Fiji Biofuel Market Assessment

Procurement, Transport and Distribution of Biofuel from the Host Islands to Viti Levu and Vanua Levu with Technical Arrangements and a Biofuel Marketing Plan

December 2016

TABLE OF CONTENTS

NO.	TOPIC	PAGE Nos
	ACRONYMS	
	EXECUTIVE SUMMARY	
1.0	INTRODUCTION	5
2.0	BACKGROUND	6
2.1	Effects of Tropical Cyclone Winston on Coconut Plantations in Fiji	8
3.0	SHIPPING NETWORK - TRANSPORTATION OF CARGO FROM MARITIME ISLANDS TO MAIN CENTRES	9
4.0	RENEWABLE DIESEL SUPPLY CHAIN, COST IMPLICATIONS & TECHNICAL ARRANGEMENTS	11
4.1	TECHNICAL ARRANGEMENTS – RENEWABLE DIESEL	13
5.0	PROACTIVE AND MEANINGFUL AWARENESS TO SUCCESSFULLY MARKET LOCALLY PRODUCED BIOFUEL IN FIJI	20
5.1	THE BIOFUEL MARKETING PLAN	20
a.	Vision Statement	
b.	Mission Statement	
c.	Goal / Objective	
d.	The Business	
i.	Business Overview	21
ii.	SWOT Analysis	
e.	The Market	24
i.	The Target Market	
ii.	Marketing Strategy	
iii.	Market Research	25
iv.	Market Target	
f.	Environment / Industry Analysis	26
G.	Customer / Clients	31
i.	Customer Demographics	31
ii.	Key Customers	33
iii.	Customer Management	34
h.	Competition / Competitors	34
i.	Pricing Strategy	35
6.0	RECOMMENDATIONS FOR BIOFUEL IN FIJI	35
7.0	CONCLUSIONS	36
	REFERENCES	37

ACRONYMS

ASTM	American Society for Testing and Materials
CMFL	Copra Millers Fiji Ltd
CNO	Coconut Oil
CRC	Co-ordinating Research Council
FAME	Fatty Acids Methyl Esters
FBOS	Fiji Bureau of Statistics
FDoE	Fiji Department of Energy
FREPP	Fiji Renewable Energy Power Project
FSC	Fiji Sugar Corporation
GEF	Global Environment Facility
GHG	Greenhouse Gases
MOU	Memorandum of Understanding
R20	Renewable Diesel – 20% Renewable Component – Coconut Oil
SWOT	Strength Weakness Opportunities Threats
UNDP	United Nations Development Program
VCO	Virgin Coconut Oil

Executive Summary

Fiji in harnessing biofuels will be able to reduce its fuel import bill and contribute positively to the economy and the environment. There are multiplier effects to the economy apart from the direct reduction in foreign exchange and expenditure on fossil fuels. It also brings in massive employment for the people and significantly contributes to economic development. Numerous studies and pilot initiatives have been launched in the country to take biofuel (biodiesel, renewable diesel and bioethanol) forward. Some of the initiatives include;

i. The establishment of the nine (9) Maritime Biofuel Mills;
ii. The putting in place of tax incentives to assist Biofuel producers (this has been in place for the past five years)
iii. Having specific standards put in place by the Ministry of Commerce and Trade to facilitate production and
iv. The set-up of the of the Biofuel Lab at the University of the South Pacific for quality assurance purposes;

These are some of the ongoing efforts to realize this important dream. Unfortunately the efforts have been thwarted by a number of issues that have become barriers to progressing biofuel development in Fiji. There is a need to take charge and leadership in successfully addressing these issues.

Fiji, being a Pacific Island and playing a leading role in the fight against climate change at the global level, needs to show commitment by ensuring that Biofuel application, a major climate mitigation initiative, is implemented with ease in the country.

The report has dwelled on important issues affecting the Maritime Biofuel Mills and the overall direction for biofuels moving forward. Some of the recommendations include;

a. There is a need to produce the real biofuel (including hydrogenation) and penetrate the market with ease in terms of the use of biofuels;
b. With the growing advances in the market there is a need to thoroughly evaluate whether coconuts and coconut oil needs to remain as a biofuel feedstock or allow it to do both or to transition to the food and cosmetics industry and
c. ;Notwithstanding the decision made above there is a need to look for alternative feedstocks with respect to the future of biofuels in Fiji.

In view of the above, it is important that national, regional and global benefits of the initiative are also taken into account. It is the intention of this report to provide the impetus to progress the biofuel development in Fiji.

1.0 INTRODUCTION

The Government of Fiji through the Department of Energy had installed a total of nine Biofuel Mills in the Maritime Provinces in Fiji. The objective of the project apart from economic gains and overall improvement in living standards, was largely to provide a means by which the energy needs of the people on the islands can be met. The mills were installed in Koro, Rotuma, Cicia, Gau, Rabi, Vanua Balavu, Lakeba, Moala and Matuku. At the moment the mills are currently suffering from the lack of demand within the host islands and as a result have affected the overall operations of the mills on the islands. The mill backers – the Government through the Department of Energy is now contemplating ways in which it can resurrect the operations of the mill. In doing so it is looking at the potential demand outside of the host islands basically in Viti Levu and Vanua Levu. In addition it is also seriously considering divesting the operations of the mills. With respect to the latter, discussions, have taken place with Copra Millers Fiji Limited (CMFL) in this regard.

The CMFL is a State Owned Enterprise (SOE) and deals directly with the export of crude coconut oil to overseas suppliers. Very recently with the current restructure of CMFL, it is now contemplating to diversify its operations and to also produce refined coconut oil and all other products that can be produced through "whole nut processing" including venturing into the marketing and sale of green nuts in the world market.

Similarly in terms of the demand outside of the mills, it is important that the Mill Management and the Department of Energy also consider focusing their efforts on all products that are produced by the mill. These are plans that will bring about profitability and the overall sustainability of the mills. However, to only consider biofuel without the uptake of other by products of the mill may be risky in view of the growing market (not only in terms of coconut oil volumes but also on the potential of the various types of coconut products). Therefore, it is important to commence operations through first considering the local demand for biofuel. This will include the islands in which the Biofuel Mills are situated and also the periphery of the islands (other islands) in which the mills are situated. Thereafter through proactive marketing it is hoped the biofuel demand will increase and production can also be increased accordingly. In addition apart from biofuel, the mills can also consider coconut oil and all other products that can be produced and effectively transported from the mill. These products include coconut oil, coconut meal and green coconuts.

2.0 BACKGROUND

Biofuels can be defined as liquid fuels produced from biomass, either from agricultural waste, forestry products or from the biodegradable component of industry and municipal wastes. These fuels are largely used for transport purposes. There are two main products that come under Biofuels; Bioethanol and Biodiesel. Bioethanol is a distilled liquid produced by fermenting sugars from sugar plants and cereal crops. On the other hand, Biodiesel or vegetable oil methyl ester is produced from the reaction of vegetable oil (rapeseed, sunflower, jatropha or coconut oil) with an alcohol in the presence of a catalyst to produce a mono-alkyl ester and glycerine. This fuel is blended with automotive diesel and the current acceptable blend is 5% or B5. In addition Biodiesel is also taken to meet the requirements ASTM D6751 but is chemically different from true diesel (Dufey, 2006).

Apart from the two classes of fuels, there is also **Renewable Diesel,** which is apparently the fuel that is produced at the Maritime Biofuel Mills (but with the absence of the hydrotreating or hydrogenation process). According to the United States Department of Energy - Alternative Fuels Data Center, the hydrotreating process involves the hydrogenation of triglycerides to remove metals and compounds with oxygen and nitrogen (www.afdc.energy.gov/fuels/emerging_green.html). The fuel is derived from biomass feedstock such as coconut oil, including other oils or animal fats and meets the requirement of ASTM D975 or D396 and is commonly referred to as non-esterified renewable diesel (www.dieselforum.org). In addition there is very little distinction between the three classes of fuel.

The fuels produced at the Maritime Biofuel Mills are used in local vehicles but there is still quite a higher level of mistrust with respect to the effects of the fuel on the vehicle. This is despite reassurance in terms of the tests earlier carried out by the FDoE Biofuel Unit.

Some of the comparisons between the three fuels are outlined on the table below;

NO.	FUEL PROPERTIES				
	Properties	Units	Petroleum Diesel	Biodiesel	Renewable Diesel (with hydrotreating process)
1.	Cetane	No.	40–55	50-65	75-90
2.	Energy Density	MJ/kg	43	38	44
3.	Density	g/ml	0.83-0.85	0.88	0.78
4.	Energy Content	BTU/gal	129K	118K	123K

NO.	Properties	Units	FUEL PROPERTIES Petroleum Diesel	Biodiesel	Renewable Diesel (with hydrotreating process)
5.	Sulphur	Ppm	10	5	10
6.	NOX Emission	Index	Baseline	+10	-10 to 0
7.	Cloud Point	C	-5	20	-10
8.	Oxidative Stability		Baseline	Poor	Excellent
9.	Cloud Flow Properties	Properties	Baseline	Poor	Excellent
10.	Lubricity		Baseline	Excellent	Similar

Figure 1 : Prevailing Standards / Properties for the 3 Classes of Fuels : Adapted from: Advanced Biofuels USA

Apart from the chemical component of the fuel another important factor that also needs to be taken into account is the prevailing and global market prices of petroleum and coconut oil products. At present (November 2016) the local prevailing price of petroleum diesel at the Bowsers is about FJD1.70 per liter, the global comparison is outlined on the figure below;

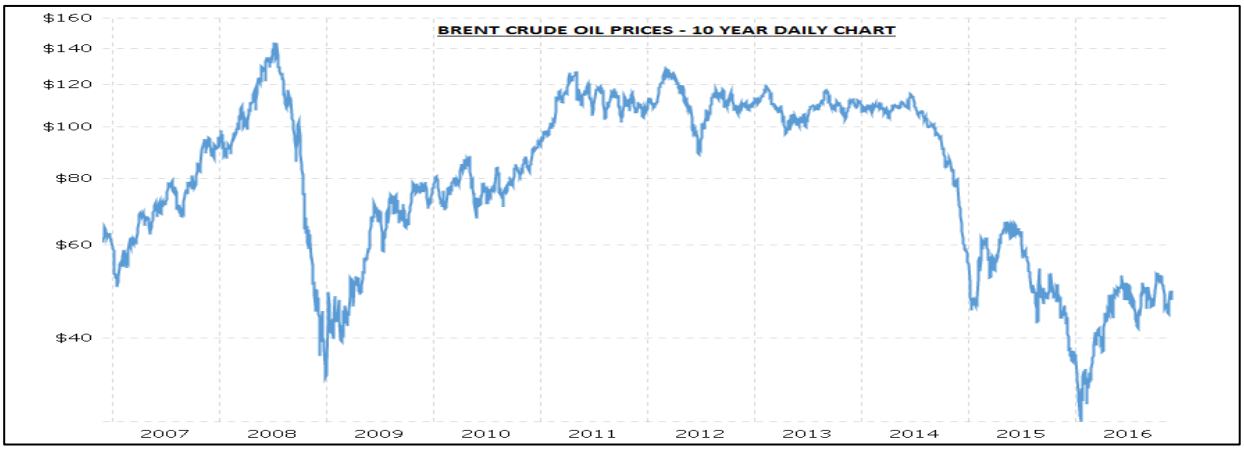
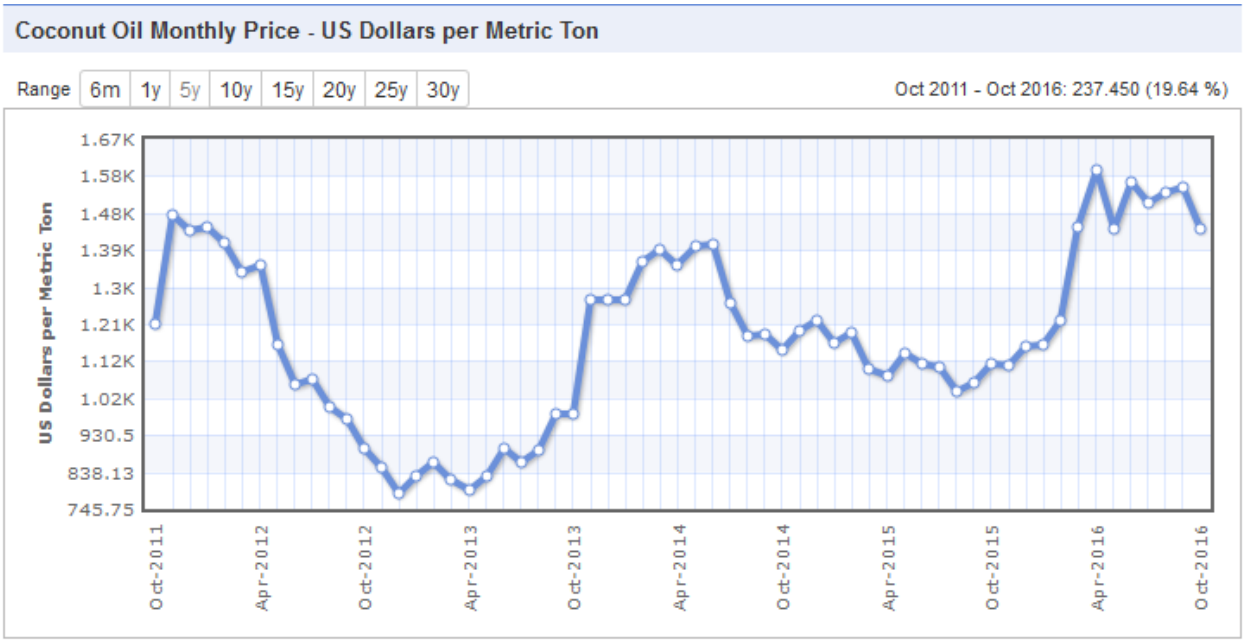


Figure 1: Adapted from: http://www.macrotrends.net/2480/brent-crude-oilprices-10-year-daily-chart

With respect to the price of a metric tonne of copra at the local level is around FJD 1026.00 and the trend has prevailed for some time. For the latter this has been the highest in which the price of coconut oil has risen in recent times. The increases are coming in as a result of the recent increase in coconut oil prices to around FJD 1,600.00 and also market development in other coconut commodities such as green nuts and the others. The global comparison in the price of coconut oil is outlined below;



Description: Coconut oil (Philippines/Indonesia), bulk, c.i.f. Rotterdam

Figure 2: http://www.indexmundi.com/commodities/?commodity=coconut-oil&months=60

Basically with the higher cost of coconut oil it would have a major effect on the prices of renewable diesel or even biodiesel (coconut oil as the feedstock) that is retailed at the local level. Therefore to make economic sense it would be good to consider another feedstock for now that would bring the prices down (retail prices of fuel) and at the same time continue with the push towards biofuels at the local level. With the current prices of coconuts it is certainly timely to venture into these upmarket uses and continue research into other premium products. These could be the new future for coconuts in Fiji and other parts of the Pacific.

Notwithstanding the above, for the purposes of this consultancy this write up will continue to focus on the use on the use of coconuts as a feedstock for local biofuel or renewable diesel.

2.1 Effects of Tropical Cyclone Winston on Coconut Plantation in Fiji

As noted in earlier reports considerable damage has been sustained in the coconut plantations around the country following Tropical Cyclone Winston in February 2016. Specifically for the Maritime Biofuel Mills, the mill in Vanua Balavu was completely damaged and as a result the equipment has been removed and taken back to Suva. Parts from the Vanua Balavu equipment has been used to rehabilitate other mills such as Lakeba and now the number of mills has been effectively reduced to eight (8).

According to the Ministry of Agriculture, it will take about 4 – 6 years for the industry to fully recover from the recent devastation. Notwithstanding the above, it is encouraging to note that a number of important initiatives have been put in place by Government to rehabilitate the industry. More specifically the initiatives to establish nurseries for coconut trees and above all to ensure that a plant reaches maturity are strong commitments that have been adopted in this regard. With the resolve from the Government (in view of the initiatives) it is hoped the industry, will make headlines again and above all capitalize on the global growth in the coconut industry.

3.0 SHIPPING NETWORK – TRANSPORTATION OF CARGO FROM THE MARITIME ISLANDS TO THE MAIN CENTRES

Shipping is the lifeline that links island communities with the outside world. It is a vital means of achieving sustainable development through ensuring economic development in terms of trade and transportation between the islands (smaller and larger or main islands). Interestingly earlier research conducted by Bola, 2013, also noted that intra and inter island sea transport is critical to every aspect of well - being in the islands. This is because of either the absence of roading networks or the dilapidated conditions of these infrastructures which has threatened intra-island transportation.

For the mills to survive shipping links to the island need to be established and if possible interventions made to ensure that coconut oil (including other products) and also diesel fuel with other goods are transported with ease when the need arises. It is also important to note that the work undertaken on the island in terms of biofuel and other activities need to synchronize with the shipping schedule. This will ensure that the efforts / profits for both for the biofuel mills or the island communities and the shipping companies are maximized

With the data provided by Maritime Safety Authority of Fiji, it was noted that apart from the Government Vessels, the following boats or vessels were travelling on scheduled times to the eight islands where the mills were situated;

i. Spirit of Harmony
ii. Neha II
iii. Sandy
iv. Liahona
v. Uluinabukelevu
vi. Lomaiviti Princess I
vii. Lomaiviti Princess II
viii. Lomaiviti Princess III

An illustration in terms of the most direct shipping routes is outlined on the map below. However, it needs to be noted that ships and ship owners rather prefer to travel through a cluster of islands rather than travelling directly to any specific island for that matter. These preferences are based on economic decisions in terms of moving cargo and passengers between the islands and the main land.

According to the Department of Transport at the Ministry of Infrastructure, Fiji also has a Franchise Scheme in place to facilitate trips to the less frequently-visited islands. The franchise schemes are basically routes where Governments provides a subsidy in terms of meeting part of the costs for travelling to those routes. The routes are classified in terms of economical routes and uneconomical ones. The economical routes are those with high capacities in terms of volume of cargo and passengers. The uneconomical routes are those with low volumes in terms of cargo and passengers.

It is these uneconomical routes that are largely the location of the biofuel mills and except for Koro which is on Suva – Savusavu route (an economical route). Two to three vessels travel through Koro on a weekly basis whereas for the remaining islands, there is only a guaranteed monthly trip that is made to the biofuel islands through the Franchise Scheme.

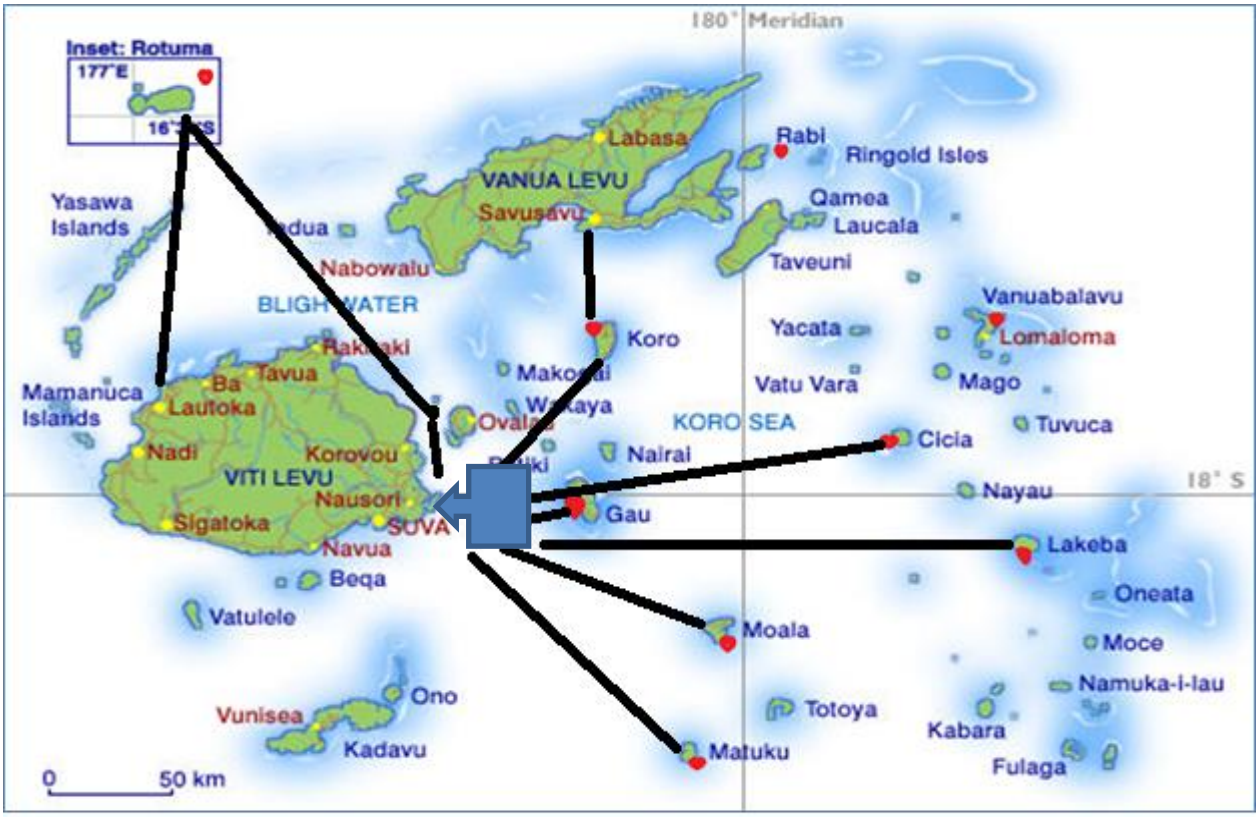


Figure 3: Outline of Map of Viti Levu and Vanua Levu with locations of the Biofuel Mills & Shipping Routes to and From the Mills

4.0 RENEWABLE DIESEL SUPPLY CHAIN, COST IMPLICATIONS & TECHNICAL ARRANGEMENTS

With the existing arrangements at the various Maritime Biofuel Mills, the whole blending process for renewable diesel(R20) takes place at each of the mill location. This occurs following the receipt of petroleum diesel that is brought in through the vessels that travel to the islands. The mill management after producing coconut oil carries out the mixing of the fuel in specific tanks taking into account the mixing ratio of 20:80 for coconut oil to petroleum diesel. Once the mix is accomplished, the fuel is largely retailed on the island and only from specific mills the fuel is brought to Suva for sale on the main land. Unfortunately, with the absence of prearranged commitments to pick up the products, it is often left standing for days. There are two reasons that have been noted for these situations;

i. The thought that the products brought to Suva from the islands are substandard and
ii. The lack of coordination between the FDoE Biofuel Unit and the Biofuel Mill Management with respect to identifying a buyer for the products before it leaves it the islands.

With the problems faced, there is a need to market (this is covered in specific sections below) the fuel on the main islands. To do this, there are very specific requirements that need to be adhered to such that it will get people and businesses to purchase the product produced or on sale;

i. For the product produced for sale (either coconut oil or renewable diesel) it has to comply with the relevant prevailing standards. For the renewable diesel the fuel has to comply to very specific ASTM Standards (ASTM D975 or D396) and similarly for coconut oil (specific coconut oil standards) and
ii. That the appropriate laboratory tests are undertaken and widely publicized before the products are retailed outside the islands.

The current supply chain may have been sufficient given the type of fuel produced and expected from the mill (absence of the hydrotreating process). However, to consider all the requirements of producing true renewable diesel (R20), one would realize that it is not only an expensive one for any individual mill, but it is a potential hazard and practically cumbersome for the current mill workers and management on the islands. In addition as part of this recommendation important economic and safety considerations have been taken into account for the production and retail of the fuel (R20). Therefore

the alternative option or recommendation that is currently being made is for the island biofuel mills to only produce coconut oil and coconut meal. The processes are very important and proper care should be taken with respect to handling and storage from the islands to Suva.

Furthermore, as part of this recommendation the Biofuel Unit at the Department of Energy or private entity needs to set up a collection center in Suva. The collection center is to house a renewable diesel blending facility and a coconut oil and meal wholesale center. It is also at this central point that the Biofuel Unit or the appointed private entity can wholesale coconut oil and also blend or produce Renewable Diesel that is demanded on the mainland. In addition, with the arrangement, quality and industry standards can be guaranteed and standard tests undertaken for each of the mill (both for the coconut oil and renewable diesel) can readily be undertaken as and when required. Apart from the standard tests the hydrotreating process of the fuel will also be carried out at this location. This arrangement will be applicable to all mills including Koro and Rabi Biofuel Mills. Similar to other mills, the two mills can be made to blend renewable diesel at their own locations (for their own use) and supply coconut oil (to maintain cost effectiveness) to the main Copra Millers Fiji Ltd Mill in Savusavu.

The arrangement above is very different from the process that was earlier put in place by Niu Industries. The latter was engaged in the collection of copra from the islands. It had its own vessels that were responsible from collecting copra from the islands. The copra was sorted and coconut oil was produced in Suva. In addition the company also directly blended coconut oil with petroleum diesel. The process was similar to that undertaken in the Biofuel Mills in the islands but with an added rigorous filtration of the coconut oil.

Some of the benefits for the recommendations above include the following;

i. With the total of eight mills spread throughout the maritime regions of the country there would definitely be varying qualities of coconut oil produced which also affects the fuel produced. Having a centralized collection center would be able to produce a single unique blend of coconut oil and bring about consistency in the product that is produced;
ii. Important standard tests would be readily undertaken through a centralized collection through certified laboratories (USP) and industry quality standards are maintained on the product;
iii. The mill management will be involved in a less cumbersome process and would be able to focus their energies on the manufacture and production of high grade coconut oil;

iv. Further a research facility can easily be accommodated as part of the collection centre and focused on further refining of the fuel and

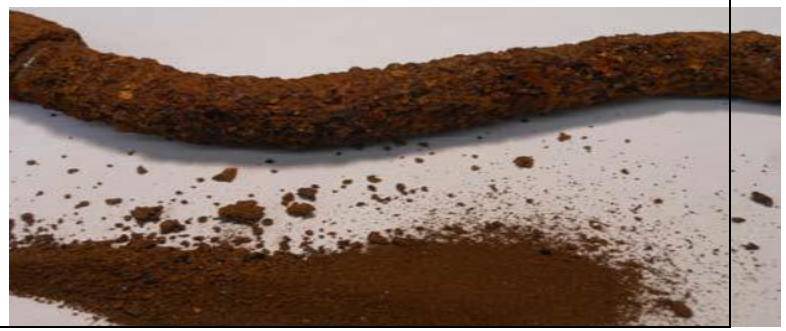
v. The efforts of each of the mill will be properly compensated in terms of the product produced as this will bring about the quest for improved productivity and sustainability of each othe mill;

4.1 Technical Arrangements – Renewable Diesel

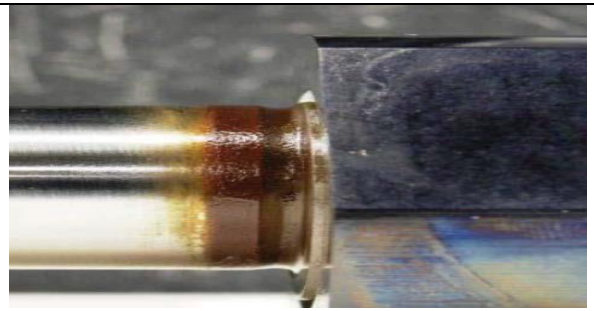
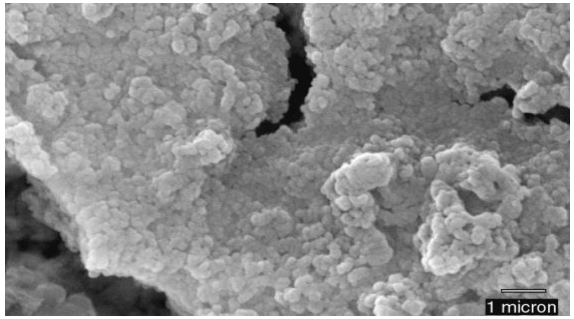
In terms of technical arrangements with respect to the handling, storage and delivery of the renewable diesel, according to the Neste Renewable Diesel Handbook (Neste, 2016), during lengthy storage neat Renewable Diesel as well as related blends behave like fossil diesel fuels. It does not contain harmful impurities eg. saturated monoglycerides, fatty acids methyl esters (FAME) and there is no risk for precipitation or separation above cloud point. The main issue in terms of handling and storage according to the Coordinating Research Council Inc. Report No. 667, that fuel contaminants come in various shapes, sizes and chemistries. Largely the contaminants basically include water, dirt, microbial growth, solids composed of organic salts, soaps, fuel degradation, polymers, oxides and these silicates greatly affect fuel quality (CRC, September 2014).

Tabulated below specific fuel contaminants and how it affects fuel systems including precautions during storage and handling (adapted from Coordinating Research Council Inc. Report No. 667)

NO.	Fuel Contaminant	Contamination	Effects	Precaution / Photo
1.	Water (The most common contaminant in fuel systems and can lead to many problems if not controlled.)	i. Water may enter the fuel system in so many ways such as the refining process, as rain, as ship ballast water or as condensation in storage tanks ii. Tank access points (man-ways, fill tube, nozzles and fittings) are also critical as these openings allow for the movement of air, product and personnel. When improperly installed or poorly maintained these openings are the main sources of product contamination. Therefore to minimize contamination all vents should be fitted with screens designed to address these situations.	i. It affects the quality of the fuel. ii. Can lead to increased corrosion and increase potential for microbial activity.	i. Recognition of potential water routes is important for the overall quality of fuel delivered to the end user. ii. The design and development of storage and transfer systems should seek to maximize water and sediment removal and minimize potential for water being carried from one point to another. iii. If work is undertaken on the tank during the day warm and humid air may be drawn to the equipment. If left overnight moisture may condense. iv. Above ground tanks should have new bottom installed and should have its floor with at least the first three (3) feet of the wall internally coated with epoxy. v. For additional protection it is preferable that all new steel underground storage tanks have their entire inner surface coated with epoxy. vi. The bottom of the tank should be equipped with a low point sump and drain line with a valve that is suitable for removing water and sediment.

NO.	Fuel Contaminant	Contamination	Effects	Precaution / Photo
2.	Microbial Growth	i. Diesel fuel is also a food source to different types of microorganisms that include bacteria and fungi (both aerobic and anaerobic types). ii. These microbial organisms do not require large amounts of water. They typically range from 0.5 to 3 microns in size. This explains why small spots of condensation on the walls of a tank are sufficient to support growth. iii. There are organisms that are found in the air, soil and even in the fuel, so it is virtually impossible to keep a fuel system sterile without the use of biocides. iv. The most abundant metabolites produced by microbial communities are low molecular weight organic acids. Although these organic acids are not as aggressive as strong inorganic acids, they can readily react with	i. Affects the quality of the fuel. ii. The microbes produce biosurfactants. The latter distributes water into the fuel phase and at the same time making fuel molecules as a source of food to the microbes. iii. The biofilms provide a protective habitat for microbes growing within them. While it is growing it has a resinous coating which further blocks fuel. It can plug filters, screens and other orifices in the fuel system.	 Microbial plug dispenser filter compared to a filter with no microbial contamination. 

NO.	Fuel Contaminant	Contamination	Effects	Precaution / Photo
		inorganic anions such as chloride, sulfate, and nitrate to produce strong inorganic acids (hydrochloric, sulfuric and nitric, respectively). These strong inorganic acids can cause corrosion and degrade fuel quality. v. The most abundant metabolites produced by microbial communities are organic and inorganic acids such as chlorides, sulfates and nitrates that can easily cause corrosion and degrade fuel quality.		Other pictures of microbial corrosion. Microbially influenced corrosion of fuel storage and dispensing systems below;
3.	Wax and other Organic Compounds	i. Wax forms when fuel is exposed to oxygen during storage or produced from exposure to high engine temperatures. ii. Wax can also	Wax precipitate and cause blockage for filters and screens.	Fuel needs to be checked during very cold temperatures or when the engine is exposed to high temperature.

NO.	Fuel Contaminant	Contamination	Effects	Precaution / Photo
		precipitate from the fuel during cold weather		
4.	Fuel Degradation	i. As fuel ages it degrades via thermal and oxidative process to form polymers and acids. ii. These chemical changes is promoted by exposure to high temperature and pressure producing acids, metals such as copper and zinc or combination of these elements.	Again the polymers and acids also cause blockage for filters and screens.	 **Eccentric shaft of common rail pump with aging polymers**  **Particulate formed by the degradation of fuel**

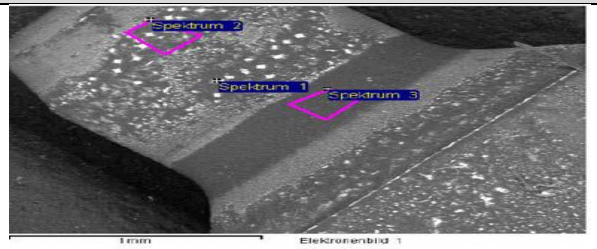
NO.	Fuel Contaminant	Contamination	Effects	Precaution / Photo
5.	Inorganic Compounds	These includes rust, other metals, dirt, gravel, sand, salt and similar contaminants.	These materials can result in blocked filters, contribute to tank corrosion, cause wear and /or promote areas for microbial activities to thrive.	 Injector valve needle with crystalline sodium chloride.

Figure 4: Table of various Contaminants and how they affect fuel systems including contamination in terms of Storage and Handling (Adapted from : Coordinating Research Council Inc. Report No. 667)

Further to the above table, proper care and preventative maintenance needed to be carried out to maintain fuel quality and more important prevent fires and other mishaps from happening. Therefore to ensure good performance of the fuel it needs to be safeguarded during delivery, storage and dispensing of the fuel. According to the CRC September report, some of the general guidelines include the following;

i. Tank fill areas should be kept clean and dry;

ii. Tank bottom water level should be verified by physically "sticking" the tank with water paste both before and 30 minutes after delivery and delivery hoses/connectors should be kept clean and dry.

iii. All tank openings should have good seals to prevent water or other contaminant entry. Fill wells should always be slightly above grade to prevent water/contaminant intrusion.

iv. Plungers in fill wells should never be depressed—these wells should be pumped out of excess fuel/water mixtures. Ideally, fuel dispensing into vehicles should be halted while fuel is received into storage tanks whenever practical.;

v. Storage tanks should be kept as full as possible. It allows less air in tanks minimizes water condensation and slows fuel oxidation/degradation reactions;

vi. Storage tanks should be kept as cool as possible. This practice helps to slow the degradation reactions associated with the heating of diesel fuel.

vii. The cool temperatures associated with the lower depths of the ground facilitate this cooling effect. Storage tanks or fuel transfer lines within close proximity of the engine or engine exhaust should be insulated from heat sources;

viii. Active tank water management should be adopted. Both above ground storage and underground storage tanks should be as "water-free" as possible. Water should be monitored frequently and be pumped out as soon as possible. As mentioned previously, water is a good solvent for contaminants and can also lead to microbial growth and corrosion problems, so minimizing water content will minimize these problems as well; Tanks should be vented properly to the atmosphere; This can allow for higher pressure gasoline or

gasoline-ethanol vapors to migrate into the diesel fuel and dramatically lower the diesel flash point to dangerous levels. It can also provide ethanol which is a food source for microbes that can cause corrosion;

ix. Tank bottoms should be sampled monthly for visual clarity and at least annually for microbiological contamination, more frequently if microbial activity is found or there is evidence downstream;

x. Dispensers should be kept clean and in good working order, especially around the nozzle area. Fuel dispensers should be fitted with a maximum of 10-micron porosity (nominal) water-absorbing type filter from a reputable manufacturers;

xi. Protocols need to be in place to allow for system checks and the treatment of water, microbial growth, vent systems violation and tank system management should be put in place to address issues of contamination, fuel quality degradation and potential fire hazards.

5.0 PROACTIVE AND MEANINGFUL AWARENESS TO SUCCESSFULLY MARKET LOCALLY PRODUCED BIOFUEL IN FIJI

THE MARKETING PLAN

According to an Australian Business Marketing proposal and accompanying template that a good marketing plan assists to identify ones customers and competitors and to develop a strategy to make business stand out (www.business.gov.au). This particular section is aimed at addressing the Marketing aspects including the awareness raising of locally produced Biofuel in the country.

5.1 The Biofuel Marketing Plan

a. Vision statement:

"Renewable, clean, and affordable energy for Fiji."

b. Mission Statement

To promote the local production and use of renewable and clean energy fuels in Fiji.

c. Goals/objectives:

The goals and objectives of the plan include;

i. To further augment Fiji's commitment to the international foras in relation to its target to reduce Green House Gases (GHGs) by 30% in 2030 (as per its commitment under the "Fiji's Intended Nationally Determined Contribution");
ii. To commence with the use of biofuels and reduce the quantity and use of mineral fuels in the country;
iii. To improve Fiji's Energy Security and.
iv. To reduce Fiji's import bill through the mobilization of Biofuels (Renewable Diesel, Biodiesel and Bioethanol) in the Fiji transport sector.

The achievement of the abovementioned objectives only becomes possible when the use of biofuels commences in the country. It is also hoped that the momentum will also create the impetus to move into other important areas such as bioethanol and increase the biofuels use in other areas such as electricity production.

d. The Business

The business essentially will either be owned by Copra Millers Fiji (Ltd) or continue to run as a community biofuel company together with the Department of Energy who are directors of the company (for all the 8 mills).

i. The Business Overview

At the moment the business belongs to the Government through the Biofuel Unit of the Department of Energy. The main product / services provided by the business is that, it is responsible for the production and sale of Renewable Diesel (R20). There is a total of about eight mills in total and are located in eight islands in the Maritime Provinces around the country. The mill includes; Koro, Rotuma, Cicia, Gau, Rabi, Lakeba, Matuku and Moala.

With respect to the processes involved the company produces coconut oil at their various locations around the country. The coconut oil is blended with diesel and with hydrogenation produce R20 or 20% of the Renewable component. In addition as part of this particular marketing plan, it insinuates that through growth in the business there will also be demand for bioethanol (including various blends but 10% is allowed in Fiji

the standards for the latter), biodiesel and other renewable fuels at the bowsers in locations throughout the country.

ii. Strength Weakness Opportunities Threats (S.W.O.T.) Analysis

Outlined below is a SWOT construct for the intended business venture. It is hoped that the construct has been able to put together weaknesses and threats that the business will come across in future but more importantly appropriate measures (through opportunities and strength) that will be able manage these situations.

Strengths	**Weaknesses**
a. Provides secure energy supply for the country. b. The use of biofuel can reduce GHG Emissions c. Production of Biofuels creates employment in the country (from the feedstock to the actual production of biofuel). d. Readily available feedstocks. e. Improves the income of farmers in the production and availability of feedstock. f. Established laboratories that can used for quality assurance purpose.	a. The current growth in the market of coconut oil that may rule it out as a feedstock for biofuel use in Fiji. b. Feedstock production will require large tracks of land and could compete with agricultural production. c. Biofuels have lesser energy content and users will see increase in the quantity of fuel that they use. d. The restrictions in terms of warranties from vehicle manufacturers. e. Although the feedstocks are known to be readily available, in reality this may not be the case (effects of Tropical Cyclone Winston in Fiji). f. Feedstock production also depends on extreme weather conditions and pest attacks.
Opportunities a. The project provides a real instrument or diplomatic vehicle to achieve Intended Nationally Determined Contribution (INDC) targets (reduction in GHG and meeting stated reduction targets.) b. Biofuels have the opportunity to replace a large percentage of fossil fuels. [At the time the TOR for this assignment was drafted, the target of the Biofuel Development Unit is to replace 25,000 kilolitres of imported fuels (gasoline) by locally produced fuels (biofuel) by 2030 and thereby reduce supply cost for imported fuels by 5% by 2016. Between 2010 - 2014, approximately 289.80 kilolitres of imported fuels (gasoline) has been replaced by locally produced fuels (bio-fuels), with only a 0.023% reduction in supply cost of imported fuels.]	**Threats** a. The need to put in place a mandate to ensure that the take up of biofuels is vigorously pursued. b. The potential for opposition from global oil companies in the country (Total, Mobil and Pacific Energy), particularly with respect to the technical changes in terms of their bowsers in the country. c. Feedstock production and potential competition with food production. d. At the Biofuel Maritime Mills, renewable diesel produced currently uses coconut as the feedstock. However, with the growing potential in terms of coconut water and other coconut products it will bring about competition and affect the selling price of the fuel.

c. Provides hope in terms of cushioning the associated increases in the prices of fossil fuels (substitute product). d. It has the opportunity to decrease dependency on crude oil. e. Numerous research initiatives undertaken in this field and Fiji being a follower in this particular field will benefit a lot from the research work undertaken in this area (feedstock and technologies). f. The Fiji Sugar Corporation is currently trying to address market issues in terms of selling of sugar produced in the country. Venturing into bioethanol would be able to address some of the marketing issues and facilitate the off-take of sugar. g. The bioethanol project may result in some of the farmers particularly those that have left sugarcane to revert in the plant of crop for biofuel purposes. h. Fiji would be able to show political leadership in the country through the wholesaling of biofuel to countries in the region.	

Outlined below is the actual separation of every "weakness" and "threat" that had been identified in the SWOT construct and also how it is intended to be managed under the project.

NO.	S.W.O.T Weakness/ Threat	Activity to address Weakness/Threat as identified from the SWOT
1.	The current growth in the market of coconut oil that may rule it out as a feedstock for biofuel use in Fiji.	There is a need to also consider a number of feedstocks (such as the planting of jatropha)to ensure that the effort is not affected when such situations arise.
2.	Feedstock production will require large tracks of land and could compete with agricultural production.	Assigned dedicated areas for agriculture and biofuel/renewable fuels.
3.	Biofuels have lesser energy content and users will see increase in the quantity of fuel that they use.	The pricing structure to be set up that takes into account the energy content, but maintaining competitiveness of the biofuel.
4.	The restrictions in terms of warranties from vehicle manufacturers.	A clear categorisation of the vehicles (year of make) and the application of different blends. In the process ensuring that recommended blend levels for the different vehicles are adhered.
5.	Although the feedstocks are known to be readily available, in reality this may not be the case. (effects of Tropical Cyclone Winston)	There is a need to also consider a number of feedstocks (such as the planting of jatropha)to ensure that the effort is not affected when such situations (natural disasters) arise.

NO.	S.W.O.T Weakness/ Threat	Activity to address Weakness/Threat as identified from the SWOT
6.	Feedstock production also depends on extreme weather conditions and pest attacks.	Appropriate protocols are put in place that monitor pest attacks. Clear documentation and control methods put in place by Biosecurity Authority of Fiji. The need to put in place a committee to monitor these developments.
7.	The need to put in place a mandate to ensure that the take up of biofuels in vigorously pursued.	There is a greater need to work closely with Trade Standards Ministry and the Government.
8.	At the Biofuel Maritime Mills, renewable diesel produced currently uses coconut as the feedstock. However, with the growing potential in terms of coconut water and other coconut products it will bring about competition and affect the selling price of the fuel.	There is a need for more research to establish the different feedstocks that can be adopted in Fiji.
9.	The potential for opposition from global oil companies in the country (Total, Mobil and Pacific Energy), particularly with respect to the technical changes in terms of their bowsers in the country.	The effort to migrate or transform the motor vehicle industry to take up biofuels will need active participation of all parties involved in the fuel and motor vehicle industry. With continuous communication it would allay fears of the unknown and allow problems to continually be resolved by all parties.

e. The Market

i. Target Market

Initially the target market will be for individuals and businesses that have diesel fleets in terms of transportation. Over time with the onset of bioethanol blends the use of biofuels will hopefully become prevalent in the country's transport sector. In addition other potential areas include; power generation and individual generators.

ii. Marketing Strategy

There are a number of plans in place in terms of entering the market. To start with, it is intended that the fuel is to retail at the local bowsers together with straight diesel, unleaded petroleum and other fuels. This would make it easier for car owners to try the fuel out as opposed to travelling some distance away to use the fuel. The volume involved or mix will be very less. The blending itself will begin at very low volumes (say 0.5 – 2% renewable content). The low blend levels are intended to facilitate the objective for maximum reach for all customers. However, those wishing to take up higher volumes, will need to go to the location where the Biofuel Unit will be having it bowsers

and accepting or receiving coconut oil from the islands. At the same time being mindful of the targeted 20% blend levels it is anticipated that the mix will be increasing over time at the bowsers and again this will depend on supply. Over time, it is intended with supply sufficiency the use of straight diesel will totally be replaced by biodiesel or renewable diesel.

In terms of attracting customers, it is intended the plan will mobilize various types / mediums of advertisements where messages such as; saving the environment or doing something good for the environment will be coupled with the main message of using biofuels.

iii. Market Research

In terms of market research it is obvious that in order for the new fuel to be used widely throughout the country it would require a compulsory mandate from relevant authorities. For a compulsory mandate there is a need for sufficient supply of processed feedstock in terms of coconut oil or other vegetable oils.

The Ministry of Commerce and Trade has outlined that biofuel blends can be used in the country. Unfortunately, the standard on its own is still voluntary and it encourages its sparing use by motor traders in the country. Therefore to move forward the Ministry of Commerce and Trade need to mandate the use of biofuels including renewable diesel and bioethanol in Fiji.

iv. Market Targets

The overall fuel market in the country is roughly around 600 million liters of petroleum products on a yearly basis. Going back to the 2009 figures that was earlier quoted in the Demand and Supply Data Report (as part of this consultancy), where the Biofuel Unit had earlier embarked on its own to determine the amount of fuel used in the country.

The results obtained included the following:

Total Volume of Diesel and Unleaded Petrol Used in Fiji in 2008

(Source : Oil Companies – Biofuel Unit Study)

OIL TYPE	TOTAL USED (litres)
Diesel	514,889,074
Motor Spirits	84,171,296
Jet Fuel	233,905,779

These figures show that if import substitution were to take place at the proposed blending levels of 5% for diesel and 10% for unleaded petrol the country has the potential to save more than $46 million at the May 2009 bowser prices.

Potential amount to be saved from imported fossil fuels if they are blended at certain percentages

Fuel Type	2007 National Consumption (litres)	Potential maximum Volume saved at 5% and 10% biofuel blending levels	Fossil fuels unit costs per litre	Value of Fossil Fuels Replaced
Diesel	514,889,074	25,744,453.70	1.27	**$32,695,456.20**
Motor Spirits	84,171,296	8,417,129.60	1.63	**$13,719,921.25**
TOTAL FOREIGN EXCHANGE SAVED				**$46,415,377.45**

f. Environmental/Industry Analysis

Generally population growth in Fiji has been on an increasing trend over the years. Even though there have not been marked increases, population growth have been rather steady. In addition the market in Fiji is a new market and the approach is to first pick-off those "environment enthusiast" and this is also in line with the position Fiji has taken globally with respect to climate change and reducing Green House Gas emissions. And as mentioned above the group using the fuel can first begin with Government vehicles as a way of promoting its use.

However, in reality all motorist or motor vehicle owners in the country is a customer or virtually part of the market. Therefore over time the use of the fuel needs to be made mandatory through the removal of options at the bowser.

Outlined below is the number in terms of registered vehicle in Fiji on an annual basis.

DISTRIBUTION OF VEHICLES REGISTERED IN FIJI ANNUALLY									
[AS AT 31ST DECEMBER]									
Period Yearly	**Private Car**	**Taxis**	**Rental And Hire Cars**	**Goods* Vehicles**	**Buses*** **	**Government Vehicles**	**Carriers**	**All Other Vehicles ****	**Total**
2001	37,546	4,027	949	15,980	1,277	171	n/a	121	**60,071**

DISTRIBUTION OF VEHICLES REGISTERED IN FIJI ANNUALLY									
[AS AT 31ST DECEMBER]									
Period Yearly	**Private Car**	**Taxis**	**Rental And Hire Cars**	**Goods* Vehicles**	**Buses*** **	**Government Vehicles**	**Carriers**	**All Other Vehicles ** **	**Total**
2002	40,938	4,196	1,027	16,688	1,339	343	n/a	212	**64,743**
2003	45,012	4,653	1,177	16,710	1,417	519	12	230	**69,730**
2004	48,607	5,029	1,424	17,783	1,468	737	55	281	**75,384**
2005	51,233	5,154	1,678	17,833	1,511	905	77	362	**78,753**
2006	53,565	5,463	1,958	18,569	1,607	1,098	87	407	**82,754**
2007	53,515	5,390	1,912	18,262	1,635	1,143	74	420	**82,351**
2008	54,167	5,137	1,873	18,375	1,567	1,156	67	414	**82,756**
2009	53,023	5,427	1,862	16,879	1,595	1,223	106	407	**80,522**
2010	53,819	5,687	1,949	16,757	1,763	1,335	222	394	**81,926**
2011	53,714	5,974	2,126	17,072	1,839	1,403	273	380	**82,781**
2012	54,919	6,079	2,096	16,646	1,890	1,313	302	410	**83,655**
2013	59,415	6,459	2,178	17,077	1,971	1,327	335	428	**89,190**
2014[p]	64,988	6,572	2,436	17,616	2,034	1,508	346	440	**95,940**
Notes					*Light and heavy goods vehicles including vans, trucks, pick-ups, ambulances and fire engines.*				
**					*Includes vehicles registered for driving schools and diplomatic purposes.*				
***					*Minibuses are included with the Buses.*				
Source:					*Land Transport Authority*				

Figure 5 : Outlines the table in terms of the No. of Vehicles registered in Fiji from 2001 – 2014.

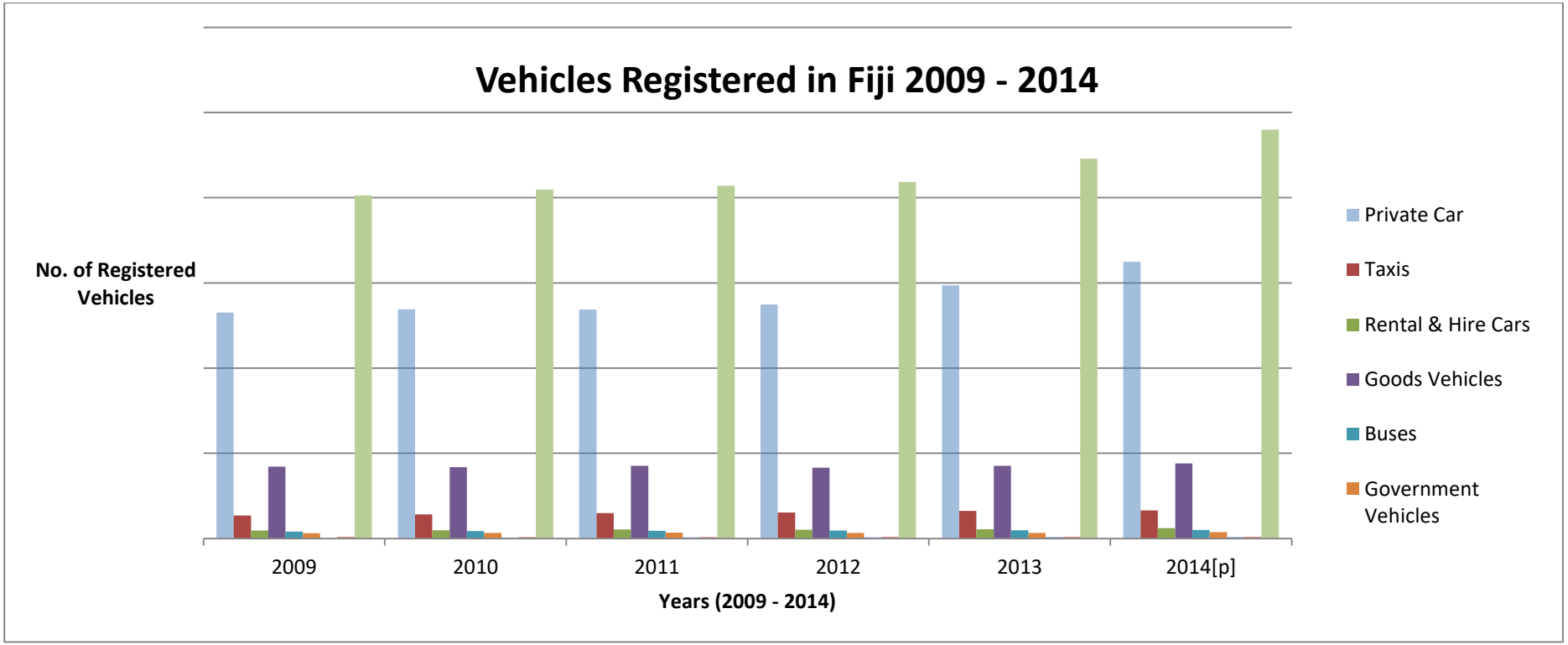


Figure 6 : Shows the Graph on the types and volume of vehicles registered in Fiji from 2009 – 2014 (Source Fiji Bureau of Statistics).

In considering the number of vehicles registered in Fiji from 2009 – 2014 it shows an increasing trend and the situation has been the case from 2001. In addition for the last three years the quantum of increase has been much bigger in view of the number of new vehicles on the road and the incentives (subsidies) that have been provided to new vehicle and bus owners for the past two years. With the increasing trend the market will continue to expand in terms of customers using biofuels and renewable diesel.

Furthermore, in terms of "environment and industry analysis" there is a need to also delve on the current and future of fossil fuels as this will determine the future of renewable and biofuels. Numerous literatures and research have already predicted that we are currently at the time of "peak oil". According to Wikipedia, "Peak oil" is an event based on M. King Hubbert's theory that it is the point in time when the maximum rate of extraction of petroleum is reached after which it is expected to enter terminal decline. The theory is based on the fact that global oil reserves is finite and tends to follow a bell shaped curve. In addition as the graph in figure 8 below depicts that we are currently at that point in time (peak oil) or we are into post peak oil.

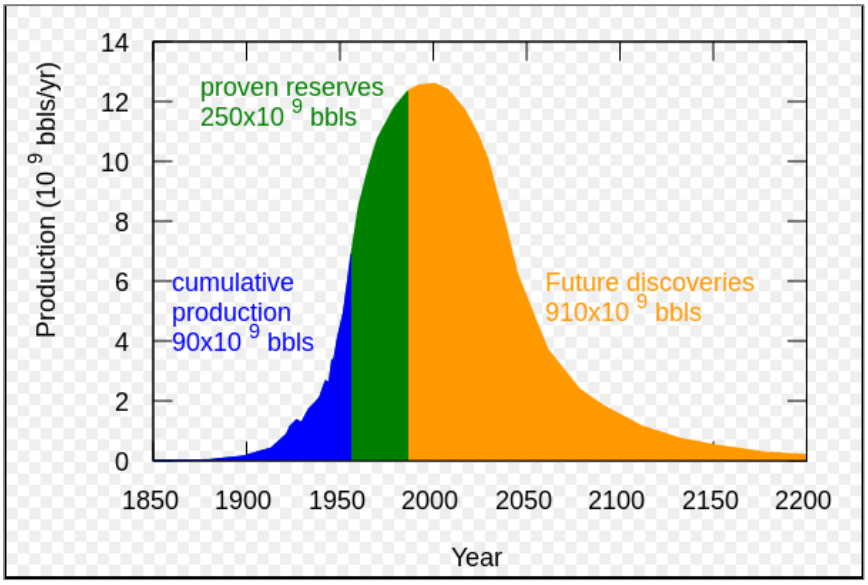


Figure 7 : A 1956 world oil production distribution, showing historical data and future production, proposed by M. King Hubbert – it has a peak of 12.5 billion barrels per year in about the year 2000 – adapted from https://en.wikipedia.org/wiki/Peak oil

Notwithstanding the above, as stated earlier on, there is also the global struggle on Green House Gases (GHG) and its implication on climate change and sea level rise that have led countries to go for emission reduction targets to avoid a catastrophe (implications of sea level rise and climate change or increase in temperatures). With the role fossil fuel plays in terms of the above issues there is a general tendency to reduce the use of fossil fuels and look for other alternatives include renewable and biofuels.

With regards to fossil fuels and the prices of fuel oil, history has it that it has been known to set unprecedented increases in the past viz a viz in the early 70's and recently in 2008. These increases have often affected economies and ushered in major repercussions for

business. Hence having renewable or biofuels would be able to slightly douse these effects.

Meanwhile the price for Brent Crude oil (depicted in deep blue on the graph below) which is normally the fuel imported into the country, the current prices in December 2016 was less than a dollar per barrel and the prices at the bowsers in Fiji $1.72. However, increases have been forecasted in the third and fourth quarter of 2017.

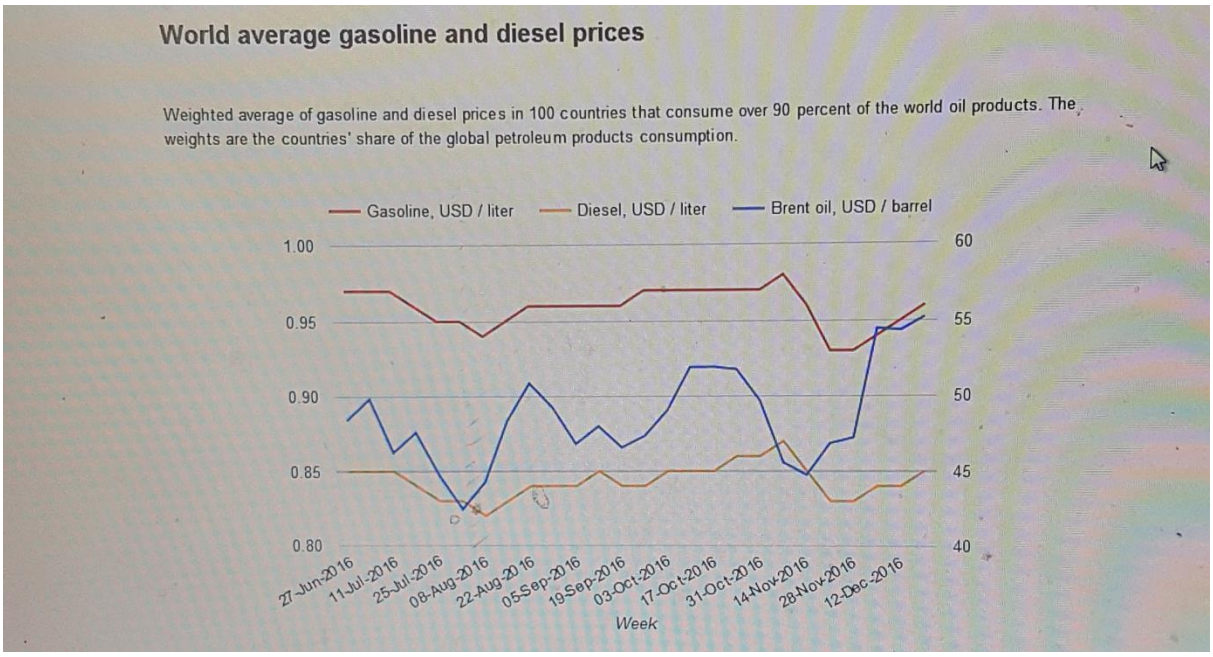


Figure 8 : Current World Market Prices for Fuel : www.gobalpetrolprices.com

As indicated on the forecasted figures below, the price of fuel in general is expected to rise or increase in 2017. The price increase is expected to reach US 1.07 and with the current exchange rate this is about $2.14 at the local bowsers.

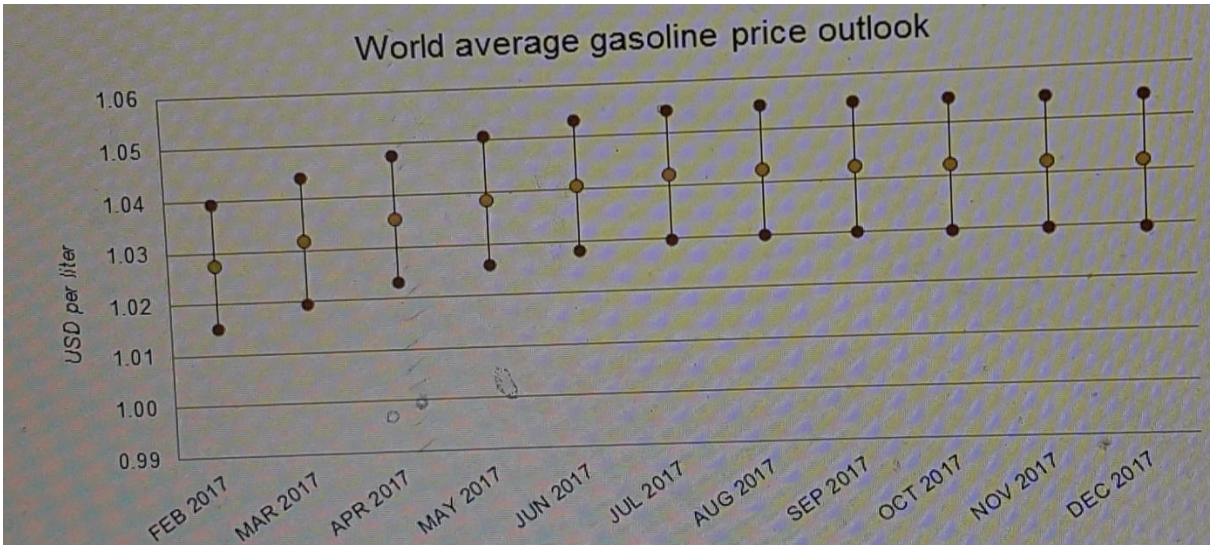


Figure 9: Forecast World Average Gasoline Price – www.globalpetrolprices.com

g. Customers / Clients

This particular section intends to discuss the target customers and their behavior particularly with respect to the environment, their values spending features, lifestyle, interests or opinions.

i. Customer Demographics

In terms of customer demographics the first important characteristic for customers that needs to be targeted is the youth population in Fiji. According to the Mundi Index, Fiji's literacy rate in 2003 was around 94%. This shows that there is a great deal of understanding on the part of customer with respect to the initiatives that are being pursued and more importantly in the promotion of environment issues such as sea level rise and climate change. The biofuel initiative is an important one and does sit very well in terms of the environment agenda in Fiji. Secondly, in terms of the spending levels, this can be gathered from the employment or unemployment levels. Outlined below is a graph on the youth unemployment level in Fiji (source World Bank).

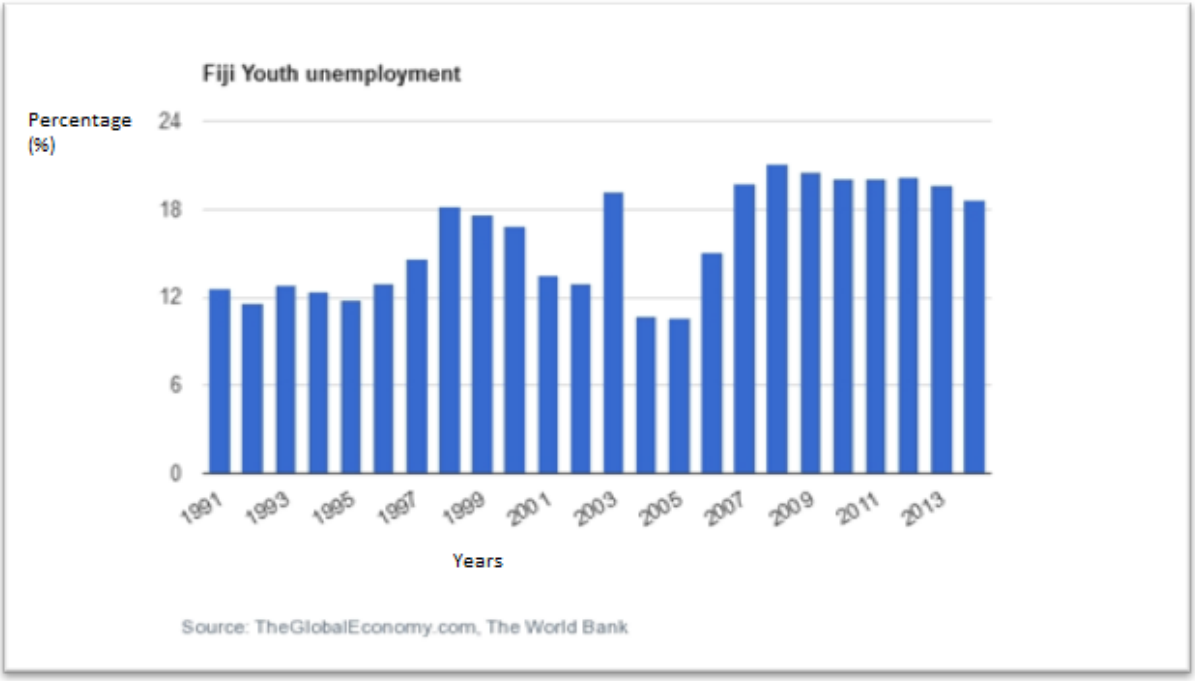
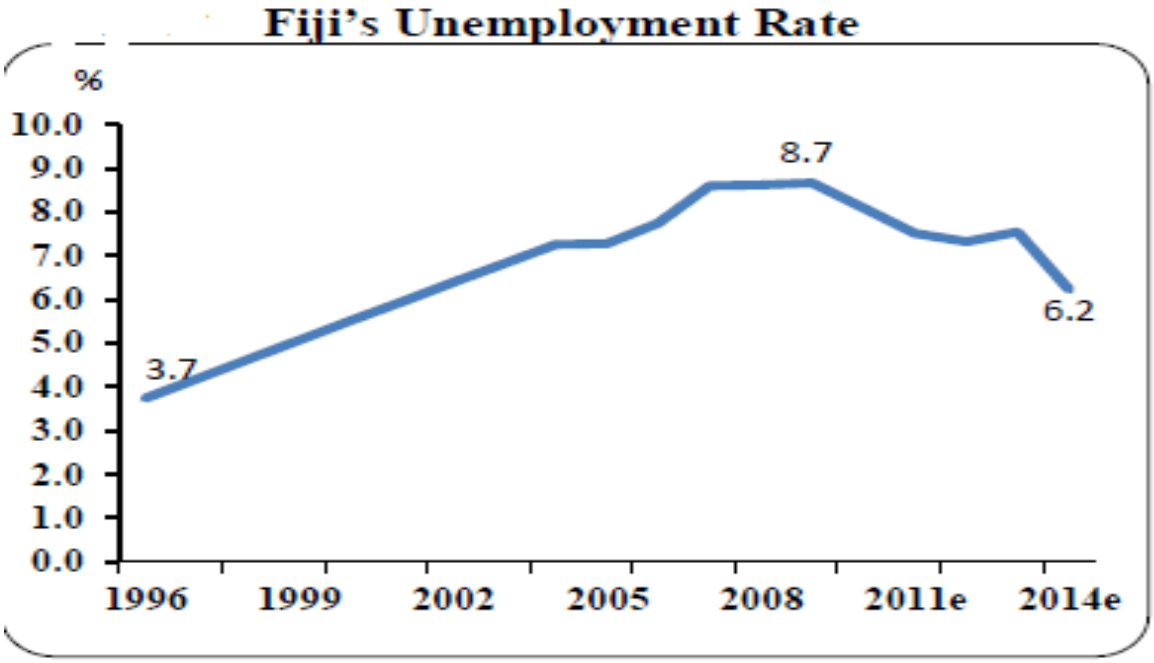


Figure 10 : Shows the level of Youth Unemployment in Fiji from 1991 – 2013 – Source World Bank

As depicted on the above World Bank graph, the average youth unemployment rate in Fiji during that period was 15.98 percent with a *minimum of 10.6 percent in 2005* and a *maximum of 21.1 percent in 2008*. Youth unemployment is basically the percent of 15-24 year olds who are part of the labor force but are unemployed. The labor force includes the employed and the unemployed people.

On the same token Fiji's Unemployment Rate in 2014 was around 6.2% indicating that there was still a high level of population with sufficient disposable incomes which had resulted in people purchasing a vehicle during that time (2013 – 2016).



Sources: Fiji Bureau of Statistics (FBOS)
Note: FBOS estimates for 2010 - 2014

Figure 11 : Fiji's Unemployment Rate -1996 – 2014.

In addition with the favourable tax regimes applicable to owning a car there was also incentives for bus operators on the purchase of new buses and in addition to a 2 cents per liter of fuel refund for bus operators. With the increase in the number of vehicles and the overall awareness of people there would be more people using renewable fuels in their vehicles. This is despite the fact that there has also been an increase in hybrid and gas vehicles during the same time.

ii. Key Customers

During the commencement of the blending process, there will be a need to continually entice vehicle owners on the use of the fuels (biofuel blends). There the need to have continual advertisements on the use of biofuels is very important. However, once a mandate is put in place (having a percentage of renewables or green component – biodiesel or renewable diesel) is part of the fuel all customers would be expected to use this fuel.

However, the key customers would be those who wish to use higher blends of green fuel than those that are provided at the bowsers. These would also involve those companies that have transport fleets and interested individuals. For these customers, there is a need to ensure that they are continually furnished with research information and other

developments taking place around the world for these type of fuels. In addition with the fact that the fuels will NOT be the similar to those traded at the bowsers (higher blends or renewable component), these fuels will be delivered specifically to the customer's premises and in addition the fuels will be coupled with the technology that will ease the dispensing of the product directly to the company's fleet. Experiences with these customers need to be continually documented and safeguarded as it would provide vital information (marketing and technical) in terms of blend increases for the overall Fiji market in future.

iii. Customer Management

In terms of maintaining good relationships with our customers as mentioned earlier there is a need to ensure that that there is appointed personnel that deal specifically deal with orders from these special customers (including the documentation and safeguarding of information or experiences of the companies). In addition as part of this process the types of blends that they are interested in will be strictly adhered to in terms of their orders.

h. Competition / Competitors

With respect to competitors, it will be mostly those that produce renewable fuels in Fiji. The advantage here will belong to local companies that will be able to react fast enough in terms of production of renewable or other forms of biofuels in country. The market is quite large enough to accommodate several companies and these will be the competitors in the industry. The desire here is to let the private sector take the lead. For example for coconuts and coconut oil with the presence of substitutes (jatropha, palm oil , pongamia etc.), the coconut oil mill can be allowed to focus on the food market and be hived off to Copra Millers Fiji Ltd,. depending on the state of the market at that point in time.

Notwithstanding the above, the fact that there is very little area of competition (competitive advantage), the business will try and improve on the quality of renewables or biofuels produced and customer satisfaction will drive the industry in future.

i. Pricing Strategy

The pricing strategy is an important area for the business as it will determine the overall viability in the industry. For Fiji the current prices for petroleum is determined through the Price Incomes Board of the Ministry of Trade and Commerce which also has the mandate to determine the price for renewable and biofuels. However, with respect to these fuels there are important considerations that need to be taken into account and particularly for using coconut oil as a feedstock at this point in time (when the market for coconut oil is at a high). These issues to name a few include;

a. The prevailing market price for coconut oil;
b. The prevailing price for diesel and
c. The energy content of the fuel.

The considerations of the above issues is important such that the issue of true value of coconut oil (as a feedstock) and the price of diesel fuel in the market does not cause a situation that may annihilate the very intention of setting up a biofuel or renewables market. With the above, the issue in terms of putting in place a subsidy may be an option, however it is also important to also consider the current prevailing price of petroleum.

6.0 RECOMMENDATIONS FOR THE BIOFUEL INDUSTRY IN FIJI

With the above commentary there are a number of significant recommendations that are relevant with respect to moving the industry forward and more particularly looking at bringing about overall sustainability of the maritime mills. The issues are quite significant with respect to the survival of the industry and the need to move forward with the biofuel industry. The issues include;

a. With respect to coconuts and coconut oil there is a need to improve the fuels and focus on the overall process through bring in the hydrogenation process to fully complete the production or processing of renewable diesel;

b. With respect to the effects of Tropical Cyclone Winston there is a need to focus on the plans and initiatives that have been put in place by Government for the industry particular on having nurseries and replanting initiatives to rehabilitate the industry;

c. With respect to the maritime biofuel mills, the importance of working closely with ship owners is fundamental to the success of the industry in Fiji;

d. There is a feeling of ambivalence with respect to the current market developments now happening with the coconut industry. More specifically whether there is need for continued focus on the biofuel industry or transition to the food and cosmetics. The latter certainly ushers in a lot of promise for coconut and coconut oil industry and particularly for the farmers in the maritime region;

e. With the above there is a need to now consider an alternative feedstock and work needs to commence immediately in this regard;

f. The important technical issues that affect "storage and handling" of biofuels are an essential component that needs to be addressed with respect to transportation and storage and;

g. The need to continually update the biofuel marketing plan in view of the changes happening to it such as considering a new feedstock including the review of its supply chain.

In terms of consideration for implementation of these recommendations it is important that a committee is set up to examine issues that have been presented as part of this report. The committee is to make decisions in terms of whether to focus on coconut oil or foster diversification and above all map the way forward for the biofuel industry in Fiji.

7.0 CONCLUSION

The establishment of the Maritime Biofuel Mills is another effort in terms of introducing and producing biofuels in Fiji. Unfortunately, the initiative has been largely affected by mismanagement of appointed mill management. The Government through the Ministry of Infrastructure is now contemplating to divest the operations of the mill to Copra Millers Fiji Ltd. It is not known whether the latter wishes to continue with producing Renewable Diesel or fully venture into the lucrative coconut market. However, it is important to note the country needs to commence producing biofuel for many reasons including leadership in its Global Climate Change Campaign.

The marketing plan has revealed that there is a lot of promise for biofuel / renewable fuels in Fiji. The benefit does provide snapshot that there is a bright future a head. Therefore the need to commence immediately such a venture will be beneficial to the country and the region in the long run.

REFERENCES

1. http://www.afdc.energy.gov/fuels/emerging_green.html

2. www.business.gov.au, "Marketing Plan"

3. www.dieselforum.org, "Renewable Diesel Fuels"

4. Bola, Amelia, 2013, Potential for Sustainable Sea Transport : A Case Study of the Southern Lomaiviti, Fiji Islands, Submitted to the Shipping in Changing Climates: provisioning the future", University of the South Pacific, Laucala Campus, Private Mail Bag, Suva, Fiji Islands.

5. Coordinating Research Council, 2014, Report 66, Diesel Fuel Storage and Handling Guide, CRC, 5755 North Point Parkway, Suite 265, Alpharetta, GA 30022.

6. Dufey. A, 2006, Biofuels production, trade and sustainable development: emerging issues, International Institute for Environment and Development, London.

7. http://en.wikipedia.org/wiki/Peak_oil

8. Fiji Bureau of Statistics, 2015, Unemployment Estimates 2010 – 2014, Government of Fiji.

9. Fiji Bureau of Statistics, 2015, Registered Vehicles in Fiji : 2009 – 2014, Government of Fiji.

10. http://www.globalpetrolprices.com/

11. Neste Corporation, 2016, Neste Renewable Diesel Handbook, Neste Proprietary Publication – www.neste.com.

@@@@@@@@@@@@@@@@@@@@@@ END @@@@@@@@@@@@@@@@@@@@@@