	0.590028298	N
811	2030	5	$ 12,381,470,802.81	12381470803	0.000727128	0.62285343	0.878958786	Y
92	4063	5	$ 12,379,426,259.30	12379426259	0.000727008	0.623580437	0.244189898	N
41	1853	5	$ 12,366,334,753.06	12366334753	0.000726239	0.624306676	0.345628632	N
1284	585	4	$ 12,355,152,505.61	12355152506	0.000725582	0.625032258	0.358636194	N
746	2354	5	$ 12,336,843,204.85	12336843205	0.000724507	0.625756765	0.756538912	Y
1121	2450	6	$ 12,332,055,861.21	12332055861	0.000724226	0.62648099	0.023642109	N
186	5161	7	$ 12,329,629,433.46	12329629433	0.000724083	0.627205074	0.958992472	Y

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No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1250	1240	5	$ 12,323,106,376.53	12323106377	0.0007237	0.627928774	0.345611106	N
618	137	3	$ 12,319,525,586.33	12319525586	0.00072349	0.628652263	0.40298421	N
1017	476	4	$ 12,317,503,111.09	12317503111	0.000723371	0.629375634	0.03839732	N
619	2280	5	$ 12,316,286,859.81	12316286860	0.0007233	0.630098934	0.319118231	N
188	2375	5	$ 12,313,474,284.61	12313474285	0.000723134	0.630822068	0.256884781	N
622	3297	6	$ 12,307,225,584.92	12307225585	0.000722767	0.631544835	0.573782853	N
382	2117	5	$ 12,298,998,011.39	12298998011	0.000722284	0.63226712	0.511487402	N
1224	2080	5	$ 12,289,998,489.83	12289998490	0.000721756	0.632988875	0.595898652	N
1251	1371	5	$ 12,276,427,794.20	12276427794	0.000720959	0.633709834	0.469595202	N
846	1635	5	$ 12,274,094,732.11	12274094732	0.000720822	0.634430656	0.106195867	N
1038	1315	5	$ 12,267,565,217.94	12267565218	0.000720438	0.635151094	0.269608813	N
105	739	4	$ 12,267,096,902.08	12267096902	0.000720411	0.635871505	0.508998058	N
1198	539	4	$ 12,265,792,371.55	12265792372	0.000720334	0.636591839	0.18148238	N
1253	1135	5	$ 12,262,813,399.79	12262813400	0.000720159	0.637311998	0.673226202	Y
48	2359	5	$ 12,258,932,238.43	12258932238	0.000719931	0.638031929	0.912140611	Y
706	977	4	$ 12,257,624,762.49	12257624762	0.000719854	0.638751784	0.545811674	N
554	2046	5	$ 12,256,705,997.27	12256705997	0.000719801	0.639471584	0.585413924	N
107	3278	6	$ 12,255,053,635.64	12255053636	0.000719703	0.640191288	0.731694684	Y
972	1091	4	$ 12,252,409,070.72	12252409071	0.000719548	0.640910836	0.938454959	Y
395	3295	6	$ 12,252,158,322.52	12252158323	0.000719533	0.641630369	0.410901722	N
144	322	3	$ 12,250,725,159.80	12250725160	0.000719449	0.642349819	0.75191973	Y
1201	1330	5	$ 12,248,807,899.87	12248807900	0.000719337	0.643069155	0.546502425	N
1041	2078	5	$ 12,248,680,798.29	12248680798	0.000719329	0.643788484	0.651390192	Y
1042	1468	5	$ 12,241,813,768.80	12241813769	0.000718926	0.64450741	0.527721641	N
768	3373	6	$ 12,241,268,800.59	12241268801	0.000718894	0.645226304	0.98288468	Y
1207	417	4	$ 12,226,545,873.20	12226545873	0.000718029	0.645944334	0.400309527	N
978	1843	5	$ 12,220,366,002.62	12220366003	0.000717666	0.646662	0.878221595	Y
269	356	3	$ 12,206,035,606.85	12206035607	0.000716825	0.647378825	0.793175734	Y
714	1543	5	$ 12,205,591,722.47	12205591722	0.000716799	0.648095623	0.80348634	Y
1103	2020	5	$ 12,185,520,907.08	12185520907	0.00071562	0.648811244	0.709386982	Y
792	881	4	$ 12,163,319,393.01	12163319393	0.000714316	0.64952556	0.232020477	N
992	762	4	$ 12,161,760,088.28	12161760088	0.000714225	0.650239784	0.430846293	N
584	1473	5	$ 12,160,989,329.26	12160989329	0.000714179	0.650953964	0.26727141	N
993	1329	5	$ 12,159,933,709.16	12159933709	0.000714117	0.651668081	0.213323989	N
586	2430	6	$ 12,152,160,316.01	12152160316	0.000713661	0.652381742	0.711333979	Y
512	3368	6	$ 12,144,408,473.78	12144408474	0.000713206	0.653094947	0.039446605	N
798	1302	5	$ 12,142,843,593.32	12142843593	0.000713114	0.653808061	0.051510843	N
589	1877	5	$ 12,142,136,337.22	12142136337	0.000713072	0.654521133	0.067301904	N
428	3776	6	$ 12,121,623,382.56	12121623383	0.000711868	0.655233001	0.618603671	N
734	2484	6	$ 12,112,347,000.91	12112347001	0.000711323	0.655944324	0.806615464	Y
1070	1298	5	$ 12,109,626,858.45	12109626858	0.000711163	0.656655487	0.512314695	N
223	4032	6	$ 12,091,651,309.74	12091651310	0.000710107	0.657365594	0.019476821	N
1265	2436	6	$ 12,087,607,994.90	12087607995	0.00070987	0.658075464	0.140059699	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1328	1215	5	$ 12,087,481,156.64	12087481157	0.000709862	0.658785326	0.975862373	Y
356	738	4	$ 12,081,251,793.55	12081251794	0.000709497	0.659494823	0.87042301	Y
127	2311	5	$ 12,046,866,643.70	12046866644	0.000707477	0.6602023	0.59600175	N
130	2293	5	$ 12,031,481,837.09	12031481837	0.000706574	0.660908874	0.209946647	N
904	1046	4	$ 12,022,637,658.58	12022637659	0.000706054	0.661614928	0.875207752	Y
761	327	3	$ 11,993,694,599.40	11993694599	0.000704355	0.662319283	0.356412316	N
1136	1369	5	$ 11,990,750,161.42	11990750161	0.000704182	0.663023464	0.016989761	N
1137	1133	5	$ 11,988,995,540.28	11988995540	0.000704079	0.663727543	0.612097538	N
763	1820	5	$ 11,988,847,002.75	11988847003	0.00070407	0.664431613	0.691362219	Y
545	2351	4	$ 11,978,028,706.33	11978028706	0.000703435	0.665135048	0.653466939	N
473	2480	6	$ 11,969,109,015.39	11969109015	0.000702911	0.665837958	0.563388875	N
306	2025	5	$ 11,964,414,809.59	11964414810	0.000702635	0.666540594	0.008911141	N
246	3309	6	$ 11,943,009,341.53	11943009342	0.000701378	0.667241972	0.475185739	N
555	2374	5	$ 11,942,602,804.05	11942602804	0.000701354	0.667943326	0.969442914	Y
389	1809	5	$ 11,939,529,756.30	11939529756	0.000701174	0.668644499	0.416753296	N
249	3826	6	$ 11,939,230,372.93	11939230373	0.000701156	0.669345655	0.135154933	N
983	1195	5	$ 11,931,932,487.21	11931932487	0.000700728	0.670046383	0.408613266	N
97	1884	5	$ 11,927,358,794.53	11927358795	0.000700459	0.670746842	0.959220516	Y
317	1624	5	$ 11,922,886,305.58	11922886306	0.000700196	0.671447038	0.640100483	N
1211	342	3	$ 11,914,264,506.43	11914264506	0.00069969	0.672146728	0.591446605	N
1060	537	4	$ 11,896,545,166.81	11896545167	0.000698649	0.672845377	0.81912288	Y
324	568	4	$ 11,895,747,652.29	11895747652	0.000698602	0.67354398	0.111104791	N
399	2085	5	$ 11,895,446,364.43	11895446364	0.000698585	0.674242565	0.968622589	Y
69	829	4	$ 11,890,332,987.67	11890332988	0.000698284	0.674940849	0.536485105	N
327	414	4	$ 11,881,472,418.64	11881472419	0.000697764	0.675638613	0.720103428	Y
650	1502	5	$ 11,878,204,928.39	11878204928	0.000697572	0.676336186	0.861540143	Y
793	1866	5	$ 11,874,375,086.77	11874375087	0.000697347	0.677033533	0.167631749	N
146	2097	5	$ 11,874,086,179.76	11874086180	0.00069733	0.677730863	0.252770234	N
1065	1810	5	$ 11,869,541,754.54	11869541755	0.000697063	0.678427927	0.353769367	N
1007	592	4	$ 11,863,178,012.19	11863178012	0.00069669	0.679124617	0.635991282	N
1067	367	3	$ 11,863,123,283.30	11863123283	0.000696687	0.679821303	0.639585627	N
1069	2086	5	$ 11,852,757,084.03	11852757084	0.000696078	0.680517381	0.135212372	N
419	2310	5	$ 11,832,661,786.84	11832661787	0.000694898	0.681212278	0.0624176	N
886	1180	4	$ 11,831,668,274.82	11831668275	0.000694839	0.681907118	0.98172368	Y
595	1880	5	$ 11,808,459,766.07	11808459766	0.000693476	0.682600594	0.49447511	N
1226	1870	5	$ 11,796,787,599.03	11796787599	0.000692791	0.683293385	0.060595737	N
1252	1251	5	$ 11,796,585,149.60	11796585150	0.000692779	0.683986164	0.398030147	N
518	1836	5	$ 11,791,991,181.91	11791991182	0.000692509	0.684678673	0.721632879	Y
816	1680	5	$ 11,791,957,964.13	11791957964	0.000692507	0.68537118	0.808267462	Y
1019	431	4	$ 11,774,596,449.23	11774596449	0.000691488	0.686062668	0.434401547	N
524	1573	5	$ 11,774,130,389.24	11774130389	0.00069146	0.686754128	0.99839028	Y
825	474	4	$ 11,766,146,611.32	11766146611	0.000690991	0.68744512	0.522294693	N
1023	1334	5	$ 11,764,609,889.23	11764609889	0.000690901	0.688136021	0.169854696	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
831	1671	5	$ 11,749,224,059.45	11749224059	0.000689998	0.688826018	0.88187805	Y
1178	594	4	$ 11,748,779,315.82	11748779316	0.000689971	0.68951599	0.959127225	Y
1206	1210	5	$ 11,747,800,356.61	11747800357	0.000689914	0.690205904	0.728816513	Y
748	1182	5	$ 11,743,306,141.78	11743306142	0.00068965	0.690895554	0.56961698	N
693	355	3	$ 11,730,551,503.44	11730551503	0.000688901	0.691584455	0.248583816	N
910	2018	5	$ 11,722,031,415.83	11722031416	0.000688401	0.692272855	0.170666782	N
1047	1868	5	$ 11,705,557,449.35	11705557449	0.000687433	0.692960289	0.160453145	N
1099	3269	6	$ 11,693,160,723.09	11693160723	0.000686705	0.693646994	0.135855881	N
233	3277	6	$ 11,667,725,316.08	11667725316	0.000685211	0.694332205	0.313506269	N
851	2116	5	$ 11,657,653,527.15	11657653527	0.00068462	0.695016825	0.183264459	N
773	1090	4	$ 11,648,198,240.99	11648198241	0.000684065	0.69570089	0.206808254	N
379	1498	5	$ 11,639,984,720.96	11639984721	0.000683582	0.696384472	0.107291307	N
475	2120	5	$ 11,632,292,459.78	11632292460	0.000683131	0.697067602	0.366181879	N
385	1907	5	$ 11,625,710,414.56	11625710415	0.000682744	0.697750346	0.675336699	N
386	3524	6	$ 11,620,405,577.00	11620405577	0.000682432	0.698432779	0.653210295	N
1001	1209	5	$ 11,609,090,591.84	11609090592	0.000681768	0.699114547	0.110599473	N
869	1297	5	$ 11,604,238,747.80	11604238748	0.000681483	0.69979603	0.096343458	N
647	1044	4	$ 11,581,258,932.53	11581258933	0.000680133	0.700476163	0.719609228	Y
649	140	3	$ 11,579,971,272.68	11579971273	0.000680058	0.701156221	0.985559313	Y
1309	466	4	$ 11,574,609,038.96	11574609039	0.000679743	0.701835964	0.179908165	N
796	761	4	$ 11,570,818,925.19	11570818925	0.00067952	0.702515484	0.644029164	N
253	1653	5	$ 11,570,116,591.80	11570116592	0.000679479	0.703194964	0.06393343	N
1077	2089	5	$ 11,564,493,451.98	11564493452	0.000679149	0.703874112	0.318074402	N
800	1118	5	$ 11,551,343,472.17	11551343472	0.000678377	0.704552489	0.603640134	N
1228	136	3	$ 11,543,787,104.72	11543787105	0.000677933	0.705230422	0.837138848	Y
802	2286	5	$ 11,540,927,254.32	11540927254	0.000677765	0.705908187	0.844295297	Y
329	2044	5	$ 11,535,011,188.97	11535011189	0.000677417	0.706585604	0.290256793	N
731	986	4	$ 11,533,223,103.03	11533223103	0.000677312	0.707262917	0.623046335	N
806	1359	5	$ 11,531,999,097.92	11531999098	0.000677241	0.707940157	0.395031556	N
662	3308	6	$ 11,527,358,390.89	11527358391	0.000676968	0.708617125	0.920073607	Y
667	3825	6	$ 11,523,122,742.01	11523122742	0.000676719	0.709293845	0.000706856	N
893	3294	6	$ 11,512,538,664.40	11512538664	0.000676098	0.709969943	0.084375998	N
1087	147	3	$ 11,495,893,430.34	11495893430	0.00067512	0.710645063	0.168866911	N
1089	2418	6	$ 11,485,619,347.12	11485619347	0.000674517	0.71131958	0.240451118	N
1140	1249	5	$ 11,473,454,844.63	11473454845	0.000673802	0.711993382	0.756561766	Y
1036	1337	5	$ 11,472,905,289.33	11472905289	0.00067377	0.712667152	0.657317693	N
427	3306	6	$ 11,468,582,481.69	11468582482	0.000673516	0.713340669	0.992847691	Y
743	2016	5	$ 11,463,498,295.81	11463498296	0.000673218	0.714013886	0.680832469	N
521	3779	6	$ 11,459,866,224.82	11459866225	0.000673004	0.714686891	0.126747195	N
745	1630	5	$ 11,457,698,602.76	11457698603	0.000672877	0.715359768	0.723351959	Y
1045	2045	5	$ 11,442,464,910.22	11442464910	0.000671983	0.71603175	0.903856041	Y
1348	157	3	$ 11,442,230,681.95	11442230682	0.000671969	0.716703719	0.04824221	N
442	996	4	$ 11,425,990,110.93	11425990111	0.000671015	0.717374734	0.252547203	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
280	1815	5	$ 11,424,768,048.53	11424768049	0.000670943	0.718045677	0.105837782	N
157	325	3	$ 11,404,188,151.09	11404188151	0.000669735	0.718715412	0.433135738	N
224	3574	6	$ 11,375,795,186.75	11375795187	0.000668067	0.719383479	0.658457027	N
625	2438	6	$ 11,370,105,691.19	11370105691	0.000667733	0.720051212	0.957413905	Y
627	2840	6	$ 11,365,984,481.68	11365984482	0.000667491	0.720718703	0.971470364	Y
1296	580	4	$ 11,355,839,746.38	11355839746	0.000666895	0.721385599	0.383749448	N
118	3286	6	$ 11,348,765,641.94	11348765642	0.00066648	0.722052078	0.477194633	N
119	3805	6	$ 11,344,337,490.67	11344337491	0.00066622	0.722718298	0.940457948	Y
997	1309	5	$ 11,343,511,669.12	11343511669	0.000666171	0.723384469	0.025100354	N
860	1808	5	$ 11,343,026,514.23	11343026514	0.000666143	0.724050612	0.681107727	N
1222	1661	5	$ 11,336,372,828.77	11336372829	0.000665752	0.724716364	0.045212952	N
1073	1876	5	$ 11,315,901,244.47	11315901244	0.00066455	0.725380914	0.439735438	N
1350	455	4	$ 11,297,451,889.00	11297451889	0.000663466	0.72604438	0.179287578	N
55	2289	5	$ 11,297,258,032.42	11297258032	0.000663455	0.726707835	0.411528417	N
1125	2321	5	$ 11,295,511,335.48	11295511335	0.000663352	0.727371188	0.285003244	N
876	2084	5	$ 11,293,925,566.74	11293925567	0.000663259	0.728034447	0.467357952	N
882	2429	6	$ 11,278,915,739.50	11278915739	0.000662378	0.728696825	0.171450764	N
1204	1111	5	$ 11,272,039,985.65	11272039986	0.000661974	0.729358799	0.620343614	N
58	1028	4	$ 11,271,579,309.78	11271579310	0.000661947	0.730020745	0.76794868	Y
1175	976	4	$ 11,268,873,229.88	11268873230	0.000661788	0.730682533	0.692028434	N
310	1675	5	$ 11,267,211,449.05	11267211449	0.00066169	0.731344224	0.395542434	N
132	1887	5	$ 11,263,621,920.41	11263621920	0.00066148	0.732005703	0.764333647	Y
801	590	4	$ 11,254,844,392.17	11254844392	0.000660964	0.732666668	0.091744962	N
489	856	4	$ 11,253,414,869.80	11253414870	0.00066088	0.733327548	0.465034878	N
1239	2075	5	$ 11,246,916,758.36	11246916758	0.000660499	0.733988046	0.87792281	Y
250	2115	5	$ 11,233,909,073.35	11233909073	0.000659735	0.734647781	0.051862797	N
401	3850	6	$ 11,226,327,862.44	11226327862	0.000659289	0.73530707	0.15224843	N
403	1875	5	$ 11,223,919,841.85	11223919842	0.000659148	0.735966218	0.39469712	N
1031	1214	5	$ 11,219,957,807.82	11219957808	0.000658915	0.736625134	0.962682214	Y
254	5171	7	$ 11,214,769,181.35	11214769181	0.000658611	0.737283744	0.581930175	N
1092	377	3	$ 11,213,655,754.75	11213655755	0.000658545	0.737942289	0.886115682	Y
966	837	4	$ 11,209,136,959.86	11209136960	0.00065828	0.738600569	0.281899187	N
1144	515	4	$ 11,187,416,072.61	11187416073	0.000657004	0.739257574	0.664222479	N
830	429	4	$ 11,179,454,972.30	11179454972	0.000656537	0.73991411	0.110030117	N
684	1052	4	$ 11,168,414,750.13	11168414750	0.000655888	0.740569999	0.357033016	N
837	1333	5	$ 11,164,829,673.04	11164829673	0.000655678	0.741225676	0.413058176	N
64	2093	5	$ 11,160,166,224.75	11160166225	0.000655404	0.74188108	0.503569632	N
1187	826	4	$ 11,149,736,910.43	11149736910	0.000654791	0.742535872	0.311488628	N
204	968	4	$ 11,147,577,283.24	11147577283	0.000654665	0.743190536	0.392953921	N
1345	555	4	$ 11,142,992,911.07	11142992911	0.000654395	0.743844932	0.853896599	Y
1311	421	4	$ 11,122,353,359.36	11122353359	0.000653183	0.744498115	0.911260764	Y
990	1835	5	$ 11,094,563,799.33	11094563799	0.000651551	0.745149666	0.983937447	Y
70	709	4	$ 11,083,981,987.43	11083981987	0.00065093	0.745800596	0.799364143	Y

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
853	1906	5	$ 11,082,194,219.91	11082194220	0.000650825	0.746451421	0.603627799	N
279	3775	6	$ 11,078,804,890.75	11078804891	0.000650626	0.747102047	0.322418822	N
1193	1703	5	$ 11,077,439,816.06	11077439816	0.000650546	0.747752593	0.674588684	N
623	3573	6	$ 11,076,545,059.31	11076545059	0.000650493	0.748403086	0.97723824	Y
772	2043	5	$ 11,068,655,848.54	11068655849	0.00065003	0.749053115	0.825832168	Y
1229	1328	5	$ 11,062,695,870.78	11062695871	0.00064968	0.749702795	0.745849877	N
710	1806	5	$ 11,040,547,712.67	11040547713	0.000648379	0.750351174	0.891567091	Y
1011	810	4	$ 11,030,614,755.35	11030614755	0.000647796	0.75099897	0.066060785	N
1079	1879	5	$ 11,029,166,250.50	11029166251	0.000647711	0.751646681	0.75196571	Y
634	1669	5	$ 11,027,248,347.35	11027248347	0.000647598	0.752294279	0.129775588	N
161	354	3	$ 11,023,600,803.45	11023600803	0.000647384	0.752941663	0.228799214	N
550	2041	5	$ 11,015,862,324.76	11015862325	0.000646929	0.753588592	0.232755536	N
551	1641	5	$ 11,013,267,469.18	11013267469	0.000646777	0.754235369	0.929663264	Y
950	2119	5	$ 11,002,315,305.21	11002315305	0.000646134	0.754881503	0.258104195	N
226	3283	6	$ 10,998,515,787.38	10998515787	0.000645911	0.755527414	0.542008873	N
297	1834	5	$ 10,996,087,208.60	10996087209	0.000645768	0.756173182	0.346485413	N
166	2024	5	$ 10,995,732,229.08	10995732229	0.000645747	0.756818929	0.490404709	N
726	2021	4	$ 10,984,352,240.11	10984352240	0.000645079	0.757464008	0.329467448	N
953	1189	5	$ 10,982,975,048.25	10982975048	0.000644998	0.758109006	0.392327259	N
477	1910	5	$ 10,978,341,008.16	10978341008	0.000644726	0.758753732	0.456325001	N
1135	1018	4	$ 10,978,040,576.28	10978040576	0.000644708	0.75939844	0.214502537	N
1287	142	3	$ 10,975,727,820.50	10975727820	0.000644572	0.760043012	0.046769222	N
478	3527	6	$ 10,973,192,865.66	10973192866	0.000644424	0.760687436	0.114926991	N
1321	475	4	$ 10,969,205,684.80	10969205685	0.000644189	0.761331625	0.43054912	N
808	1239	5	$ 10,948,667,540.44	10948667540	0.000642983	0.761974608	0.47246926	N
1040	1217	5	$ 10,929,781,837.34	10929781837	0.000641874	0.762616843	0.603748203	N
898	1041	4	$ 10,925,756,785.89	10925756786	0.000641638	0.76325812	0.823121593	Y
739	1308	5	$ 10,922,422,088.37	10922422088	0.000641442	0.763899562	0.48422963	N
668	2114	5	$ 10,915,067,810.27	10915067810	0.00064101	0.764540572	0.959850562	Y
587	2630	6	$ 10,906,766,144.22	10906766144	0.000640522	0.765181095	0.834803542	Y
905	3305	6	$ 10,906,656,542.32	10906656542	0.000640516	0.765821611	0.51356989	N
1351	410	4	$ 10,882,513,506.76	10882513507	0.000639098	0.766460709	0.416142491	N
911	1362	5	$ 10,882,140,728.72	10882140729	0.000639076	0.767099785	0.821565466	Y
509	353	3	$ 10,871,521,300.64	10871521301	0.000638453	0.767738238	0.372748488	N
1274	1045	4	$ 10,870,002,322.74	10870002323	0.000638363	0.768376601	0.4391411	N
752	1696	5	$ 10,853,746,799.52	10853746800	0.000637409	0.76901401	0.132134802	N
1162	706	4	$ 10,848,301,170.69	10848301170	0.000637089	0.769651099	0.977623205	Y
687	1055	4	$ 10,845,742,479.43	10845742479	0.000636939	0.770288038	0.214008485	N
1108	156	3	$ 10,841,794,190.94	10841794191	0.000636707	0.770924745	0.7736967	Y
1110	1103	5	$ 10,838,391,679.19	10838391679	0.000636507	0.771561252	0.685031718	N
695	2316	5	$ 10,824,258,286.27	10824258286	0.000635677	0.772196929	0.251006904	N
1257	550	4	$ 10,822,646,268.00	10822646268	0.000635582	0.772832511	0.77470672	Y
1197	1131	5	$ 10,815,038,064.14	10815038064	0.000635136	0.773467647	0.492459642	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1329	1314	5	$ 10,800,971,498.23	10800971498	0.000634309	0.774101956	0.775070386	Y
862	2435	6	$ 10,777,746,256.68	10777746257	0.000632946	0.774734902	0.674041152	N
1128	1043	4	$ 10,775,984,146.76	10775984147	0.000632842	0.775367744	0.163027683	N
944	995	4	$ 10,770,651,529.73	10770651530	0.000632529	0.776000273	0.830014611	Y
445	736	4	$ 10,759,276,915.53	10759276916	0.000631861	0.776632134	0.031310704	N
1242	1865	5	$ 10,758,674,120.85	10758674121	0.000631825	0.777263959	0.918918794	Y
628	1358	5	$ 10,748,604,162.88	10748604163	0.000631234	0.777895193	0.194374232	N
1243	473	4	$ 10,740,368,686.92	10740368687	0.00063075	0.778525944	0.953083545	Y
1262	1179	4	$ 10,736,868,775.67	10736868776	0.000630545	0.779156489	0.996269114	Y
630	3328	6	$ 10,734,219,636.16	10734219636	0.000630389	0.779786878	0.362446525	N
541	984	4	$ 10,724,077,372.83	10724077373	0.000629794	0.780416672	0.204683999	N
1245	1670	5	$ 10,723,445,735.31	10723445735	0.000629757	0.781046428	0.568123302	N
880	1874	5	$ 10,719,999,810.26	10719999810	0.000629554	0.781675983	0.693146723	N
362	2055	5	$ 10,715,690,853.90	10715690854	0.000629301	0.782305284	0.458568913	N
1141	535	4	$ 10,707,186,823.53	10707186824	0.000628802	0.782934086	0.73716788	N
108	3553	6	$ 10,706,567,980.53	10706567981	0.000628765	0.783562851	0.695595479	N
462	799	4	$ 10,700,661,759.38	10700661759	0.000628419	0.78419127	0.845031135	Y
150	1059	4	$ 10,697,120,986.65	10697120987	0.000628211	0.78481948	0.879184978	Y
1095	549	4	$ 10,681,241,333.19	10681241333	0.000627278	0.785446758	0.332066767	N
471	139	3	$ 10,680,009,954.08	10680009954	0.000627206	0.786073964	0.785822815	N
803	3264	6	$ 10,676,452,217.41	10676452217	0.000626997	0.786700961	0.548035166	N
965	690	4	$ 10,667,737,049.37	10667737049	0.000626485	0.787327446	0.406712078	N
1214	1114	5	$ 10,660,919,318.90	10660919319	0.000626085	0.78795353	0.211832867	N
1335	1108	5	$ 10,657,195,278.30	10657195278	0.000625866	0.788579396	0.964504795	Y
968	717	4	$ 10,653,242,438.83	10653242439	0.000625634	0.78920503	0.682227688	N
732	1833	5	$ 10,646,654,460	10646654460	0.000625247	0.789830277	0.263572073	N
1188	985	4	$ 10,643,299,085.35	10643299085	0.00062505	0.790455327	0.791351071	Y
481	1082	4	$ 10,635,942,171.90	10635942172	0.000624618	0.791079945	0.394129824	N
903	376	3	$ 10,632,739,221.72	10632739222	0.00062443	0.791704374	0.868310859	Y
1316	591	4	$ 10,620,859,020.21	10620859020	0.000623732	0.792328106	0.858374754	Y
307	1631	5	$ 10,592,145,154.05	10592145154	0.000622046	0.792950152	0.05807511	N
1320	1194	5	$ 10,586,668,130.27	10586668130	0.000621724	0.793571876	0.084089063	N
677	1011	4	$ 10,586,559,511.47	10586559511	0.000621718	0.794193594	0.504878649	N
841	1213	5	$ 10,583,184,331.82	10583184332	0.000621519	0.794815113	0.234773866	N
985	855	4	$ 10,577,872,041.64	10577872042	0.000621207	0.795436321	0.611965931	N
120	3357	6	$ 10,573,617,063.48	10573617063	0.000620958	0.796057278	0.50411504	N
1233	1208	5	$ 10,572,389,353.45	10572389353	0.000620886	0.796678164	0.756782175	N
400	3378	6	$ 10,570,074,031.03	10570074031	0.00062075	0.797298914	0.025216376	N
1167	518	4	$ 10,563,346,030.93	10563346031	0.000620354	0.797919268	0.454044648	N
1199	1629	5	$ 10,559,882,794.83	10559882795	0.000620151	0.798539419	0.883399867	Y
408	3598	6	$ 10,555,878,032.69	10555878033	0.000619916	0.799159335	0.478051994	N
926	522	4	$ 10,539,463,997.70	10539463998	0.000618952	0.799778287	0.212936645	N
996	846	4	$ 10,537,289,096.31	10537289096	0.000618824	0.800397111	0.729249816	N

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515	1831	5	$ 10,532,042,113.63	10532042114	0.000618516	0.801015627	0.227938027	N
1322	430	4	$ 10,524,135,179.80	10524135180	0.000618052	0.801633679	0.232980284	N
251	1905	5	$ 10,523,095,749.98	10523095750	0.000617991	0.802251669	0.34461683	N
252	3523	6	$ 10,516,357,534.87	10516357535	0.000617595	0.802869264	0.489032886	N
699	1188	5	$ 10,487,857,686.87	10487857687	0.000615921	0.803485185	0.970611867	Y
1181	1102	5	$ 10,486,602,277.53	10486602278	0.000615847	0.804101033	0.872076933	Y
1016	626	4	$ 10,480,764,180.76	10480764181	0.000615505	0.804716538	0.134417773	N
56	1883	5	$ 10,473,453,236.06	10473453236	0.000615075	0.805331613	0.947109708	Y
1210	2015	5	$ 10,468,604,887.71	10468604888	0.000614791	0.805946403	0.764376482	N
340	2023	5	$ 10,452,467,693.90	10452467694	0.000613843	0.806560246	0.913727522	Y
952	1909	5	$ 10,446,192,761.02	10446192761	0.000613474	0.807173721	0.469897478	N
537	2270	5	$ 10,420,927,160.87	10420927161	0.000611991	0.807785711	0.084499128	N
1151	1051	4	$ 10,402,091,864.81	10402091865	0.000610884	0.808396596	0.599277436	N
278	3304	6	$ 10,389,077,784.75	10389077785	0.00061012	0.809006716	0.617752333	N
1044	1640	5	$ 10,386,431,980.06	10386431980	0.000609965	0.809616681	0.215133936	N
145	5201	7	$ 10,384,929,452.63	10384929453	0.000609877	0.810226557	0.825402801	Y
147	1814	5	$ 10,382,019,157.86	10382019158	0.000609706	0.810836263	0.985589391	Y
367	828	4	$ 10,360,980,049.78	10360980050	0.00060847	0.811444733	0.610991433	N
973	458	4	$ 10,351,762,810.75	10351762811	0.000607929	0.812052662	0.496161266	N
1232	589	4	$ 10,334,240,322.73	10334240323	0.0006069	0.812659561	0.569422815	N
827	2054	5	$ 10,331,539,083.25	10331539083	0.000606741	0.813266302	0.501369883	N
1109	1668	5	$ 10,326,997,326.45	10326997326	0.000606474	0.813872777	0.517260612	N
916	1242	5	$ 10,318,145,861.17	10318145861	0.000605955	0.814478731	0.957538125	Y
1063	2040	5	$ 10,312,520,735.46	10312520735	0.000605624	0.815084356	0.666742625	N
1115	554	4	$ 10,307,794,321.10	10307794321	0.000605347	0.815689702	0.531424166	N
670	1904	5	$ 10,302,158,218.42	10302158218	0.000605016	0.816294718	0.227642428	N
588	1650	5	$ 10,275,629,821.19	10275629821	0.000603458	0.816898176	0.13558549	N
1208	1296	5	$ 10,275,562,285.53	10275562286	0.000603454	0.817501629	0.602205058	N
591	2052	5	$ 10,273,187,917.42	10273187917	0.000603314	0.818104944	0.340347703	N
1000	1104	5	$ 10,265,555,851.85	10265555852	0.000602866	0.81870781	0.109591457	N
925	805	4	$ 10,264,713,632.92	10264713633	0.000602817	0.819310626	0.071976654	N
497	1050	4	$ 10,260,351,821.16	10260351821	0.00060256	0.819913187	0.404403427	N
929	154	3	$ 10,256,595,657.54	10256595658	0.00060234	0.820515527	0.160869835	N
1078	1636	5	$ 10,254,553,148.36	10254553148	0.00060222	0.821117747	0.208382277	N
1244	428	4	$ 10,250,980,843.75	10250980844	0.00060201	0.821719757	0.741622585	N
169	1674	5	$ 10,249,079,755.36	10249079755	0.000601898	0.822321655	0.404602098	N
407	990	4	$ 10,229,326,651.02	10229326651	0.000600738	0.822922394	0.298622912	N
1081	1113	5	$ 10,222,671,747.89	10222671748	0.000600348	0.823522741	0.59024817	N
947	735	4	$ 10,205,669,552.77	10205669553	0.000599349	0.82412209	0.295550976	N
1336	146	3	$ 10,205,514,929.17	10205514929	0.00059934	0.82472143	0.605130893	N
418	679	4	$ 10,188,114,644.85	10188114645	0.000598318	0.825319749	0.322432274	N
519	1694	5	$ 10,188,093,261.97	10188093262	0.000598317	0.825918066	0.52552857	N
776	1316	5	$ 10,183,039,359.59	10183039360	0.00059802	0.826516086	0.506901999	N

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328	1845	5	$ 10,176,684,663.52	10176684664	0.000597647	0.827113733	0.603033482	N
877	3377	6	$ 10,167,204,974.61	10167204975	0.00059709	0.827710823	0.674478142	N
1186	1805	5	$ 10,167,079,028.26	10167079028	0.000597083	0.828307906	0.100480756	N
1027	983	4	$ 10,159,845,754.84	10159845755	0.000596658	0.828904564	0.954225989	Y
955	1081	4	$ 10,150,746,376.82	10150746377	0.000596124	0.829500687	0.115343984	N
709	3303	6	$ 10,149,709,868.54	10149709869	0.000596063	0.83009675	0.992506754	Y
187	2032	5	$ 10,132,633,161.50	10132633162	0.00059506	0.83069181	0.056272749	N
629	1238	5	$ 10,127,898,863.39	10127898863	0.000594782	0.831286592	0.774741329	N
1157	1054	4	$ 10,126,363,681.05	10126363681	0.000594692	0.831881284	0.903840184	Y
1304	836	4	$ 10,116,451,902.25	10116451902	0.00059411	0.832475393	0.945600795	Y
718	3331	6	$ 10,113,200,670.74	10113200671	0.000593919	0.833069312	0.356524531	N
969	1666	5	$ 10,102,569,023.78	10102569024	0.000593294	0.833662606	0.814407502	N
1053	1307	5	$ 10,093,401,795.47	10093401795	0.000592756	0.834255362	0.079504427	N
450	850	4	$ 10,077,074,213.93	10077074214	0.000591797	0.834847159	0.649791732	N
202	1062	4	$ 10,068,834,523.05	10068834523	0.000591313	0.835438473	0.798955967	N
203	1068	4	$ 10,068,834,523.05	10068834523	0.000591313	0.836029786	0.06434938	N
1289	451	4	$ 10,061,127,555.53	10061127556	0.000590861	0.836620646	0.553215787	N
1205	1695	5	$ 10,052,702,361.61	10052702362	0.000590366	0.837211012	0.124456741	N
93	324	3	$ 10,042,276,781.89	10042276782	0.000589754	0.837800766	0.469027091	N
984	517	4	$ 10,038,158,680.62	10038158681	0.000589512	0.838390278	0.677998399	N
569	3263	6	$ 10,033,041,203.99	10033041204	0.000589211	0.838979489	0.423007852	N
1124	557	4	$ 10,028,624,853.02	10028624853	0.000588952	0.839568441	0.666055275	N
839	2490	6	$ 10,023,398,302.14	10023398302	0.000588645	0.840157085	0.127543729	N
368	3785	6	$ 10,022,762,409.43	10022762409	0.000588608	0.840745693	0.320817413	N
919	579	4	$ 10,019,255,447.09	10019255447	0.000588402	0.841334095	0.767883057	N
1003	726	4	$ 9,988,732,041.34	9988732041	0.000586609	0.841920704	0.949125975	Y
1359	135	3	$ 9,987,338,441.64	9987338442	0.000586527	0.842507231	0.328118829	N
679	2434	6	$ 9,980,069,391.55	9980069392	0.0005861	0.843093331	0.990905043	Y
933	413	4	$ 9,972,532,877.16	9972532877	0.000585658	0.843678989	0.246924987	N
1184	1125	5	$ 9,967,125,505.25	9967125505	0.00058534	0.844264329	0.962357202	Y
1015	1830	5	$ 9,950,169,195.94	9950169196	0.000584344	0.844848673	0.08618343	N
1145	1010	4	$ 9,921,403,692.17	9921403692	0.000582655	0.845431328	0.110719302	N
771	1844	5	$ 9,909,374,420.62	9909374421	0.000581949	0.846013277	0.31795181	N
309	1813	5	$ 9,904,102,607.61	9904102608	0.000581639	0.846594916	0.675720758	N
1277	878	4	$ 9,881,175,088.78	9881175089	0.000580293	0.847175208	0.414976983	N
879	981	4	$ 9,877,079,978.39	9877079978	0.000580052	0.84775526	0.925674415	Y
1279	1040	4	$ 9,874,772,423.89	9874772424	0.000579917	0.848335177	0.967676284	Y
885	685	4	$ 9,866,705,403.91	9866705404	0.000579443	0.84891462	0.399273832	N
791	844	4	$ 9,859,133,330.67	9859133331	0.000578998	0.849493618	0.925207638	Y
712	816	4	$ 9,844,778,937.98	9844778938	0.000578155	0.850071773	0.731927001	N
1308	2285	5	$ 9,823,376,327.38	9823376327	0.000576898	0.850648671	0.463625994	N
429	1009	4	$ 9,822,665,570.13	9822665570	0.000576856	0.851225527	0.483548865	N
1107	529	4	$ 9,818,395,891.46	9818395891	0.000576606	0.851802133	0.607190898	N

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No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
971	1049	4	$ 9,816,354,291.25	9816354291	0.000576486	0.852378619	0.972624184	Y
331	2029	5	$ 9,814,350,357.44	9814350357	0.000576368	0.852954987	0.704219943	N
332	1634	5	$ 9,813,281,895.72	9813281896	0.000576305	0.853531292	0.411272141	N
631	2273	5	$ 9,809,611,480.76	9809611481	0.00057609	0.854107382	0.742134117	N
343	1673	5	$ 9,766,269,994.22	9766269994	0.000573544	0.854680927	0.810353454	N
1297	642	4	$ 9,765,932,139.46	9765932139	0.000573525	0.855254451	0.937831854	Y
449	3327	6	$ 9,760,505,228.79	9760505229	0.000573206	0.855827657	0.737540836	N
1068	332	3	$ 9,758,213,128.58	9758213129	0.000573071	0.856400729	0.785674045	N
735	1508	5	$ 9,749,456,564.22	9749456564	0.000572557	0.856973286	0.932095879	Y
737	1196	5	$ 9,748,235,887.38	9748235887	0.000572485	0.857545771	0.081531799	N
1072	1649	5	$ 9,745,616,692.22	9745616692	0.000572332	0.858118103	0.138428107	N
1074	2051	5	$ 9,742,871,186.88	9742871187	0.00057217	0.858690273	0.804675103	N
994	1693	5	$ 9,734,815,656.83	9734815657	0.000571697	0.85926197	0.755183966	N
1002	1187	5	$ 9,724,137,747.47	9724137747	0.00057107	0.85983304	0.388274102	N
1339	1109	5	$ 9,716,378,325.47	9716378325	0.000570614	0.860403655	0.353110632	N
134	3282	6	$ 9,699,466,767.57	9699466768	0.000569621	0.860973276	0.41102249	N
747	1691	5	$ 9,698,188,751.08	9698188751	0.000569546	0.861542823	0.908935231	Y
1275	548	4	$ 9,695,882,972.77	9695882973	0.000569411	0.862112233	0.236756471	N
934	871	4	$ 9,695,533,008.71	9695533009	0.00056939	0.862681624	0.806082655	N
1014	1084	4	$ 9,685,548,328.68	9685548329	0.000568804	0.863250428	0.621401254	N
370	708	4	$ 9,683,026,758.72	9683026759	0.000568656	0.863819083	0.383772351	N
940	553	4	$ 9,681,269,349.50	9681269350	0.000568553	0.864387636	0.267427223	N
1254	321	3	$ 9,679,402,289.66	9679402290	0.000568443	0.864956079	0.581927826	N
1221	443	4	$ 9,668,417,488.88	9668417489	0.000567798	0.865523877	0.249193107	N
1306	716	4	$ 9,658,702,035.05	9658702035	0.000567227	0.866091104	0.799754178	N
1342	155	3	$ 9,651,546,098.56	9651546099	0.000566807	0.866657911	0.909408986	Y
1282	471	4	$ 9,636,508,964.55	9636508965	0.000565924	0.867223835	0.069379883	N
596	3268	6	$ 9,631,614,340.81	9631614341	0.000565637	0.867789472	0.204443649	N
1030	1107	5	$ 9,625,370,215.19	9625370215	0.00056527	0.868354742	0.791451853	N
1032	1313	5	$ 9,622,700,902.08	9622700902	0.000565113	0.868919855	0.311087814	N
599	351	3	$ 9,618,182,331.88	9618182332	0.000564848	0.869484703	0.716027363	N
502	2344	5	$ 9,612,334,027.48	9612334027	0.000564504	0.870049207	0.3522614	N
956	1124	5	$ 9,602,058,820.63	9602058821	0.000563901	0.870613108	0.050304587	N
1292	406	4	$ 9,595,886,326.62	9595886327	0.000563538	0.871176646	0.602347811	N
785	2074	5	$ 9,582,230,592.79	9582230593	0.000562736	0.871739383	0.578677519	N
410	730	4	$ 9,556,957,535.70	9556957536	0.000561252	0.872300635	0.311905308	N
312	1080	4	$ 9,545,404,890.29	9545404890	0.000560574	0.872861208	0.65525603	N
1314	845	4	$ 9,543,480,840.19	9543480840	0.000560461	0.873421669	0.428732586	N
974	2010	5	$ 9,528,152,264.24	9528152264	0.000559561	0.87398123	0.334386626	N
1119	305	3	$ 9,522,114,897.69	9522114898	0.000559206	0.874540436	0.168359937	N
167	1822	5	$ 9,519,221,296.71	9519221297	0.000559036	0.875099472	0.646048228	N
168	2299	5	$ 9,519,221,296.71	9519221297	0.000559036	0.875658508	0.982695789	Y
909	1008	4	$ 9,505,447,406.49	9505447406	0.000558227	0.876216735	0.655265478	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1300	454	4	$ 9,489,649,178.64	9489649179	0.000557299	0.876774034	0.843230019	N
330	3533	6	$ 9,476,195,889.75	9476195890	0.000556509	0.877330543	0.497442259	N
1354	448	4	$ 9,444,621,211.62	9444621212	0.000554655	0.877885198	0.156662923	N
448	806	4	$ 9,435,167,933.56	9435167934	0.0005541	0.878439298	0.336291523	N
1258	2315	5	$ 9,423,019,847.84	9423019848	0.000553386	0.878992685	0.254992803	N
558	2124	5	$ 9,419,820,040.09	9419820040	0.000553198	0.879545883	0.397763005	N
560	1705	5	$ 9,418,713,685.30	9418713685	0.000553134	0.880099017	0.930320113	Y
1013	582	4	$ 9,418,060,812.48	9418060812	0.000553095	0.880652112	0.24582434	N
1280	758	4	$ 9,417,071,233.14	9417071233	0.000553037	0.881205149	0.308412639	N
663	615	4	$ 9,406,357,563.97	9406357564	0.000552408	0.881757557	0.385241321	N
1349	534	4	$ 9,399,472,200.42	9399472200	0.000552004	0.88230956	0.312694754	N
1286	804	4	$ 9,398,780,577.22	9398780577	0.000551963	0.882861523	0.999340041	Y
189	1682	5	$ 9,396,145,553.78	9396145554	0.000551808	0.883413331	0.934486823	Y
671	1006	4	$ 9,392,624,844.78	9392624845	0.000551601	0.883964933	0.043419343	N
191	2103	5	$ 9,392,329,336.13	9392329336	0.000551584	0.884516517	0.951389213	Y
1288	153	3	$ 9,388,245,292.53	9388245293	0.000551344	0.885067861	0.484529873	N
673	696	4	$ 9,385,758,519.77	9385758520	0.000551198	0.885619059	0.628234566	N
756	1079	4	$ 9,382,816,685.62	9382816686	0.000551025	0.886170085	0.036331468	N
857	3262	6	$ 9,374,636,461.83	9374636462	0.000550545	0.88672063	0.103425378	N
1021	1841	5	$ 9,373,866,578.78	9373866579	0.0005505	0.887271129	0.313262063	N
1355	1130	5	$ 9,367,531,869.15	9367531869	0.000550128	0.887821257	0.692456614	N
366	2269	5	$ 9,361,931,399.27	9361931399	0.000549799	0.888371056	0.333910509	N
1195	398	4	$ 9,357,131,467.33	9357131467	0.000549517	0.888920573	0.4494497	N
865	528	4	$ 9,355,324,297.83	9355324298	0.000549411	0.889469984	0.572305755	N
1163	241	3	$ 9,339,575,646.59	9339575647	0.000548486	0.89001847	0.343314472	N
1264	442	4	$ 9,333,974,648.75	9333974649	0.000548157	0.890566627	0.813538978	N
602	3271	6	$ 9,303,558,521.55	9303558522	0.000546371	0.891112998	0.430407676	N
89	1058	4	$ 9,286,209,456.78	9286209457	0.000545352	0.89165835	0.350739923	N
794	724	4	$ 9,271,672,387.32	9271672387	0.000544498	0.892202848	0.998125161	Y
1352	403	4	$ 9,260,688,370.57	9260688371	0.000543853	0.892746701	0.73442283	N
303	1819	5	$ 9,254,217,574.65	9254217575	0.000543473	0.893290174	0.679933025	N
1180	815	4	$ 9,250,252,547.95	9250252548	0.00054324	0.893833414	0.073478245	N
402	1648	5	$ 9,242,430,849.96	9242430850	0.000542781	0.894376195	0.512674571	N
980	1193	5	$ 9,241,061,387.25	9241061387	0.000542701	0.894918896	0.172384832	N
405	2050	5	$ 9,239,340,398.87	9239340399	0.000542599	0.895461495	0.138316252	N
805	19	2	$ 9,235,227,975.67	9235227976	0.000542358	0.896003853	0.878324461	N
225	989	4	$ 9,218,780,982.03	9218780982	0.000541392	0.896545245	0.909054737	Y
227	3815	6	$ 9,217,659,086.67	9217659087	0.000541326	0.897086571	0.456964413	N
725	578	4	$ 9,210,675,241.83	9210675242	0.000540916	0.897627487	0.060959559	N
1220	843	4	$ 9,190,719,060.15	9190719060	0.000539744	0.898167232	0.315187125	N
1225	381	4	$ 9,175,207,162.12	9175207162	0.000538833	0.898706065	0.712330929	N
1285	426	4	$ 9,173,475,187.76	9173475188	0.000538731	0.899244796	0.29865617	N
740	825	4	$ 9,147,740,710.43	9147740710	0.00053722	0.899782016	0.42683382	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1153	444	4	$ 9,138,413,689.25	9138413689	0.000536672	0.900318688	0.627666671	N
936	751	4	$ 9,136,881,456.44	9136881456	0.000536582	0.900855271	0.494797591	N
939	1800	5	$ 9,131,892,995.58	9131892996	0.000536289	0.90139156	0.211655595	N
335	1679	5	$ 9,126,241,894.58	9126241895	0.000535958	0.901927518	0.712889955	N
1313	1665	5	$ 9,125,847,170.78	9125847171	0.000535934	0.902463452	0.265289632	N
1192	811	4	$ 9,125,379,334.21	9125379334	0.000535907	0.902999359	0.938577812	Y
1096	341	3	$ 9,120,010,224.73	9120010225	0.000535592	0.90353495	0.409196018	N
1261	684	4	$ 9,117,498,195.84	9117498196	0.000535444	0.904070394	0.368360741	N
1101	350	3	$ 9,103,159,231.28	9103159231	0.000534602	0.904604996	0.368657497	N
1200	453	4	$ 9,095,192,032.36	9095192032	0.000534134	0.90513913	0.129909078	N
1315	725	4	$ 9,092,457,806.01	9092457806	0.000533973	0.905673104	0.084050082	N
257	849	4	$ 9,091,903,055.63	9091903056	0.000533941	0.906207045	0.840741492	N
683	869	4	$ 9,062,595,247.09	9062595247	0.00053222	0.906739264	0.915697065	Y
580	294	3	$ 9,062,455,364.97	9062455365	0.000532212	0.907271476	0.965539182	Y
1049	2123	5	$ 9,048,545,324.20	9048545324	0.000531395	0.90780287	0.405224186	N
1050	1704	5	$ 9,047,287,130.42	9047287130	0.000531321	0.908334191	0.112222138	N
476	1020	4	$ 9,045,771,227.33	9045771227	0.000531232	0.908865423	0.977588592	Y
1273	980	4	$ 9,040,755,950.52	9040755951	0.000530937	0.90939636	0.122147356	N
1248	397	4	$ 9,039,839,139.62	9039839140	0.000530883	0.909927243	0.865867002	N
878	1647	5	$ 9,035,114,093.88	9035114094	0.000530606	0.910457849	0.053314611	N
881	2049	5	$ 9,031,567,530.66	9031567531	0.000530398	0.910988247	0.785116543	N
1303	409	4	$ 9,030,828,908.97	9030828909	0.000530354	0.911518601	0.654218837	N
1212	1690	5	$ 9,012,746,039.50	9012746040	0.000529292	0.912047893	0.85229166	N
782	1702	5	$ 9,008,047,572.51	9008047573	0.000529016	0.912576909	0.124209759	N
890	2077	5	$ 8,997,284,483.82	8997284484	0.000528384	0.913105294	0.70559928	N
1127	196	3	$ 8,996,873,061.20	8996873061	0.00052836	0.913633654	0.506093878	N
789	1864	5	$ 8,994,317,766.37	8994317766	0.00052821	0.914161864	0.138428269	N
1129	841	4	$ 8,986,390,065.45	8986390065	0.000527744	0.914689608	0.464310718	N
1131	621	4	$ 8,981,205,627.16	8981205627	0.00052744	0.915217048	0.937494699	Y
1307	1112	5	$ 8,951,954,073.15	8951954073	0.000525722	0.91574277	0.067863592	N
391	3293	6	$ 8,944,619,714.38	8944619714	0.000525291	0.916268062	0.015144158	N
1291	870	4	$ 8,926,376,777.39	8926376777	0.00052422	0.916792282	0.021262313	N
723	2009	5	$ 8,917,596,512.62	8917596513	0.000523704	0.917315986	0.611322877	N
1004	1368	5	$ 8,913,480,432.10	8913480432	0.000523463	0.917839449	0.824766196	N
1005	1132	5	$ 8,912,260,339.07	8912260339	0.000523391	0.91836284	0.55923826	N
1147	695	4	$ 8,908,625,634.93	8908625635	0.000523178	0.918886017	0.820595536	N
409	686	4	$ 8,902,140,706.40	8902140706	0.000522797	0.919408814	0.744081522	N
1091	138	3	$ 8,883,952,834.03	8883952834	0.000521729	0.919930542	0.701525024	N
840	1106	5	$ 8,874,186,723.69	8874186724	0.000521155	0.920451697	0.824638268	N
842	1312	5	$ 8,870,754,536.39	8870754536	0.000520953	0.920972651	0.606466508	N
1266	516	4	$ 8,855,144,290.40	8855144290	0.000520037	0.921492688	0.42605392	N
1268	465	4	$ 8,849,505,252.43	8849505252	0.000519706	0.922012393	0.247318238	N
1100	1175	4	$ 8,848,617,278.78	8848617279	0.000519653	0.922532047	0.082757208	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1160	1005	4	$ 8,847,713,441.58	8847713442	0.0005196	0.923051647	0.897762318	N
1331	331	3	$ 8,824,446,990.99	8824446991	0.000518234	0.923569881	0.548269259	N
1209	1123	5	$ 8,812,786,765.07	8812786765	0.000517549	0.92408743	0.337933429	N
951	1019	4	$ 8,810,618,104.53	8810618105	0.000517422	0.924604852	0.033075903	N
1172	691	4	$ 8,790,691,952.22	8790691952	0.000516252	0.925121104	0.75465147	N
565	1914	5	$ 8,786,121,903.05	8786121903	0.000515983	0.925637087	0.393307212	N
447	988	4	$ 8,785,095,728.12	8785095728	0.000515923	0.92615301	0.422954543	N
1111	399	4	$ 8,784,460,146.09	8784460146	0.000515886	0.926668896	0.472177996	N
451	622	4	$ 8,774,185,093.57	8774185094	0.000515282	0.927184178	0.275841964	N
170	1893	5	$ 8,773,525,359.24	8773525359	0.000515243	0.927699421	0.565128332	N
572	3337	6	$ 8,772,642,265.37	8772642265	0.000515192	0.928214613	0.172754802	N
1054	300	3	$ 8,770,951,347.85	8770951348	0.000515092	0.928729705	0.866020265	N
1323	131	3	$ 8,763,553,292.19	8763553292	0.000514658	0.929244363	0.425622745	N
456	323	3	$ 8,760,386,200.79	8760386201	0.000514472	0.929758835	0.667106221	N
769	2320	5	$ 8,748,375,635.02	8748375635	0.000513767	0.930272602	0.791965642	N
1218	25	2	$ 8,715,770,045.92	8715770046	0.000511852	0.930784453	0.456446948	N
1223	723	4	$ 8,700,864,023.42	8700864023	0.000510976	0.93129543	0.692303404	N
482	809	4	$ 8,696,820,480.54	8696820481	0.000510739	0.931806168	0.5087206	N
365	1840	5	$ 8,692,150,000.37	8692150000	0.000510465	0.932316633	0.431161559	N
702	1017	4	$ 8,688,556,192.52	8688556193	0.000510254	0.932826886	0.433859096	N
703	705	4	$ 8,686,420,386.28	8686420386	0.000510128	0.933337014	0.783955191	N
912	536	4	$ 8,658,074,235.22	8658074235	0.000508463	0.933845478	0.259159175	N
610	2073	5	$ 8,654,295,901.22	8654295901	0.000508241	0.934353719	0.606501497	N
500	848	4	$ 8,653,180,248.47	8653180248	0.000508176	0.934861895	0.969389381	Y
1190	824	4	$ 8,649,445,862.44	8649445862	0.000507957	0.935369852	0.84014335	N
1340	257	3	$ 8,643,191,291.08	8643191291	0.000507589	0.935877441	0.780129018	N
1150	868	4	$ 8,641,061,784.31	8641061784	0.000507464	0.936384906	0.61923894	N
1152	527	4	$ 8,636,030,566.63	8636030567	0.000507169	0.936892074	0.70108944	N
1196	627	4	$ 8,623,531,024.56	8623531025	0.000506435	0.937398509	0.06758762	N
205	3563	6	$ 8,610,207,414.91	8610207415	0.000505652	0.937904162	0.872004562	N
927	866	4	$ 8,606,599,482.00	8606599482	0.00050544	0.938409602	0.60770102	N
928	632	4	$ 8,604,311,757.76	8604311758	0.000505306	0.938914908	0.683802474	N
835	1839	5	$ 8,601,289,312.58	8601289313	0.000505129	0.939420037	0.691421643	N
1202	408	4	$ 8,597,616,787.03	8597616787	0.000504913	0.93992495	0.451912027	N
1356	449	4	$ 8,575,793,491.66	8575793492	0.000503631	0.940428581	0.01801099	N
208	1633	5	$ 8,564,649,470.33	8564649470	0.000502977	0.940931558	0.495340407	N
209	2028	5	$ 8,561,139,110.95	8561139110	0.000502771	0.941434328	0.518079386	N
411	3267	6	$ 8,560,448,914.42	8560448914	0.00050273	0.941937058	0.120040057	N
742	2014	5	$ 8,538,962,423.40	8538962423	0.000501468	0.942438527	0.338550743	N
1173	447	4	$ 8,537,926,107.40	8537926107	0.000501407	0.942939934	0.577766688	N
1114	464	4	$ 8,517,114,810.00	8517114810	0.000500185	0.943440119	0.051458	N
1052	1913	5	$ 8,512,676,815.83	8512676816	0.000499925	0.943940044	0.174651452	N
229	729	4	$ 8,497,153,218.88	8497153219	0.000499013	0.944439057	0.863401063	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1217	1701	5	$ 8,491,260,848.12	8491260848	0.000498667	0.944937724	0.987047927	Y
562	345	3	$ 8,473,758,151.68	8473758152	0.000497639	0.945435363	0.573316335	N
1132	721	4	$ 8,467,106,984.12	8467106984	0.000497248	0.945932611	0.809572594	N
1293	750	4	$ 8,465,559,561.37	8465559561	0.000497158	0.946429769	0.563917545	N
685	749	4	$ 8,453,576,714.58	8453576715	0.000496454	0.946926223	0.590286223	N
686	1799	5	$ 8,447,307,715.65	8447307716	0.000496086	0.947422309	0.130203278	N
975	1625	5	$ 8,442,936,002.54	8442936003	0.000495829	0.947918137	0.90404283	N
895	1867	5	$ 8,428,785,145.86	8428785146	0.000494998	0.948413135	0.719934939	N
783	1192	5	$ 8,427,914,509.36	8427914509	0.000494947	0.948908082	0.027821267	N
899	339	3	$ 8,411,288,184.57	8411288185	0.00049397	0.949402053	0.579886292	N
255	997	4	$ 8,398,868,227.21	8398868227	0.000493241	0.949895293	0.916528873	N
1332	373	3	$ 8,390,988,243.79	8390988244	0.000492778	0.950388072	0.358755114	N
1194	1129	5	$ 8,384,387,073.87	8384387074	0.000492391	0.950880462	0.706798828	N
1271	420	4	$ 8,380,815,033.24	8380815033	0.000492181	0.951372643	0.418796808	N
480	2279	5	$ 8,380,288,947.20	8380288947	0.00049215	0.951864793	0.949789544	N
1353	404	4	$ 8,378,000,998.78	8378000999	0.000492016	0.952356808	0.902959886	N
483	3296	6	$ 8,374,483,285.99	8374483286	0.000491809	0.952848617	0.735872433	N
1008	1248	5	$ 8,369,739,513.77	8369739514	0.00049153	0.953340148	0.255887197	N
717	880	4	$ 8,336,191,526.34	8336191526	0.00048956	0.953829708	0.413133472	N
828	230	3	$ 8,328,806,891.88	8328806892	0.000489126	0.954318834	0.35289538	N
836	311	3	$ 8,313,859,764.46	8313859764	0.000488249	0.954807083	0.338573828	N
1168	1016	4	$ 8,307,340,409.99	8307340410	0.000487866	0.955294949	0.550808249	N
1169	704	4	$ 8,304,901,403.39	8304901403	0.000487723	0.955782671	0.784268969	N
1024	2008	5	$ 8,303,408,816.33	8303408816	0.000487635	0.956270306	0.312826232	N
1170	1660	5	$ 8,298,696,595.39	8298696595	0.000487358	0.956757664	0.260968779	N
1278	123	3	$ 8,284,938,401.43	8284938401	0.00048655	0.957244215	0.925224108	N
1338	340	3	$ 8,283,926,541.29	8283926541	0.000486491	0.957730705	0.748851042	N
283	857	4	$ 8,282,160,754.68	8282160755	0.000486387	0.958217093	0.736683764	N
1039	366	3	$ 8,281,881,834.05	8281881834	0.000486371	0.958703463	0.505057754	N
1122	1178	4	$ 8,242,186,890.43	8242186890	0.00048404	0.959187503	0.427256269	N
749	2017	5	$ 8,229,020,473.07	8229020473	0.000483266	0.959670706	0.232839876	N
1361	470	4	$ 8,226,701,043.75	8226701044	0.00048313	0.960153899	0.521104875	N
1330	134	3	$ 8,223,907,632.01	8223907632	0.000482966	0.960636865	0.384132462	N
1341	212	3	$ 8,220,275,651.71	8220275652	0.000482753	0.961119618	0.514833502	N
1138	533	4	$ 8,183,113,643.94	8183113644	0.00048057	0.961600188	0.235796662	N
1139	402	4	$ 8,180,750,780.26	8180750780	0.000480432	0.96208062	0.131089912	N
1357	387	4	$ 8,175,212,206.49	8175212206	0.000480106	0.962560726	0.450791152	N
440	994	4	$ 8,165,996,400.35	8165996400	0.000479565	0.963040291	0.24634744	N
1333	151	3	$ 8,163,333,610.96	8163333611	0.000479409	0.9635197	0.57900346	N
441	689	4	$ 8,161,419,052.88	8161419053	0.000479296	0.963998996	0.543813129	N
563	823	4	$ 8,160,099,297.40	8160099297	0.000479219	0.964478215	0.083004998	N
1143	1085	4	$ 8,157,122,427.61	8157122428	0.000479044	0.964957259	0.129704435	N
1360	128	3	$ 8,147,434,346.38	8147434346	0.000478475	0.965435734	0.859704253	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
896	1039	4	$ 8,142,952,960.26	8142952960	0.000478212	0.965913946	0.503019967	N
1154	748	4	$ 8,129,950,466.62	8129950467	0.000477448	0.966391394	0.145898941	N
1343	620	4	$ 8,129,021,984.73	8129021985	0.000477394	0.966868788	0.233248177	N
452	728	4	$ 8,123,885,256.39	8123885256	0.000477092	0.96734588	0.453081666	N
1305	106	3	$ 8,107,644,139.50	8107644139	0.000476138	0.967822018	0.889185592	N
1363	386	4	$ 8,103,578,131.40	8103578131	0.000475899	0.968297918	0.925447083	N
1097	975	4	$ 8,080,527,887.64	8080527888	0.000474546	0.968772463	0.631179038	N
1337	380	4	$ 8,077,287,811.43	8077287811	0.000474355	0.969246819	0.837343286	N
708	1804	5	$ 8,070,004,780.49	8070004780	0.000473928	0.969720747	0.988658802	Y
1326	299	3	$ 8,054,384,144.12	8054384144	0.00047301	0.970193757	0.286918268	N
930	746	4	$ 8,047,947,863.69	8047947864	0.000472632	0.970666389	0.270308742	N
1346	840	4	$ 8,046,585,048.17	8046585048	0.000472552	0.971138942	0.871336089	N
486	854	4	$ 8,044,243,097.33	8044243097	0.000472415	0.971611357	0.352690919	N
488	625	4	$ 8,043,327,692.18	8043327692	0.000472361	0.972083718	0.10550048	N
607	1700	5	$ 8,042,738,824.00	8042738824	0.000472327	0.972556044	0.346791035	N
612	1863	5	$ 8,029,390,828.97	8029390829	0.000471543	0.973027587	0.157696081	N
1290	631	4	$ 8,023,788,090.50	8023788091	0.000471214	0.973498801	0.37323985	N
371	3367	6	$ 8,010,885,836.11	8010885836	0.000470456	0.973969257	0.975677311	Y
1117	419	4	$ 7,998,207,372.82	7998207373	0.000469711	0.974438968	0.840588923	N
1182	879	4	$ 7,996,463,786.16	7996463786	0.000469609	0.974908577	0.016454483	N
1318	122	3	$ 7,985,027,275.32	7985027275	0.000468937	0.975377514	0.573282326	N
1051	822	4	$ 7,984,454,723.60	7984454724	0.000468904	0.975846418	0.889438893	N
1227	75	2	$ 7,966,150,791.24	7966150791	0.000467829	0.976314247	0.925268042	N
1298	865	4	$ 7,957,750,251.72	7957750252	0.000467335	0.976781582	0.114722055	N
960	877	4	$ 7,957,219,428.17	7957219428	0.000467304	0.977248886	0.022718539	N
963	641	4	$ 7,949,747,979.29	7949747979	0.000466865	0.977715752	0.632400597	N
193	1818	5	$ 7,939,773,940.11	7939773940	0.00046628	0.978182031	0.895213123	N
1237	236	3	$ 7,933,128,844.29	7933128844	0.000465889	0.978647921	0.097864111	N
1269	382	4	$ 7,925,610,908.55	7925610909	0.000465448	0.979113369	0.513097743	N
970	1645	5	$ 7,918,701,414.92	7918701415	0.000465042	0.979578411	0.522232235	N
1272	338	3	$ 7,900,583,845.96	7900583846	0.000463978	0.98004239	0.877894863	N
976	1798	5	$ 7,898,422,546.13	7898422546	0.000463851	0.98050624	0.95008552	N
1344	452	4	$ 7,887,171,761.76	7887171762	0.000463191	0.980969431	0.625301192	N
549	2039	5	$ 7,876,652,062.20	7876652062	0.000462573	0.981432004	0.296808027	N
1155	472	4	$ 7,870,166,114.39	7870166114	0.000462192	0.981894196	0.14873063	N
1247	310	3	$ 7,869,741,089.71	7869741090	0.000462167	0.982356362	0.849478116	N
1362	425	4	$ 7,866,182,838.22	7866182838	0.000461958	0.98281832	0.151972818	N
1090	1699	5	$ 7,848,409,254.58	7848409255	0.000460914	0.983279235	0.490962914	N
568	301	3	$ 7,841,116,525.22	7841116525	0.000460486	0.98373972	0.34078603	N
213	1678	5	$ 7,836,421,342.04	7836421342	0.00046021	0.98419993	0.234457189	N
1009	446	4	$ 7,832,345,817.58	7832345818	0.000459971	0.984659901	0.094003517	N
1010	1628	5	$ 7,820,512,355.08	7820512355	0.000459276	0.985119177	0.644792993	N
1283	96	3	$ 7,816,378,366.27	7816378366	0.000459033	0.98557821	0.786155935	N

No	Route	Total Consumers	Total Cost ($)	Fitness Value	Normalized Fitness Value	Accumulated Normalized Fitness Value	Random Number	SELECTION
1255	133	3	$ 7,799,044,900.42	7799044900	0.000458015	0.986036225	0.72696442	N
705	1089	4	$ 7,782,558,683.48	7782558683	0.000457047	0.986493272	0.19961407	N
1295	463	4	$ 7,772,283,445.61	7772283446	0.000456443	0.986949716	0.840463273	N
1260	306	3	$ 7,758,823,898.49	7758823898	0.000455653	0.987405369	0.896271467	N
713	1807	5	$ 7,756,737,022.78	7756737023	0.00045553	0.987860899	0.731964861	N
1219	124	3	$ 7,754,448,786.30	7754448786	0.000455396	0.988316295	0.448133656	N
1358	24	2	$ 7,752,843,626.55	7752843627	0.000455302	0.988771597	0.794199263	N
833	185	3	$ 7,748,982,188.02	7748982188	0.000455075	0.989226672	0.117497538	N
945	1659	5	$ 7,744,174,446.40	7744174446	0.000454793	0.989681465	0.269056023	N
722	760	4	$ 7,732,990,078.43	7732990078	0.000454136	0.990135601	0.208237808	N
727	2083	5	$ 7,725,280,420.73	7725280421	0.000453683	0.990589284	0.077728081	N
613	237	3	$ 7,719,388,352.00	7719388352	0.000453337	0.991042621	0.051023821	N
1299	2319	5	$ 7,710,599,115.04	7710599115	0.000452821	0.991495442	0.228576094	N
1058	1128	5	$ 7,700,989,678.91	7700989679	0.000452257	0.991947699	0.098937378	N
256	3292	6	$ 7,689,744,145.98	7689744146	0.000451596	0.992399295	0.711721216	N
258	737	4	$ 7,687,481,850.00	7687481850	0.000451463	0.992850758	0.379829364	N
1325	365	3	$ 7,669,178,475.08	7669178475	0.000450388	0.993301147	0.031617034	N
1191	336	3	$ 7,665,664,396.13	7665664396	0.000450182	0.993751329	0.033954488	N
870	320	3	$ 7,654,819,336.24	7654819336	0.000449545	0.994200874	0.911375071	N
523	1015	4	$ 7,638,209,478.51	7638209479	0.00044857	0.994649444	0.485087623	N
525	703	4	$ 7,637,332,335.29	7637332335	0.000448518	0.995097962	0.920952861	N
643	1842	4	$ 7,629,620,078.65	7629620079	0.000448065	0.995546027	0.070781189	N
1347	720	4	$ 7,629,504,130.56	7629504131	0.000448058	0.995994085	0.459138332	N
987	1042	4	$ 7,606,361,352.40	7606361352	0.000446699	0.996440785	0.411043409	N
766	364	3	$ 7,597,723,205.83	7597723206	0.000446192	0.996886977	0.483632247	N
1281	242	3	$ 7,596,741,916.52	7596741917	0.000446134	0.997333111	0.222538595	N
1312	145	3	$ 7,586,432,159.80	7586432160	0.000445529	0.99777864	0.121380262	N
1093	247	3	$ 7,580,601,616.76	7580601617	0.000445187	0.998223827	0.352115528	N
998	1014	4	$ 7,579,605,966.94	7579605967	0.000445128	0.998668955	0.722453895	N
999	702	4	$ 7,578,576,927.31	7578576927	0.000445068	0.999114023	0.714264658	N
1171	1088	4	$ 7,547,937,909.17	7547937909	0.000443268	0.999557291	0.304879318	N
302	2309	5	$ 7,538,414,035.61	7538414036	0.000442709	1	0.26275225	N

Appendix G For 7500 m³

No	No. Route	Combination Route															Ship Capacity (m³)	LNG Volume/trip (m³/trip)	Turn Round Voy	Total Cost
		X14 .Ta	X3. Fa	X5. Ka	X13 .Ti	X7. Me	X2. Bn	X12 .So	X9. Ra	X6. Mw	X8. Na	X11 .Se	X1 .Bi	X10 .Sa	X4. Jp	X14 .Ta				
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0				

No	No. Route	0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0	Ship Capacity (m³)	LNG Volume/trip (m³/trip)	age (Days)	Total Cost
1	252	0	-1									6		8		0	7500	3306.53	7.9	$ 2,838,573,958.31
2	306	0		-2	-3	-4										0	23000	9290.36	7.5	$ 7,743,395,012.96
3	4	0													9	0	23000	19375.57	7.3	$ 15,811,998,849.50
4	205	0					1	2	3							0	7500	4922.65	4.4	$ 4,137,970,938.69
5	6	0								4						0	7500	2570.90	4.8	$ 2,255,544,486.11
6	8	0									5					0	2500	1919.52	5.7	$ 1,677,457,755.42
7	1	0											7			0	7500	4353.75	5.3	$ 3,680,417,512.54
TOTAL COST																				$ 38,145,358,513.53

Appendix H For 10000 m³

No	No. Route	X14. Ta	X3. Fa	X5. Ka	X13. Ti	X7. Me	X2. Bn	X12. So	X9. Ra	X6. Mw	X8. Na	X11. Se	X1. Bi	X10. Sa	X4. Jp	X14. Ta	Ship Capacity (m³)	LNG Volume/trip (m³/trip)	Turn Round Voyage (Days)	Total Cost
		0	-1	-2	-3	-4	1	2	3	4	5	6	7	8	9	0				
1	978	0		-2					3	4				8		0	10000	7137.85	10.6	$ 5,940,751,260.86
2	242	0	-1		-3	-4										0	23000	9087.07	7.3	$ 7,581,286,855.54
3	4	0													9	0	23000	19375.57	7.3	$ 15,811,998,849.50
4	35	0					1	2								0	7500	3973.44	3.5	$ 3,382,317,417.82

No	No. Route	X14. Ta (0)	X3. Fa (-1)	X5. Ka (-2)	X13. Ti (-3)	X7. Me (-4)	X2. Bn (1)	X12. So (2)	X9. Ra (3)	X6. Mw (4)	X8. Na (5)	X11. Se (6)	X1. Bi (7)	X10. Sa (8)	X4. Jp (9)	X14. Ta (0)	Ship Capacity (m³)	LNG Volume /trip (m³/trip)	Turn Round Voyage (Days)	Total Cost
5	8	0									5					0	2500	1919.52	5.7	$ 1,677,457,755.42
6	11	0										6				0	2500	1418.43	5.6	$ 1,276,770,005.91
7	1	0											7			0	7500	4353.75	5.3	$ 3,680,417,512.54
TOTAL COST																				$ 39,350,999,657.60

Appendix I For 23000 m³

N o	No. Route	X14. Ta (0)	X3. Fa (-1)	X5. Ka (-2)	X13. Ti (-3)	X7. Me (-4)	X2. Bn (1)	X12. So (2)	X9. Ra (3)	X6. Mw (4)	X8. Na (5)	X11. Se (6)	X1. Bi (7)	X10. Sa (8)	X4. Jp (9)	X14. Ta (0)	Ship Capacity (m³)	LNG Volume /trip (m³/trip)	Turn Round Voyage (Days)	Total Cost
		Combination Route																		
1	3367	0	-1				1		3		5	6		8			23000	9613.73	12.1	$ 7,995,772,651.16
2	306	0		-2	-3	-4										0	23000	9290.36	7.5	$ 7,743,395,012.96
3	4	0													9	0	23000	19375.57	7.3	$ 15,811,998,849.50
4	12	0						2								0	7500	3195.79	2.8	$ 2,765,209,470.37
5	6									4							7500	2570.90	4.8	$ 2,255,544,486.11
6	1												7				7500	4353.75	5.3	$ 3,680,417,512.54
TOTAL COST																				$ 40,252,337,982.64

Appendix J Margin USD 2.00

Year	Cumulative Investment	Revenue	Operational Cost	Depreciation	Earning Before Tax	Tax 25%	Earning After Tax	Proceeds	Cummulative Proceeds	Inv. Before Payback

0	$300,254,478									(300,254,478)
0	$300,254,478									(300,254,478)
1		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	31,074,440	(269,180,038)
2		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	62,148,879	(238,105,598)
3		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	93,223,319	(207,031,158)
4		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	124,297,759	(175,956,719)
5		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	155,372,199	(144,882,279)
6		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	186,446,638	(113,807,839)
7		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	217,521,078	(82,733,399)
8		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	248,595,518	(51,658,960)
9		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	279,669,958	(20,584,520)
10		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	310,744,397	10,489,920
11		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	341,818,837	41,564,360
12		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	372,893,277	72,638,799
13		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	403,967,716	103,713,239
14		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	435,042,156	134,787,679
15		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	466,116,596	165,862,118
16		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	497,191,036	196,936,558
17		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	528,265,475	228,010,998
18		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	559,339,915	259,085,438
19		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	590,414,355	290,159,877
20		$ 80,632,296	$ 42,702,679	10,508,907	27,420,711	6,855,178	20,565,533	31,074,440	621,488,795	321,234,317
ROI	10.35%									

Year	Investment	Proceeds	i 5.0%	NPV	i 7.5%	NPV	i 10.0%	NPV	i 12.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		31,074,440	0.9524	29,594,705	0.9302	28,906,456	0.9091	28,249,491	0.8889	27,621,724
2		31,074,440	0.9070	28,185,433	0.8653	26,889,726	0.8264	25,681,355	0.7901	24,552,644
3		31,074,440	0.8638	26,843,269	0.8050	25,013,699	0.7513	23,346,686	0.7023	21,824,572
4		31,074,440	0.8227	25,565,018	0.7488	23,268,557	0.6830	21,224,260	0.6243	19,399,620
5		31,074,440	0.7835	24,347,637	0.6966	21,645,169	0.6209	19,294,782	0.5549	17,244,106

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6		31,074,440	0.7462	23,188,225	0.6480	20,135,041	0.5645	17,540,711	0.4933	15,328,095
7		31,074,440	0.7107	22,084,024	0.6028	18,730,271	0.5132	15,946,101	0.4385	13,624,973
8		31,074,440	0.6768	21,032,404	0.5607	17,423,508	0.4665	14,496,455	0.3897	12,111,087
9		31,074,440	0.6446	20,030,861	0.5216	16,207,914	0.4241	13,178,596	0.3464	10,765,411
10		31,074,440	0.6139	19,077,010	0.4852	15,077,129	0.3855	11,980,542	0.3079	9,569,254
11		31,074,440	0.5847	18,168,581	0.4513	14,025,237	0.3505	10,891,402	0.2737	8,506,004
12		31,074,440	0.5568	17,303,411	0.4199	13,046,732	0.3186	9,901,274	0.2433	7,560,892
13		31,074,440	0.5303	16,479,439	0.3906	12,136,495	0.2897	9,001,158	0.2163	6,720,793
14		31,074,440	0.5051	15,694,704	0.3633	11,289,763	0.2633	8,182,871	0.1922	5,974,038
15		31,074,440	0.4810	14,947,337	0.3380	10,502,105	0.2394	7,438,974	0.1709	5,310,256
16		31,074,440	0.4581	14,235,559	0.3144	9,769,400	0.2176	6,762,703	0.1519	4,720,228
17		31,074,440	0.4363	13,557,675	0.2925	9,087,814	0.1978	6,147,912	0.1350	4,195,758
18		31,074,440	0.4155	12,912,072	0.2720	8,453,780	0.1799	5,589,011	0.1200	3,729,563
19		31,074,440	0.3957	12,297,211	0.2531	7,863,982	0.1635	5,080,919	0.1067	3,315,167
20		31,074,440	0.3769	11,711,630	0.2354	7,315,332	0.1486	4,619,017	0.0948	2,946,815
			Total	87,001,727	Total	16,533,630	Total	(35,700,255)	Total	(75,233,479)

Year	Investment	Proceeds	i 15.0%	NPV	i 17.5%	NPV	i 20.0%	NPV	i 22.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		31,074,440	0.8696	27,021,252	0.8511	26,446,332	0.8333	25,895,366	0.8163	25,366,890
2		31,074,440	0.7561	23,496,741	0.7243	22,507,516	0.6944	21,579,472	0.6664	20,707,665
3		31,074,440	0.6575	20,431,949	0.6164	19,155,333	0.5787	17,982,893	0.5440	16,904,216
4		31,074,440	0.5718	17,766,912	0.5246	16,302,411	0.4823	14,985,744	0.4441	13,799,360
5		31,074,440	0.4972	15,449,488	0.4465	13,874,392	0.4019	12,488,120	0.3625	11,264,784
6		31,074,440	0.4323	13,434,338	0.3800	11,807,994	0.3349	10,406,767	0.2959	9,195,742
7		31,074,440	0.3759	11,682,033	0.3234	10,049,356	0.2791	8,672,306	0.2416	7,506,728
8		31,074,440	0.3269	10,158,289	0.2752	8,552,644	0.2326	7,226,922	0.1972	6,127,941
9		31,074,440	0.2843	8,833,295	0.2342	7,278,846	0.1938	6,022,435	0.1610	5,002,401
10		31,074,440	0.2472	7,681,126	0.1994	6,194,762	0.1615	5,018,696	0.1314	4,083,593
11		31,074,440	0.2149	6,679,240	0.1697	5,272,138	0.1346	4,182,246	0.1073	3,333,545
12		31,074,440	0.1869	5,808,035	0.1444	4,486,926	0.1122	3,485,205	0.0876	2,721,261
13		31,074,440	0.1625	5,050,465	0.1229	3,818,660	0.0935	2,904,338	0.0715	2,221,438

14		31,074,440	0.1413	4,391,709	0.1046	3,249,924	0.0779	2,420,281	0.0584	1,813,419
15		31,074,440	0.1229	3,818,877	0.0890	2,765,893	0.0649	2,016,901	0.0476	1,480,342
16		31,074,440	0.1069	3,320,763	0.0758	2,353,951	0.0541	1,680,751	0.0389	1,208,442
17		31,074,440	0.0929	2,887,620	0.0645	2,003,363	0.0451	1,400,626	0.0317	986,483
18		31,074,440	0.0808	2,510,974	0.0549	1,704,989	0.0376	1,167,188	0.0259	805,293
19		31,074,440	0.0703	2,183,455	0.0467	1,451,055	0.0313	972,657	0.0212	657,382
20		31,074,440	0.0611	1,898,657	0.0397	1,234,940	0.0261	810,547	0.0173	536,638
			Total	**(105,749,259)**	**Total**	**(129,743,052)**	**Total**	**(148,935,016)**	**Total**	**(164,530,915)**

Appendix K NPV Graph for Margin USD 2.00

NET PRESENT VALUE
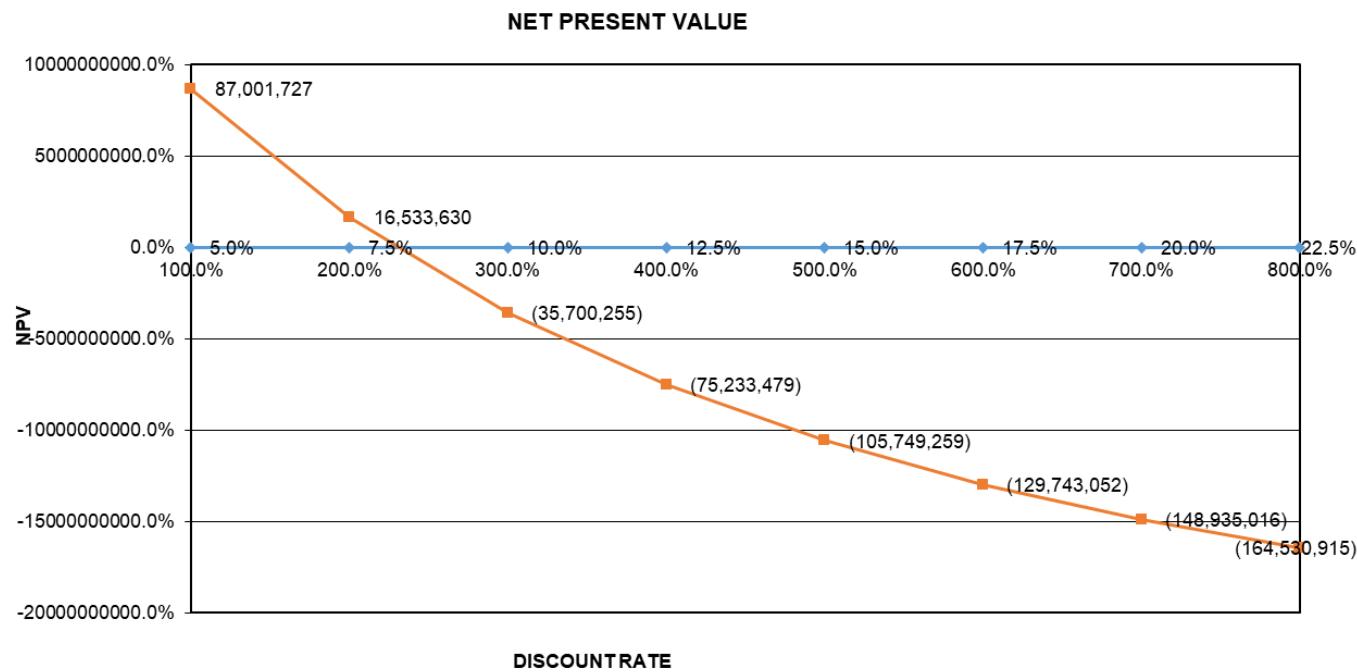
Appendix L Margin USD 2.50

Year	Cumulative Investment	Revenue	Operational Cost	Depreciation	Earning Before Tax	Tax 25%	Earning After Tax	Proceeds	Cummulative Proceeds	Inv. Before Payback
0	$300,254,478									(300,254,478)
0	$300,254,478									(300,254,478)
1		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	46,192,995	(254,061,482)
2		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	92,385,990	(207,868,487)
3		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	138,578,986	(161,675,492)
4		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	184,771,981	(115,482,497)
5		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	230,964,976	(69,289,501)
6		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	277,157,971	(23,096,506)
7		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	323,350,967	23,096,489
8		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	369,543,962	69,289,484
9		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	415,736,957	115,482,480
10		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	461,929,952	161,675,475
11		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	508,122,948	207,868,470
12		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	554,315,943	254,061,465
13		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	600,508,938	300,254,460
14		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	646,701,933	346,447,456
15		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	692,894,928	392,640,451
16		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	739,087,924	438,833,446
17		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	785,280,919	485,026,441
18		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	831,473,914	531,219,437
19		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	877,666,909	577,412,432
20		$ 100,790,370	$ 42,702,679	10,508,907	47,578,785	11,894,696	35,684,089	46,192,995	923,859,905	623,605,427
ROI	15.38%									

Year	Investment	Proceeds	i 5.0%	NPV	i 7.5%	NPV	i 10.0%	NPV	i 12.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		46,192,995	0.9524	43,993,329	0.9302	42,970,228	0.9091	41,993,632	0.8889	41,060,440
2		46,192,995	0.9070	41,898,408	0.8653	39,972,305	0.8264	38,176,029	0.7901	36,498,169
3		46,192,995	0.8638	39,903,246	0.8050	37,183,540	0.7513	34,705,481	0.7023	32,442,817
4		46,192,995	0.8227	38,003,091	0.7488	34,589,339	0.6830	31,550,437	0.6243	28,838,060
5		46,192,995	0.7835	36,193,420	0.6966	32,176,130	0.6209	28,682,216	0.5549	25,633,831
6		46,192,995	0.7462	34,469,924	0.6480	29,931,283	0.5645	26,074,742	0.4933	22,785,627
7		46,192,995	0.7107	32,828,499	0.6028	27,843,054	0.5132	23,704,311	0.4385	20,253,891
8		46,192,995	0.6768	31,265,237	0.5607	25,900,516	0.4665	21,549,373	0.3897	18,003,459
9		46,192,995	0.6446	29,776,417	0.5216	24,093,503	0.4241	19,590,339	0.3464	16,003,074
10		46,192,995	0.6139	28,358,492	0.4852	22,412,561	0.3855	17,809,399	0.3079	14,224,955
11		46,192,995	0.5847	27,008,088	0.4513	20,848,894	0.3505	16,190,363	0.2737	12,644,404
12		46,192,995	0.5568	25,721,988	0.4199	19,394,320	0.3186	14,718,512	0.2433	11,239,471
13		46,192,995	0.5303	24,497,132	0.3906	18,041,228	0.2897	13,380,465	0.2163	9,990,640
14		46,192,995	0.5051	23,330,602	0.3633	16,782,537	0.2633	12,164,059	0.1922	8,880,569
15		46,192,995	0.4810	22,219,621	0.3380	15,611,663	0.2394	11,058,236	0.1709	7,893,839
16		46,192,995	0.4581	21,161,543	0.3144	14,522,477	0.2176	10,052,942	0.1519	7,016,746
17		46,192,995	0.4363	20,153,851	0.2925	13,509,281	0.1978	9,139,038	0.1350	6,237,108
18		46,192,995	0.4155	19,194,144	0.2720	12,566,773	0.1799	8,308,216	0.1200	5,544,096
19		46,192,995	0.3957	18,280,137	0.2531	11,690,021	0.1635	7,552,924	0.1067	4,928,085
20		46,192,995	0.3769	17,409,654	0.2354	10,874,438	0.1486	6,866,294	0.0948	4,380,520
			Total	275,412,345	Total	170,659,613	Total	93,012,531	Total	34,245,324

Year	Investment	Proceeds	i 15.0%	NPV	i 17.5%	NPV	i 20.0%	NPV	i 22.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		46,192,995	0.8696	40,167,822	0.8511	39,313,187	0.8333	38,494,163	0.8163	37,708,568
2		46,192,995	0.7561	34,928,541	0.7243	33,458,032	0.6944	32,078,469	0.6664	30,782,504
3		46,192,995	0.6575	30,372,644	0.6164	28,474,921	0.5787	26,732,057	0.5440	25,128,575
4		46,192,995	0.5718	26,410,995	0.5246	24,233,975	0.4823	22,276,715	0.4441	20,513,122
5		46,192,995	0.4972	22,966,083	0.4465	20,624,660	0.4019	18,563,929	0.3625	16,745,406
6		46,192,995	0.4323	19,970,507	0.3800	17,552,902	0.3349	15,469,941	0.2959	13,669,719
7		46,192,995	0.3759	17,365,658	0.3234	14,938,640	0.2791	12,891,617	0.2416	11,158,954
8		46,192,995	0.3269	15,100,572	0.2752	12,713,736	0.2326	10,743,014	0.1972	9,109,351
9		46,192,995	0.2843	13,130,932	0.2342	10,820,201	0.1938	8,952,512	0.1610	7,436,205
10		46,192,995	0.2472	11,418,202	0.1994	9,208,682	0.1615	7,460,427	0.1314	6,070,371
11		46,192,995	0.2149	9,928,871	0.1697	7,837,176	0.1346	6,217,022	0.1073	4,955,405
12		46,192,995	0.1869	8,633,801	0.1444	6,669,937	0.1122	5,180,852	0.0876	4,045,229
13		46,192,995	0.1625	7,507,653	0.1229	5,676,542	0.0935	4,317,377	0.0715	3,302,227
14		46,192,995	0.1413	6,528,394	0.1046	4,831,100	0.0779	3,597,814	0.0584	2,695,696
15		46,192,995	0.1229	5,676,864	0.0890	4,111,574	0.0649	2,998,178	0.0476	2,200,568
16		46,192,995	0.1069	4,936,404	0.0758	3,499,212	0.0541	2,498,482	0.0389	1,796,382
17		46,192,995	0.0929	4,292,525	0.0645	2,978,053	0.0451	2,082,068	0.0317	1,466,434
18		46,192,995	0.0808	3,732,630	0.0549	2,534,513	0.0376	1,735,057	0.0259	1,197,089
19		46,192,995	0.0703	3,245,766	0.0467	2,157,032	0.0313	1,445,881	0.0212	977,216
20		46,192,995	0.0611	2,822,405	0.0397	1,835,772	0.0261	1,204,901	0.0173	797,727
			Total	(11,117,209)	Total	(46,784,632)	Total	(75,314,004)	Total	(98,497,730)

Appendix M for Margin USD 2.50

NET PRESENT VALUE
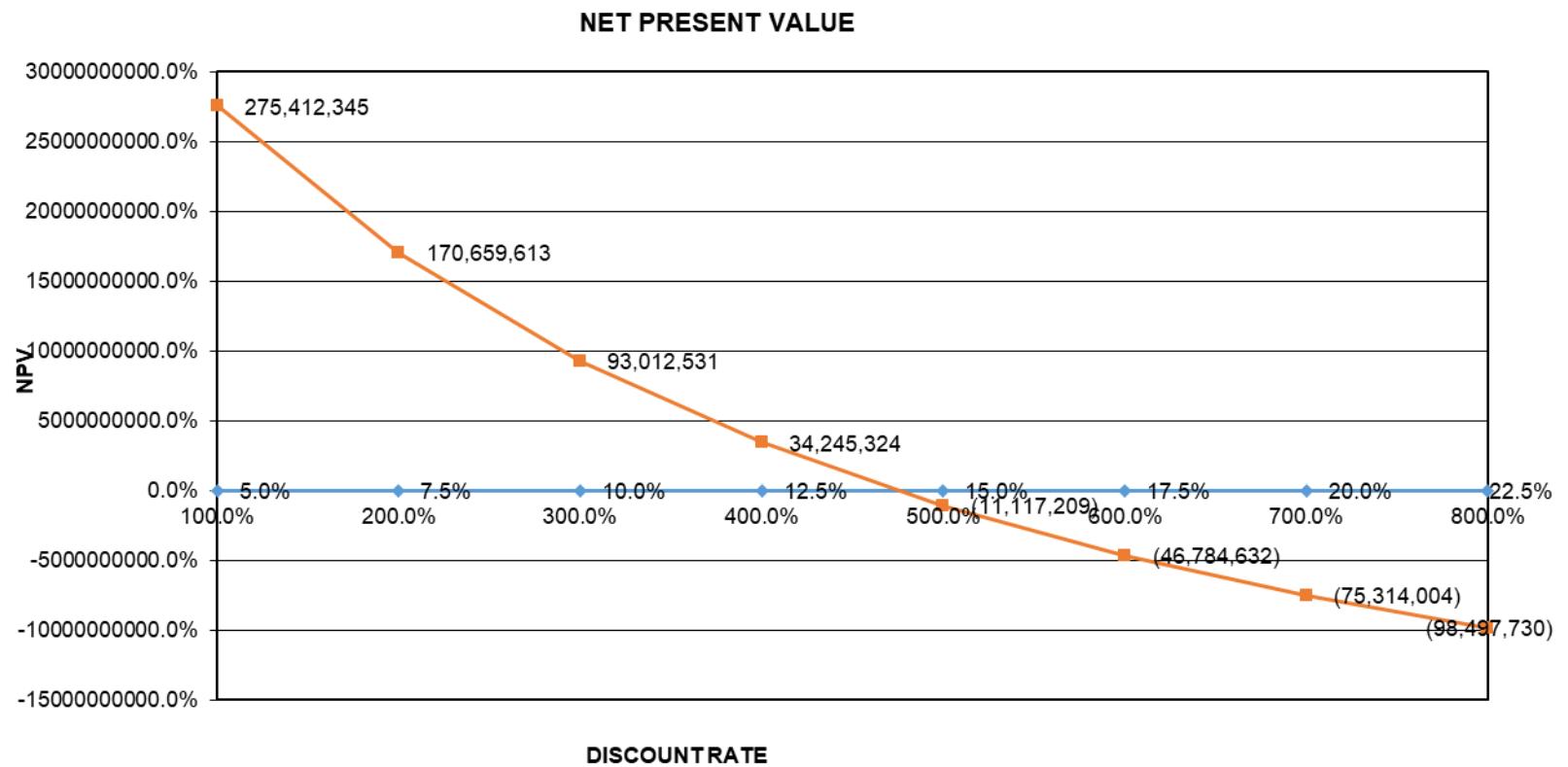
Appendix N Margin USD 3.00

Year	Cumulative Investment	Revenue	Operational Cost	Depreciation	Earning Before Tax	Tax 25%	Earning After Tax	Proceeds	Cummulative Proceeds	Inv. Before Payback
0	$300,254,478									(300,254,478)
0	$300,254,478									(300,254,478)
1		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	61,311,551	(238,942,927)
2		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	122,623,101	(177,631,376)
3		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	183,934,652	(116,319,825)
4		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	245,246,203	(55,008,275)
5		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	306,557,754	6,303,276
6		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	367,869,304	67,614,827
7		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	429,180,855	128,926,378
8		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	490,492,406	190,237,928
9		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	551,803,957	251,549,479
10		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	613,115,507	312,861,030
11		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	674,427,058	374,172,581
12		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	735,738,609	435,484,131
13		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	797,050,159	496,795,682
14		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	858,361,710	558,107,233
15		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	919,673,261	619,418,783
16		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	980,984,812	680,730,334
17		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	1,042,296,362	742,041,885
18		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	1,103,607,913	803,353,436
19		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	1,164,919,464	864,664,986
20		$ 120,948,444	$ 42,702,679	10,508,907	67,736,859	16,934,215	50,802,644	61,311,551	1,226,231,015	925,976,537
ROI	20.42%									

Year	Investment	Proceeds	i 5.0%	NPV	i 7.5%	NPV	i 10.0%	NPV	i 12.5%	NPV
0	**(300,254,478)**	-								
0	**(300,254,478)**	-		**(300,254,478)**		**(300,254,478)**		**(300,254,478)**		**(300,254,478)**
1		61,311,551	0.9524	58,391,953	0.9302	57,034,001	0.9091	55,737,773	0.8889	54,499,156
2		61,311,551	0.9070	55,611,384	0.8653	53,054,884	0.8264	50,670,703	0.7901	48,443,694
3		61,311,551	0.8638	52,963,223	0.8050	49,353,381	0.7513	46,064,276	0.7023	43,061,062
4		61,311,551	0.8227	50,441,165	0.7488	45,910,122	0.6830	41,876,614	0.6243	38,276,499
5		61,311,551	0.7835	48,039,204	0.6966	42,707,090	0.6209	38,069,649	0.5549	34,023,555
6		61,311,551	0.7462	45,751,623	0.6480	39,727,526	0.5645	34,608,772	0.4933	30,243,160
7		61,311,551	0.7107	43,572,974	0.6028	36,955,838	0.5132	31,462,520	0.4385	26,882,809
8		61,311,551	0.6768	41,498,071	0.5607	34,377,523	0.4665	28,602,291	0.3897	23,895,830
9		61,311,551	0.6446	39,521,972	0.5216	31,979,092	0.4241	26,002,083	0.3464	21,240,738
10		61,311,551	0.6139	37,639,974	0.4852	29,747,992	0.3855	23,638,257	0.3079	18,880,656
11		61,311,551	0.5847	35,847,594	0.4513	27,672,551	0.3505	21,489,324	0.2737	16,782,805
12		61,311,551	0.5568	34,140,566	0.4199	25,741,908	0.3186	19,535,750	0.2433	14,918,049
13		61,311,551	0.5303	32,514,824	0.3906	23,945,961	0.2897	17,759,772	0.2163	13,260,488
14		61,311,551	0.5051	30,966,499	0.3633	22,275,312	0.2633	16,145,248	0.1922	11,787,100
15		61,311,551	0.4810	29,491,904	0.3380	20,721,221	0.2394	14,677,498	0.1709	10,477,423
16		61,311,551	0.4581	28,087,528	0.3144	19,275,554	0.2176	13,343,180	0.1519	9,313,265
17		61,311,551	0.4363	26,750,026	0.2925	17,930,748	0.1978	12,130,163	0.1350	8,278,457
18		61,311,551	0.4155	25,476,216	0.2720	16,679,766	0.1799	11,027,421	0.1200	7,358,629
19		61,311,551	0.3957	24,263,063	0.2531	15,516,061	0.1635	10,024,928	0.1067	6,541,003
20		61,311,551	0.3769	23,107,679	0.2354	14,433,545	0.1486	9,113,571	0.0948	5,814,225
			Total	**463,822,964**	**Total**	**324,785,597**	**Total**	**221,725,316**	**Total**	**143,724,126**

Year	Investment	Proceeds	i 15.0%	NPV	i 17.5%	NPV	i 20.0%	NPV	i 22.5%	NPV
0	(300,254,478)	-				(300,254,478)		(300,254,478)		(300,254,478)
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		61,311,551	0.8696	53,314,392	0.8511	52,180,043	0.8333	51,092,959	0.8163	50,050,245
2		61,311,551	0.7561	46,360,341	0.7243	44,408,547	0.6944	42,577,466	0.6664	40,857,343
3		61,311,551	0.6575	40,313,340	0.6164	37,794,508	0.5787	35,481,221	0.5440	33,352,933
4		61,311,551	0.5718	35,055,078	0.5246	32,165,539	0.4823	29,567,685	0.4441	27,226,884
5		61,311,551	0.4972	30,482,677	0.4465	27,374,927	0.4019	24,639,737	0.3625	22,226,028
6		61,311,551	0.4323	26,506,675	0.3800	23,297,810	0.3349	20,533,114	0.2959	18,143,696
7		61,311,551	0.3759	23,049,283	0.3234	19,827,923	0.2791	17,110,929	0.2416	14,811,181
8		61,311,551	0.3269	20,042,855	0.2752	16,874,829	0.2326	14,259,107	0.1972	12,090,760
9		61,311,551	0.2843	17,428,569	0.2342	14,361,556	0.1938	11,882,589	0.1610	9,870,008
10		61,311,551	0.2472	15,155,278	0.1994	12,222,601	0.1615	9,902,158	0.1314	8,057,149
11		61,311,551	0.2149	13,178,502	0.1697	10,402,214	0.1346	8,251,798	0.1073	6,577,265
12		61,311,551	0.1869	11,459,567	0.1444	8,852,948	0.1122	6,876,498	0.0876	5,369,196
13		61,311,551	0.1625	9,964,841	0.1229	7,534,424	0.0935	5,730,415	0.0715	4,383,017
14		61,311,551	0.1413	8,665,079	0.1046	6,412,275	0.0779	4,775,346	0.0584	3,577,973
15		61,311,551	0.1229	7,534,851	0.0890	5,457,256	0.0649	3,979,455	0.0476	2,920,794
16		61,311,551	0.1069	6,552,045	0.0758	4,644,473	0.0541	3,316,213	0.0389	2,384,322
17		61,311,551	0.0929	5,697,430	0.0645	3,952,743	0.0451	2,763,510	0.0317	1,946,385
18		61,311,551	0.0808	4,954,287	0.0549	3,364,037	0.0376	2,302,925	0.0259	1,588,886
19		61,311,551	0.0703	4,308,076	0.0467	2,863,010	0.0313	1,919,105	0.0212	1,297,050
20		61,311,551	0.0611	3,746,153	0.0397	2,436,604	0.0261	1,599,254	0.0173	1,058,816
			Total	83,514,842	Total	36,173,789	Total	(1,692,993)	Total	(32,464,546)

Appendix O NPV Graph for Margin USD 3.00

NET PRESENT VALUE

Chart showing NPV versus Discount Rate. Y-axis labeled NPV ranging from -10000000000.0% to 50000000000.0%. X-axis labeled DISCOUNT RATE with values 5.0%/100.0%, 7.5%/200.0%, 10.0%/300.0%, 12.5%/400.0%, 15.0%/500.0%, 17.5%/600.0%, 20.0%/700.0%, 22.5%/800.0%. Data points: 463,822,964; 324,785,597; 221,725,316; 143,724,126; 83,514,842; 36,173,789; (2,993); (32,464,546).
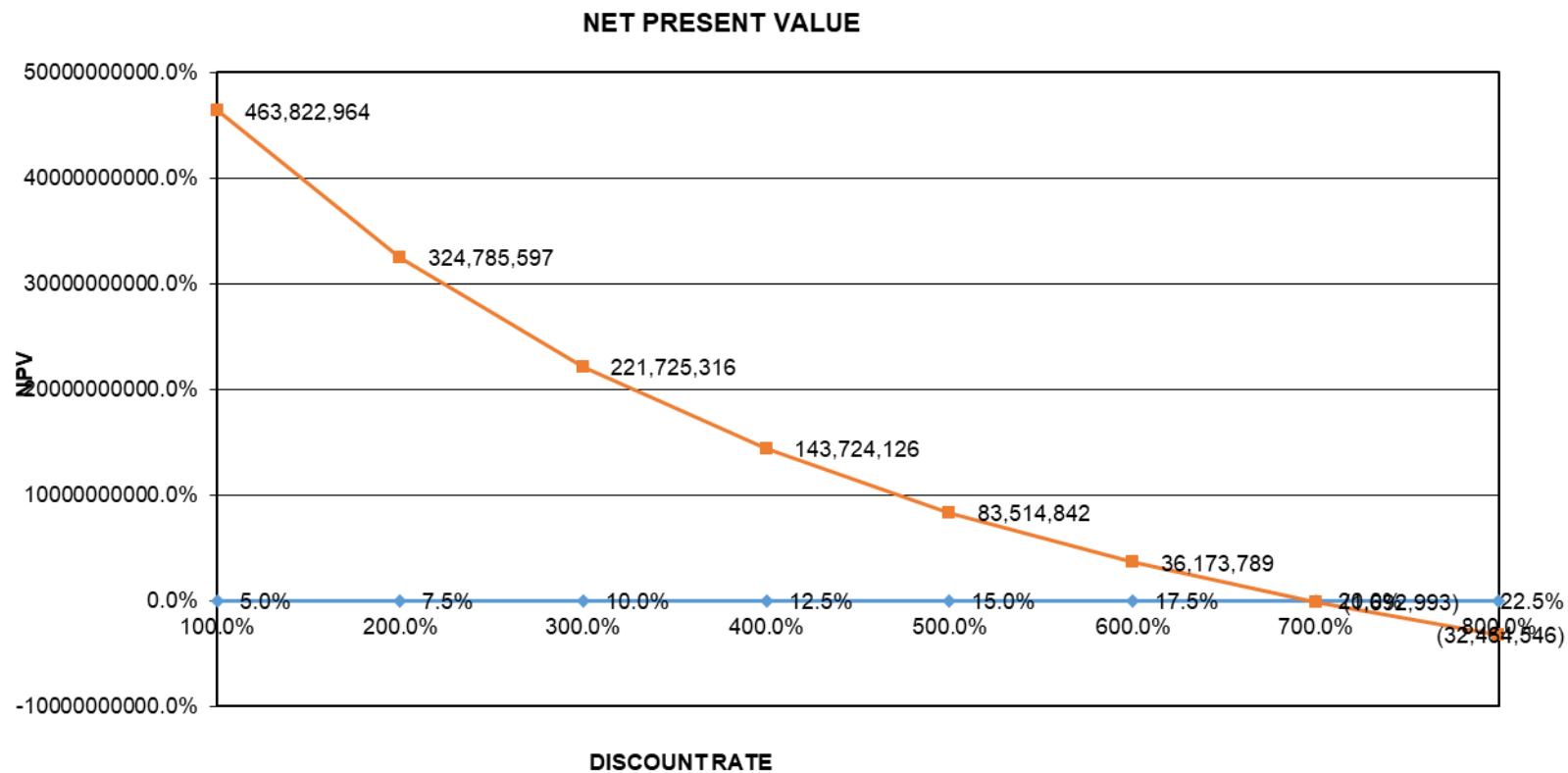
Appendix P Margin USD 3.50

Year	Cumulative Investment	Revenue	Operational Cost	Depreciation	Earning Before Tax	Tax 25%	Earning After Tax	Proceeds	Cummulative Proceeds	Inv. Before Payback
0	$300,254,478									(300,254,478)
0	$300,254,478									(300,254,478)
1		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	76,430,106	(223,824,371)
2		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	152,860,212	(147,394,265)
3		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	229,290,319	(70,964,159)
4		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	305,720,425	5,465,947
5		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	382,150,531	81,896,054
6		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	458,580,637	158,326,160
7		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	535,010,744	234,756,266
8		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	611,440,850	311,186,372
9		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	687,870,956	387,616,479
10		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	764,301,062	464,046,585
11		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	840,731,169	540,476,691
12		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	917,161,275	616,906,797
13		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	993,591,381	693,336,903
14		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,070,021,487	769,767,010
15		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,146,451,593	846,197,116
16		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,222,881,700	922,627,222
17		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,299,311,806	999,057,328
18		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,375,741,912	1,075,487,435
19		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,452,172,018	1,151,917,541
20		$ 141,106,518	$ 42,702,679	10,508,907	87,894,933	21,973,733	65,921,200	76,430,106	1,528,602,125	1,228,347,647
ROI	25.46%									

Year	Investment	Proceeds	i 5.0%	NPV	i 7.5%	NPV	i 10.0%	NPV	i 12.5%	NPV
0	**(300,254,478)**	-								
0	**(300,254,478)**	-		**(300,254,478)**		**(300,254,478)**		**(300,254,478)**		**(300,254,478)**
1		76,430,106	0.9524	72,790,577	0.9302	71,097,773	0.9091	69,481,915	0.8889	67,937,872
2		76,430,106	0.9070	69,324,359	0.8653	66,137,463	0.8264	63,165,377	0.7901	60,389,220
3		76,430,106	0.8638	66,023,199	0.8050	61,523,222	0.7513	57,423,070	0.7023	53,679,306
4		76,430,106	0.8227	62,879,238	0.7488	57,230,904	0.6830	52,202,791	0.6243	47,714,939
5		76,430,106	0.7835	59,884,988	0.6966	53,238,050	0.6209	47,457,083	0.5549	42,413,279
6		76,430,106	0.7462	57,033,322	0.6480	49,523,768	0.5645	43,142,802	0.4933	37,700,693
7		76,430,106	0.7107	54,317,450	0.6028	46,068,621	0.5132	39,220,729	0.4385	33,511,727
8		76,430,106	0.6768	51,730,904	0.5607	42,854,531	0.4665	35,655,209	0.3897	29,788,202
9		76,430,106	0.6446	49,267,528	0.5216	39,864,680	0.4241	32,413,826	0.3464	26,478,401
10		76,430,106	0.6139	46,921,455	0.4852	37,083,423	0.3855	29,467,115	0.3079	23,536,357
11		76,430,106	0.5847	44,687,100	0.4513	34,496,208	0.3505	26,788,286	0.2737	20,921,206
12		76,430,106	0.5568	42,559,143	0.4199	32,089,496	0.3186	24,352,987	0.2433	18,596,628
13		76,430,106	0.5303	40,532,517	0.3906	29,850,694	0.2897	22,139,079	0.2163	16,530,336
14		76,430,106	0.5051	38,602,397	0.3633	27,768,087	0.2633	20,126,436	0.1922	14,693,632
15		76,430,106	0.4810	36,764,188	0.3380	25,830,779	0.2394	18,296,760	0.1709	13,061,006
16		76,430,106	0.4581	35,013,512	0.3144	24,028,631	0.2176	16,633,418	0.1519	11,609,783
17		76,430,106	0.4363	33,346,202	0.2925	22,352,215	0.1978	15,121,289	0.1350	10,319,807
18		76,430,106	0.4155	31,758,288	0.2720	20,792,758	0.1799	13,746,626	0.1200	9,173,162
19		76,430,106	0.3957	30,245,988	0.2531	19,342,101	0.1635	12,496,933	0.1067	8,153,922
20		76,430,106	0.3769	28,805,703	0.2354	17,992,652	0.1486	11,360,848	0.0948	7,247,930
			Total	**652,233,583**	**Total**	**478,911,580**	**Total**	**350,438,102**	**Total**	**253,202,929**

Year	Investment	Proceeds	i 15.0%	NPV	i 17.5%	NPV	i 20.0%	NPV	i 22.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		76,430,106	0.8696	66,460,962	0.8511	65,046,899	0.8333	63,691,755	0.8163	62,391,923
2		76,430,106	0.7561	57,792,141	0.7243	55,359,063	0.6944	53,076,463	0.6664	50,932,182
3		76,430,106	0.6575	50,254,035	0.6164	47,114,096	0.5787	44,230,386	0.5440	41,577,292
4		76,430,106	0.5718	43,699,161	0.5246	40,097,103	0.4823	36,858,655	0.4441	33,940,646
5		76,430,106	0.4972	37,999,271	0.4465	34,125,194	0.4019	30,715,546	0.3625	27,706,650
6		76,430,106	0.4323	33,042,844	0.3800	29,042,718	0.3349	25,596,288	0.2959	22,617,674
7		76,430,106	0.3759	28,732,908	0.3234	24,717,207	0.2791	21,330,240	0.2416	18,463,407
8		76,430,106	0.3269	24,985,137	0.2752	21,035,921	0.2326	17,775,200	0.1972	15,072,169
9		76,430,106	0.2843	21,726,206	0.2342	17,902,911	0.1938	14,812,667	0.1610	12,303,811
10		76,430,106	0.2472	18,892,353	0.1994	15,236,520	0.1615	12,343,889	0.1314	10,043,928
11		76,430,106	0.2149	16,428,133	0.1697	12,967,251	0.1346	10,286,574	0.1073	8,199,125
12		76,430,106	0.1869	14,285,333	0.1444	11,035,959	0.1122	8,572,145	0.0876	6,693,163
13		76,430,106	0.1625	12,422,029	0.1229	9,392,305	0.0935	7,143,454	0.0715	5,463,806
14		76,430,106	0.1413	10,801,764	0.1046	7,993,451	0.0779	5,952,878	0.0584	4,460,250
15		76,430,106	0.1229	9,392,839	0.0890	6,802,937	0.0649	4,960,732	0.0476	3,641,021
16		76,430,106	0.1069	8,167,686	0.0758	5,789,734	0.0541	4,133,943	0.0389	2,972,262
17		76,430,106	0.0929	7,102,335	0.0645	4,927,433	0.0451	3,444,953	0.0317	2,426,336
18		76,430,106	0.0808	6,175,944	0.0549	4,193,560	0.0376	2,870,794	0.0259	1,980,683
19		76,430,106	0.0703	5,370,386	0.0467	3,568,987	0.0313	2,392,328	0.0212	1,616,884
20		76,430,106	0.0611	4,669,901	0.0397	3,037,436	0.0261	1,993,607	0.0173	1,319,905
			Total	178,146,892	Total	119,132,210	Total	71,928,019	Total	33,568,639

Appendix Q for Margin USD 3.50

NET PRESENT VALUE
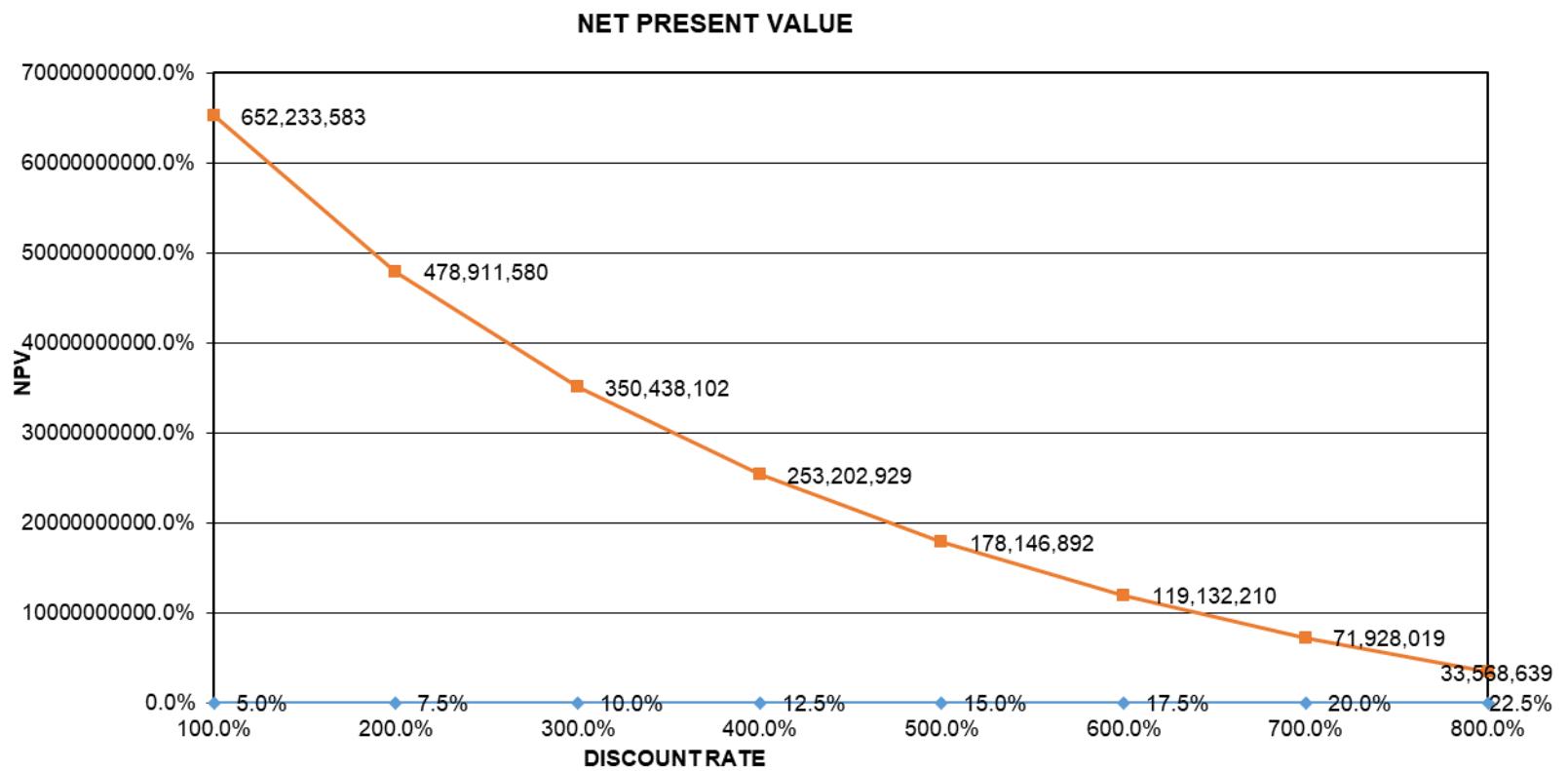
Appendix R Margin USD 4.00

Year	Cumulative Investment	Revenue	Operational Cost	Depreciation	Earning Before Tax	Tax 25%	Earning After Tax	Proceeds	Cummulative Proceeds	Inv. Before Payback
0	$300,254,478									(300,254,478)
0	$300,254,478									(300,254,478)
1		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	91,548,662	(208,705,816)
2		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	183,097,323	(117,157,154)
3		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	274,645,985	(25,608,492)
4		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	366,194,647	65,940,169
5		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	457,743,309	157,488,831
6		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	549,291,970	249,037,493
7		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	640,840,632	340,586,155
8		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	732,389,294	432,134,816
9		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	823,937,956	523,683,478
10		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	915,486,617	615,232,140
11		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,007,035,279	706,780,802
12		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,098,583,941	798,329,463
13		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,190,132,602	889,878,125
14		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,281,681,264	981,426,787
15		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,373,229,926	1,072,975,448
16		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,464,778,588	1,164,524,110
17		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,556,327,249	1,256,072,772
18		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,647,875,911	1,347,621,434
19		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,739,424,573	1,439,170,095
20		$ 161,264,592	$ 42,702,679	10,508,907	108,053,007	27,013,252	81,039,755	91,548,662	1,830,973,235	1,530,718,757
ROI	30.49%									

Year	Investment	Proceeds	i 5.0%	NPV	i 7.5%	NPV	i 10.0%	NPV	i 12.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		91,548,662	0.9524	87,189,202	0.9302	85,161,546	0.9091	83,226,056	0.8889	81,376,588
2		91,548,662	0.9070	83,037,335	0.8653	79,220,043	0.8264	75,660,051	0.7901	72,334,745
3		91,548,662	0.8638	79,083,176	0.8050	73,693,063	0.7513	68,781,865	0.7023	64,297,551
4		91,548,662	0.8227	75,317,311	0.7488	68,551,686	0.6830	62,528,968	0.6243	57,153,379
5		91,548,662	0.7835	71,730,772	0.6966	63,769,011	0.6209	56,844,516	0.5549	50,803,003
6		91,548,662	0.7462	68,315,021	0.6480	59,320,010	0.5645	51,676,833	0.4933	45,158,225
7		91,548,662	0.7107	65,061,925	0.6028	55,181,405	0.5132	46,978,939	0.4385	40,140,645
8		91,548,662	0.6768	61,963,738	0.5607	51,331,539	0.4665	42,708,126	0.3897	35,680,573
9		91,548,662	0.6446	59,013,084	0.5216	47,750,269	0.4241	38,825,569	0.3464	31,716,065
10		91,548,662	0.6139	56,202,937	0.4852	44,418,855	0.3855	35,295,972	0.3079	28,192,058
11		91,548,662	0.5847	53,526,606	0.4513	41,319,865	0.3505	32,087,247	0.2737	25,059,607
12		91,548,662	0.5568	50,977,720	0.4199	38,437,084	0.3186	29,170,225	0.2433	22,275,206
13		91,548,662	0.5303	48,550,210	0.3906	35,755,427	0.2897	26,518,386	0.2163	19,800,183
14		91,548,662	0.5051	46,238,295	0.3633	33,260,862	0.2633	24,107,624	0.1922	17,600,163
15		91,548,662	0.4810	44,036,472	0.3380	30,940,337	0.2394	21,916,022	0.1709	15,644,589
16		91,548,662	0.4581	41,939,497	0.3144	28,781,709	0.2176	19,923,656	0.1519	13,906,301
17		91,548,662	0.4363	39,942,378	0.2925	26,773,682	0.1978	18,112,415	0.1350	12,361,157
18		91,548,662	0.4155	38,040,360	0.2720	24,905,751	0.1799	16,465,832	0.1200	10,987,695
19		91,548,662	0.3957	36,228,914	0.2531	23,168,141	0.1635	14,968,938	0.1067	9,766,840
20		91,548,662	0.3769	34,503,728	0.2354	21,551,759	0.1486	13,608,125	0.0948	8,681,636
			Total	840,644,202	Total	633,037,563	Total	479,150,888	Total	362,681,732

Year	Investment	Proceeds	i 15.0%	NPV	i 17.5%	NPV	i 20.0%	NPV	i 22.5%	NPV
0	(300,254,478)	-								
0	(300,254,478)	-		(300,254,478)		(300,254,478)		(300,254,478)		(300,254,478)
1		91,548,662	0.8696	79,607,532	0.8511	77,913,755	0.8333	76,290,551	0.8163	74,733,601
2		91,548,662	0.7561	69,223,941	0.7243	66,309,578	0.6944	63,575,460	0.6664	61,007,022
3		91,548,662	0.6575	60,194,731	0.6164	56,433,684	0.5787	52,979,550	0.5440	49,801,650
4		91,548,662	0.5718	52,343,244	0.5246	48,028,667	0.4823	44,149,625	0.4441	40,654,408
5		91,548,662	0.4972	45,515,865	0.4465	40,875,461	0.4019	36,791,354	0.3625	33,187,272
6		91,548,662	0.4323	39,579,013	0.3800	34,787,627	0.3349	30,659,462	0.2959	27,091,651
7		91,548,662	0.3759	34,416,533	0.3234	29,606,491	0.2791	25,549,551	0.2416	22,115,633
8		91,548,662	0.3269	29,927,420	0.2752	25,197,013	0.2326	21,291,293	0.1972	18,053,578
9		91,548,662	0.2843	26,023,843	0.2342	21,444,267	0.1938	17,742,744	0.1610	14,737,615
10		91,548,662	0.2472	22,629,429	0.1994	18,250,440	0.1615	14,785,620	0.1314	12,030,706
11		91,548,662	0.2149	19,677,764	0.1697	15,532,289	0.1346	12,321,350	0.1073	9,820,984
12		91,548,662	0.1869	17,111,099	0.1444	13,218,970	0.1122	10,267,792	0.0876	8,017,130
13		91,548,662	0.1625	14,879,217	0.1229	11,250,187	0.0935	8,556,493	0.0715	6,544,596
14		91,548,662	0.1413	12,938,450	0.1046	9,574,627	0.0779	7,130,411	0.0584	5,342,527
15		91,548,662	0.1229	11,250,826	0.0890	8,148,619	0.0649	5,942,009	0.0476	4,361,247
16		91,548,662	0.1069	9,783,327	0.0758	6,934,995	0.0541	4,951,674	0.0389	3,560,202
17		91,548,662	0.0929	8,507,241	0.0645	5,902,123	0.0451	4,126,395	0.0317	2,906,287
18		91,548,662	0.0808	7,397,600	0.0549	5,023,084	0.0376	3,438,663	0.0259	2,372,479
19		91,548,662	0.0703	6,432,696	0.0467	4,274,965	0.0313	2,865,552	0.0212	1,936,718
20		91,548,662	0.0611	5,593,649	0.0397	3,638,268	0.0261	2,387,960	0.0173	1,580,994
			Total	272,778,942	Total	202,090,630	Total	145,549,030	Total	99,601,823

Appendix S for Margin USD 4.00

NET PRESENT VALUE

840,644,202
633,037,563
479,150,888
362,681,732
272,778,942
202,090,630
145,549,030
99,601,823
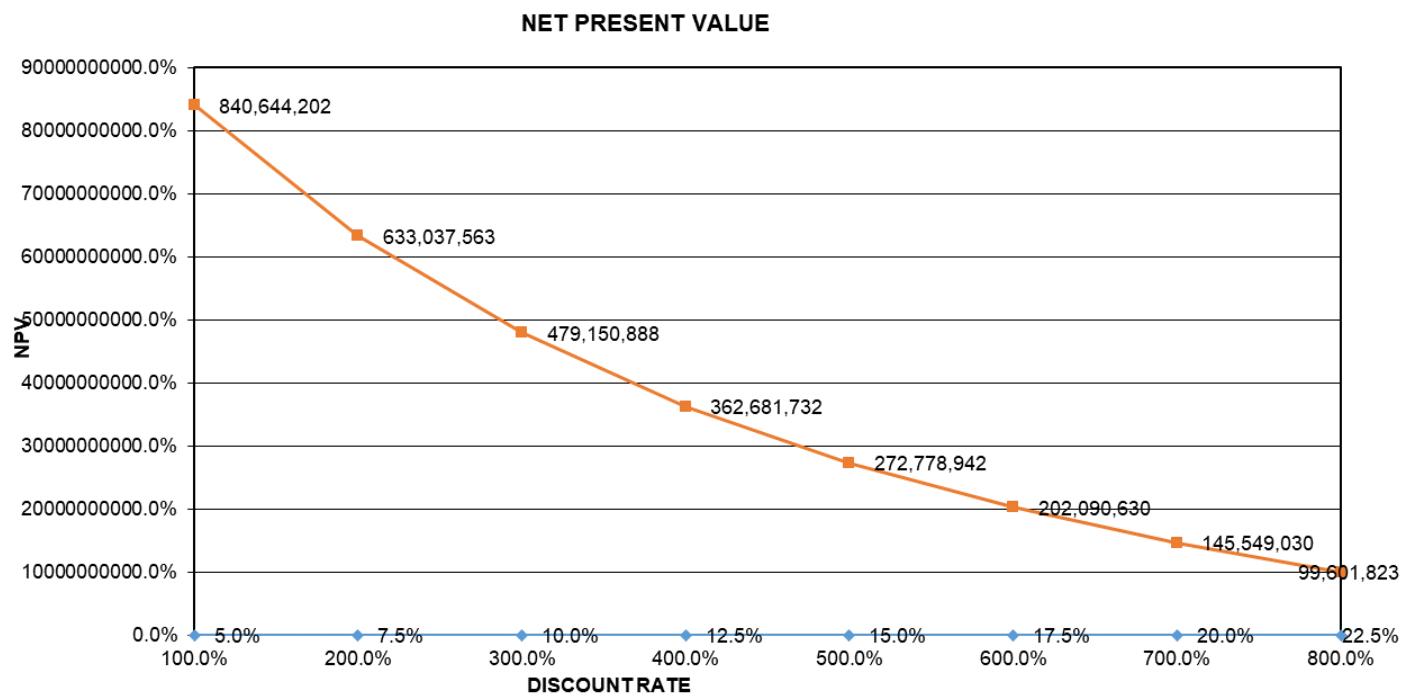
BIOGRAPHY

Ade Putri Aulia Wijharnasir was born in Banjarmasin, April 28th 1994. She holds bachelor degree in Marine Engineering from Sepuluh Nopember Institute of Technology (ITS) in Indonesia on 2015. Later, she enrolled master degree of technology management, majoring industrial management in Sepuluh Nopember Institute of Technology, Surabaya, Indonesia on 2017. She enrolled her master degree funded by *Lembaga Pengelola Dana Pendidikan* (LPDP) of Ministry of Finance of Indonesia, hence she is an awardee from PK-81 of LPDP. She joined short-term exchange fall program to finish her research supervised by Manabu Iwasa in Applied Mathematics Laboratory, GSST, Kumamoto University, Japan, during September 2017-March 2018. She is also passionately join as member of *Persatuan Pelajar Indonesia-Jepang* (PPIJ) Kumamoto, Profession and Interest Division Staff in Mata Garuda (LPDP awardee and alumni organization) Jatim, and Alumni Support Staff in Mata Garuda Indonesia. Her passion is liquefied natural gas (LNG) and supply chain management. Currently her area of interest are LNG supply chain, particularly maritime transportation. In addition, she interested and joined as volunteer in some voluntarily organization related to children, education, and animals. Please do not hesitate to correspondence the author regarding comments or discussion.
Email: adeputriaulia@gmail.com