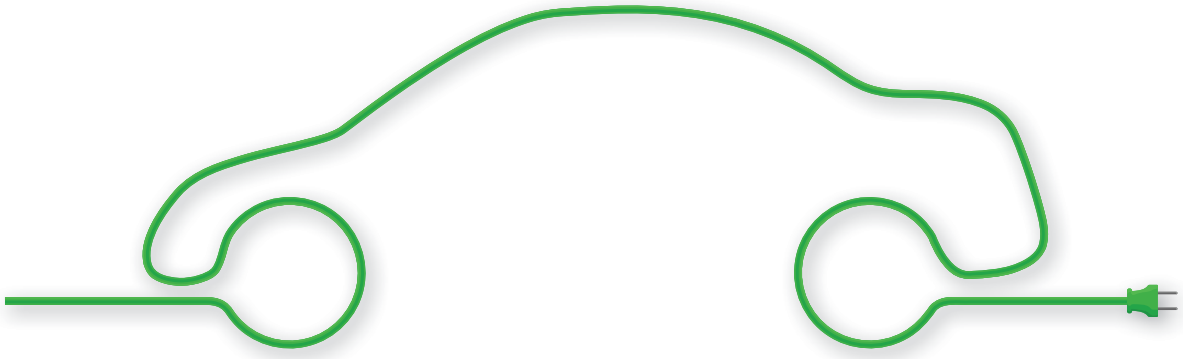
Electromobility in Pacific Island Countries

DRAFT

15 May 2017

Gerhard H. Zieroth



Contents

Abbreviations and Acronyms iii

1. Introduction 5

2. Overview Pacific Island Countries 6

2.1 General Characteristics 6

The Three Pacific Sub-Regions 7

Economic Conditions 7

History and Political Landscape 7

PIC Vulnerability and Climate Change 8

Critical Infrastructure Issues 8

2.2 The Energy Sector in PIC 9

3. Case Studies Fiji and Solomon Islands 11

3.1 Available Technology 11

3.2 Summary of Characteristics of Case Study Countries 12

3.3 Fiji 12

Energy and Electricity Supply 12

Transport Infrastructure 13

Enabling Framework for EV 15

3.4 Solomon Islands 16

Energy and Electricity Supply 16

The Honiara Power System 18

Transport Infrastructure 18

Enabling Framework for EV 19

3.5 Analysis 20

4. The Way Forward 23

4.1 Status of Electromobility in PIC 23

4.2 Barriers to the Introduction of EV 23

Financial Barriers 23

Weak Power Systems 24

Lack of Charging Infrastructure 24

4.3 Determining Urban Development Policy Priorities 25

4.4 Stakeholders 25

4.5 Market Segments for EVs in PIC 26

Government Fleets 27

NGO and Development Partners 27

Public Transport: Buses 28
Public Transport: Taxi 28
Medium and long term Options 29
Bibliography 30
Annex 1: FEA Tariff 31
Annex 2: SIEA Tariff 32
Annex 3: Map Solomon Islands 33
Annex 4: Map Fiji Islands 34
Annex 5 Levelised Transport Cost 35

Abbreviations and Acronyms

AC	Alternate Current
ADO	Automotive diesel oil
Ah	Ampere hours
BMS	Battery Management System
CPI	Consumer Price Index
DSM	Demand-side management
DC	Direct Current
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EU	European Union
EV	Electric Vehicle
FIRR	Financial Internal Rate of Return
FOB	Freight On Board
GIS	Geographical Information Systems
GoF	Government of Fiji
GoSI	Government of Solomon Islands
IC	Internal Combustion Vehicle (diesel or petrol powered)
IEC	International Electrotechnical Commission
IRR	Internal Rate of Return
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
kV	Kilo Volts (thousands of volts)
kW	Kilowatt
kWh	Kilowatt Hour
kWp	Kilowatt Hour peak for PV panels under standard conditions
LRAEC	Long Run Average Electricity Cost
MPPT	Maximum Power Point Tracking
MJ	Megajoule
MWh	Megawatt hour (1000 kWh)
MoU	Memorandum of Understanding
NPV	Net Present Value
O&M	Operation and Maintenance
OPEC	Organization of the Petroleum Exporting Countries
PIC	Pacific Island Country
PPA	Pacific Power Association
PNG	Papua New Guinea

RMI	Republic of Marshall Islands
SME	Small and Medium Scale Enterprise
SPC/SOPAC	Pacific Community / Pacific Islands Applied Geoscience Commission
ToR	Terms of Reference
TCO	Total Cost of Ownership
TRHP	Tina River Hydro Project (Honiara, Solomon Islands)
UNDP	United Nations Development Programme
Wh	Watt hours

All currency in the report is € unless indicated otherwise.

Exchange rate Fiji $ against €: 0.45, Solomon Island $ against €: 0.12

1. Introduction

Worldwide, transportation of people and goods produces approximately 23 percent of the global CO_2 emissions from fuel combustion. Transportation is also the fastest growing consumer of fossil fuels and the fastest growing source of CO_2 emissions. With rapid urbanization in developing countries - including the Pacific Island Countries - energy consumption, CO_2 emissions and local air pollution by urban transport are increasing quickly.

Within the last 15 years, the emergence of four complementary developments has been driving the trend towards electromobility. The first development is the emergence of global climate change policies that propose significant reduction in CO_2 emissions. Rising concerns of economic and security issues related to oil are the second driver, particularly in countries with high shares of imported oil in their energy balances.

In this regard, most Pacific Island Countries (PIC) stand out as their economies rely to almost 100% on imported fuels. A third driver for vehicle electrification is the increase in urban congestion, which is creating significant air quality issues. The fourth trend—rapid technology advancement—has resulted in battery and drive train technology innovations to a point, where electric vehicles are now becoming feasible in market applications where governments have set favorable regulatory regimes and provide incentives for buyers of electric vehicles.

The electric vehicle (EV) is one of the new technologies that have attracted attention in both developed and developing countries as one of the key green low-carbon urban mobility options. Although EV technology and market penetration are developing rapidly, EVs are still in an emerging stage. The technical, financial, and economic viability of EVs largely depends on different regulatory and economic environments in which the technology is being introduced.

A successful introduction of the new technology in PIC will also depend on an integrated approach, which establishes links between economic conditions, urban development, transport, energy, environment, and climate change in an overall framework of the EV initiative. The present study tries to address several issues that form an integral part of EV introduction in PIC, from technological issues and stakeholder analysis to public awareness economic, financial, and fiscal implications.

Electromobility is an emerging sub-sector that is gaining more interest among policy makers and practitioners in other developing countries. It is expected that the present study will be a first step towards developing policy options for PIC that will assist governments to make sound decisions to promote investments in electromobility.

The automotive industry has adopted electrification as a pillar of future drive train technology with a penetration rate that the International Energy Agency (IEA) has projected to reach 6 miilion units by 2020 or 5 % of total car sales. This penetration rate is generally indicative of a pilot stage technology prior to widespread adoption once costs decrease and availability improves. The question is, whether the particular sectoral and structural characteristics of PIC warrant pursuing the technology in individual vehicle markets (cars, scooters) or in the provision of public transport services (buses, mini busses and taxis).

It is clear that small island countries such as PIC show a completely different context for EV development compared to leading Western and Asian markets. In these markets consumers buy EVs as a second or third vehicle used to travel shorter distances. In developing economies like the PIC, the development of the transport sector is at a different stage characterized by high cost of vehicles in general due to high vehicle tax rates, limited road networks and inadequate public urban transport systems. Providing access to safe, dependable, effective, and inexpensive transport services for remains a key challenge in PIC.

Successful electromobility programs for PIC must focus on target groups, as different segments of a country's transport service market may not be similarly suited for a switch to EVs. For example, only few PIC have current electricity tariffs that would allow operating EVs in a financially sound manner. This report essentially aims to answer the question related to constraints and opportunities for electromobility in order to guide future discussions of EV priorities in PIC.

2. Overview Pacific Island Countries

2.1 General Characteristics

The 14 Pacific Island Counties (PIC) are characterised by their very small sizes and their physical isolation. As shown in Table 1, the countries range in size from about 26 km^2 of land (Tuvalu) to nearly 463,000 km^2 (Papua New Guinea), most having between several hundred and several thousand km^2. The populations range from 1,500 people (Niue) to over 7 million (PNG). In general, the PIC economies are heavily dependent on development assistance, tourism, receipts from citizens living abroad, agriculture, and services – particularly government services. As small markets far from suppliers, PICs face high import prices for petroleum fuels and high energy costs in general. They also tend to receive low prices for exports, which are expensive to ship in small vessels to far-off markets.

Figure 1: Map of PIC



Table 1: Key Characteristics PIC

	Population	GDP €/Cap	Land Area km2
Cook Islands	16,000	9,500	240
Fiji	850,000	4,920	18,333
FSM	103,600	3,100	701
Kiribati	99,000	1,600	811
Nauru	9,800	5,632	21
Niue	1,500	12,631	259
Palau	20,300	8,055	488
PNG	7,400,000	3,450	462,243
RMI	62,000	2,600	181
Samoa	185,000	4,200	2,935
Solomon Islands	640,000	1,900	28,370
Tonga	103,977	4,400	748
Tuvalu	11,093	3,880	26
Vanuatu	235,000	3,100	234,023

Sources: SPC, ADB, Population Estimates Prism

Of all the PIC, PNG stands out in terms of scale, diversity and urbanization. PNG is the most populated and largest landmass, containing some 70% of the Pacific population. With the exception of PNG, all other Pacific economies have national populations of less than a million, with some having fewer than 100,000 persons (Table 1).

The Three Pacific Sub-Regions

The PIC are divided in three sub-regions. Melanesia includes the larger Pacific economies of the southwest Pacific located to the north and east of Australia's eastern seaboard. Pacific economies included are Fiji, New Caledonia, PNG, Solomon Islands, and Vanuatu, as well as the indigenous peoples of the Indonesian provinces of Papua and West Papua. Melanesian countries consist of large, mostly volcanic islands with hydropower resources, low electrification rates and limited road networks. Melanesia is richly endowed with natural resources, including minerals, timber, fish, natural gas and oil.

Micronesia includes more than 2,000 atolls, islands, and reefs in the Western Pacific to the east and northeast of Melanesia. Micronesia is characterized by low islands and atolls with harsh climates, and includes Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, and Palau. Although some Micronesian countries enjoy very high rainfall (Up to 1000 mm for locations in FSM), catchment areas are too small to generate significant hydropower.

Polynesia comprises the central and southern Pacific economies, and includes the Cook Islands, Samoa, Tonga, and Tuvalu. Resource endowment in Polynesia is low; the economies are dependent on remittances, tourism and foreign aid. Only Samoa has significant hydro resources.

Economic Conditions

The constraints to development faced by PICs are well known and have been discussed in numerous studies. They include small, highly dispersed land areas and populations; distances far from world markets; narrow resource bases and primary production options, and vulnerability to natural disasters such as tropical cyclones, droughts and climate change, the last two to being especially problematic for the atoll countries Kiribati, Tuvalu and RMI. In the smallest, most resource-poor PICs, a sustainable future with an improved quality of life for a growing population will be difficult to achieve.

Constraints to economic growth include very limited human resources available to public and private sector organisations. Combined with cultures that emphasise communal sharing of resources as a safety net strategy, these reduce incentives for individual entrepreneurship, labour, and wealth accumulation. Significant numbers of the best educated, most skilled, and most motivated Pacific islanders have emigrated and continue to emigrate to the USA, New Zealand and Australia.

Some PICs encourage this brain drain as it increases remittances, thereby supporting the domestic economy, at least in the short term. However, emigration can also result in a downward spiral in local skills and capacity. The governments of most PICs have developed and adopted national development plans – influenced and often supported financially by donor agencies – that emphasise more rapid economic growth, equitable distribution of the benefits of growth, increased emphasis on the private sector as an engine of growth, and the recent recognition of poverty and gender equality as genuine problems which need to be addressed.

History and Political Landscape

European explorers including the Spanish, Dutch, French, British, and Germans, and later the Americans, ventured to the Pacific islands between the 16th and 19t^{h} centuries and claimed discovery of the islands they found. Spanish explorer Álvaro de Mandaña de Neira, was the first European visitor in Solomon Islands on a voyage from Peru in 1568, Portuguese explorer Pedro Fernándes de Quirós was the first European visitor in Vanuatu in 1606, Dutchman Abel Tasman was the first European visitor in the Fiji archipelago in 1643, and officers of the British Navy were the first European visitors in Kiribati during the period 1764 –1824. With the exception of Tonga, which has never been a colony, the other PIC were brought under colonial rule which ended for most PIC in the

60ies. However, France still controls a vast EEZ area of the Pacific surrounding its territories French Polynesia and New Caledonia.

Although political systems differ within the region, most PICs have adopted a Westminster form of parliamentary democracy with voters electing members of Parliament (or equivalent) with the head of government then chosen by Parliament. The former Trust Territories in the north Pacific have adopted a form of the US system with direct elections of the President whereas Tonga is a Kingdom. There have been military and civilian coups (Fiji), civil war (Solomon Islands) and political instability (Papua New Guinea).

PIC Vulnerability and Climate Change

Low-lying atolls in Micronesia and the dispersed islands of Melanesia and Polynesia are subject to the effects of climate change, sea level rise, and extreme weather events (cyclones). These occurrences threaten infrastructure assets such as roads and power systems, livelihoods, and precious sources of limited water and land supplies in atolls. Recent examples are the flooding and asset damage from cyclones that lashed Honiara and the northwestern coast of Guadalcanal Island in April 2014, and in Port Vila and wider Vanuatu in March 2015. These events were causing deaths and washing away town bridges, roads, and squatter housing. Similar devastation was caused throughout the islands of Fiji by cyclone Winston in February 2016. The majority of Pacific economies have been classified as "extremely vulnerable" to climate change and most are in the top tier of the world's most vulnerable nations.

PIC are highly vulnerable not only to natural hazards and disasters, but to economic shocks such as the global financial crisis. They have not been able to successfully manage such vulnerabilities and their consequences in existing fragile settings. Weak economic performance of Pacific economies combined with generally poor management approaches have resulted in two main crosscutting themes characterizing urban growth in the new millennium: (i) growing poverty, and (ii) the rise of squatter and informal settlements in Pacific towns and cities. Limited income opportunities in remote "outer" islands are a main driver of internal rural – urban migration in PIC. Many unplanned and informal settlements taking the form of village-like settlements or urban villages, have established kin-based social and organizational structures and systems that underpin their operation and management. Poverty and the expansion of these urban sprawls are strongly connected, as it is the growth of such settlements that allows settlers to generate income and cope with poverty (ADB 2016).

Critical Infrastructure Issues

The development of physical and social infrastructure varies considerably amongst PIC. All countries share a large dependence on external transport (shipping, air) to supply goods, export products and move people. For multi-island countries with smaller and dispersed populations such as Fiji, Kiribati, Marshal Islands, Cook Islands, Tonga, Solomon Islands and Vanuatu, inter-island shipping is often the most critical infrastructure service. Even transport within individual islands is often by small boat and on foot as road networks are either non-existent, very limited or in poor conditions. This is more prominent in the Melanesian countries.

Urban centres in the larger countries (especially Fiji, PNG and Solomon Islands) have started to experience significant road infrastructure problems. Rapid growth of individual vehicle[1] ownership and lack of efficient public transport are creating traffic grid-lock during peak hours. Local air quality in the capital cities of these countries has deteriorated as a consequence.

A specific type of informal urbanisation that can be observed in the larger Melanesian countries limits transport infrastructure development in PIC. The future of the Pacific islands will be increasingly determined by continued patterns of urbanization; especially the ongoing growth of what the ADB has labelled urban village types. As the rate of urbanization accelerated in the post independence PIC,

[1] In Fiji, the growth rate for registered vehicles over the last ten years was approx. 5-6 % p.a.

new village-like settlement forms such as informal and squatter settlements became a more visible feature of Pacific towns and cities. These settlements began outstripping the planned development in both number and population size. The ADB estimates that in 2015 more than one million urban residents lived in native and traditional villages and informal and squatter settlements within the boundaries of the Melanesian Pacific capitals—Honiara, Port Moresby, Port Vila, and Suva—and smaller towns of Micronesia, such as South Tarawa. All Pacific towns and cities contain a mix of native and traditional villages and village-like settlements, with the largest proportion being in Port Moresby, where 50% of the population lives in some type of urban village. The functioning of these urban centers is heavily dependent on the availability of flexible, low cost transport for the low-income population. The minibus seems to be the most effective means to satisfy the demand for transport. Throughout the Pacific Islands the typical minibus is a Toyota Hiace, configured to transport up to 15 passengers. Most minibuses are operated as small owner/operator enterprises.

2.2 The Energy Sector in PIC

PICs' small sizes and the limited number of economic enterprises that heavily depend on fossil fuels make them acutely susceptible to oil price shocks. Oil consumption comprises 80% of total energy consumption, of which 75% is accrued by transportation and power generation alone (IRENA 2012). Fuel imports for the PICs in 2016 were worth 10% of their GDP, except for Fiji, for which it is 14%. Subsequently, most of the PICs suffered greatly during the oil surge in 2007/08 with prices spiking at US$150 a barrel. For instance, inflation rose from 2.5% to 12% while gross national incomes fell sharply. Such volatility in prices of oil and oil-based commodities has prompted the PICs to invest in renewable energy projects to stabilize their economies and reduce their vulnerability to global economic fluctuations. Table 2 below exhibits some key characteristic of the PIC energy sectors.

Table 2: PIC Energy and Transport Sectors

	Fuel Use		**Electricity Generation**						
	Diesel ML	Petrol ML	Diesel GWh	SFC kWh/L	Renewable GWh	Total Generation	% Renewable	Average Tariff €/kWh	Road Network km
Cook Islands	12.7	4.2	27.7	3.81	1	28.7	3.5%	0.50	60
Fiji	259.0	58	470.0	4.10	434.0	904.0	48.0%	0.17	11,100
FSM	34.9	23.8	68.0	3.59	1.0	69.0	1.4%	0.42	200
Kiribati	12.0	5.3	22.0	3.80	0.5	22.5	2.2%	0.44	700
Nauru	11.7	2.2	17.0	2.50	0.1	17.1	0.3%	0.16	18
Niue	1.2	0.5	3.9	4.05	0.1	4.0	1.3%	0.45	120
Palau	25.6	14.3	83.0	3.48	0.2	83.2	0.3%	0.34	90
PNG	885.3	124.8	306.3	3.69	589.4	895.7	65.8%	0.28	19,600
RMI	37.4	7.2	67.7	4.08	0.2	67.9	0.2%	0.35	90
Samoa	37.4	7.2	90.72	3.85	17.28	108.0	16.0%	0.29	2,300
Solomon Is	97.7	21.6	78.0	3.85	0.5	78.5	0.6%	0.50	1,875
Tonga	27.2	11.8	51.4	4.00	2	53.4	3.7%	0.37	700
Tuvalu	3.8	0.8	5.51	3.50	0.09	5.6	1.6%	0.40	20
Vanuatu	36.7	8.2	55.8	3.78	8.9	64.7	13.8%	0.40	1,100
Most recent data (2015) from various sources: SPC Data Base, ADB, Utility Annual Reports									

Table 2 above shows, that conditions for the introduction and dissemination of EVs vary considerably across the PIC: While the larger Melanesian countries Fiji and PNG show substantial road networks, a relatively high share of renewable energy (mainly hydropower) in the generation mix and electricity tariffs below 0.3 €/kWh, most of the smaller countries have only very small road networks and high electricity tariffs due to their high percentages of diesel in the generation mix.

From a first analysis of the conditions in PIC it can be concluded that at present only Fiji, PNG and Samoa show conditions where the use of EVs can be contemplated. The three countries have a) electricity tariffs below 0.3 €/kWh, have significant and increasing percentages of renewable energy in their mixes (hydro, biomass, solar and wind) and have road networks and population sizes where short and medium distance motorized transport becomes a vital necessity. Five out of fourteen PIC have road networks below 100 km and can therefore only be considered for special EV applications such as electro scooters or electrical bikes. The GDP per capita figures (Table 1) also provide a first indication of a market size for EV: The higher the GDP figure the higher the share of population using private vehicles for their transport requirements.

In the following section two case studies are presented that analyze the framework conditions for EVs in Fiji and the Solomon Islands, two PIC, which exhibit significant structural differences and mark the two extreme points when it comes to the viability of electromobility: Fiji which already has incentives for EVs (no import tax and excise) and has a high RE share in its generation mix, while Solomon Island has the highest power tariff in the region, a marginal share of RE and very limited road transport infrastructure.

3. Case Studies Fiji and Solomon Islands

3.1 Available Technology

The ToR for this study cover all forms of "electromobility", i.e. all forms of transport on land, at water and in the air. It seems, however, necessary to limit considerations to those technologies that are readily available and technically mature, as it seems extremely unlikely that specific technologies would be developed for a market as small as the PIC. With regard to maturity and viability of technology the following must be taken into consideration:

- **Electric Vehicles (EV)** These are battery powered cars and buses. In the meantime these EVs are available from most major manufacturers and typically cost – in the market segment relevant for PIC about € 15,000 more (ex factory and before subsidies) than the equivalent vehicle with an IC engine.
- **Electric buses.** These are state of the art and have been in use for a number of years. China is a leading manufacturer and user of electric buses that range from 8 seater mini buses to full scale 40 seater underfloor buses (such as the Sc6100bev) which retails at around € 200,000. These buses are capable of 100 km/h and have a range of approx. 100 km.
- **Electric scooters and bikes.** There is a large variety of vehicles on offer all of which are designed for short ranges (up to 50 km) and with prices from € 500 to € 5000. These vehicles compete with small 50 cc IC scooters that retail for € 2000 and have fuel efficiencies of 1.5 – 2 l/100 km. The German made electric "Scrooser" is an upmarket design, which retails for € 4,500.
- **Electric trains.** These are state of the art for several decades. However, as there is no rail infrastructure in PIC, the technology is irrelevant at present. Fiji, however, has discussed a light rail system for the Suva-Nausori corridor and the technology may become relevant in the medium to long term.
- **Electric boats.** While technically feasible, there are no electric boats or electric outboard motors commercially available at present. While the importance of small boat transport may merit some applied research for this type of electromobility, the technology is not considered further here.
- **Electric aeroplanes.** This technology is certainly in an early stage (PV powered plane Gossamer), but commercially not available and thus not considered further.

As a reference for further discussions on economics of EVs we will use the VW e-Up and its IC equivalent the Up TSI. This is a compact four-seater city car, that is designed for urban and peri urban transport. It costs € 29,500 as an EV and € 12,000 as a three cylinder TSI. The performance is about the same (60/66 kW). The e-Up uses approx. 12.7 kWh per 100 km and has a range of 100-140 km. The Up TSI uses 4.5 liter per 100 km and has a range of over 500 km[2]. In our calculation, it is assumed that the cars are both depreciated over 10 years and travel a distance of 20,000 km per year (personal experience). According to the manufacturer, the CO_2 emission of the IC TSI is 101 g/100 km, the CO_2 emission of the eUp depends on the generation mix of the electricity system it taps into. If electricity is generated using diesel power, and the eUp uses 12.7 kWh per 100 Km, the CO_2 emission of the eUp is 79 g/100 km based on a CO_2 footprint of diesel generation of 2,700 gram per liter and a specific fuel consumption of 4 kWh per liter of diesel. I.e. the EV's fuel related carbon footprint is smaller than if the petrol engine is used. This is due to higher efficiency of large-scale diesel engines as compared to small vehicle motors. A similar comparison can be made for the EV Nissan Leaf and the Nissan Note, both offering similar utility but at a price difference of about a €11,000 and a range for the Leaf of about 120 km.

[2] Manufacturer's data

3.2 Summary of Characteristics of Case Study Countries

The following table summarise the characteristics and market conditions for the two countries studied in detail. In the following section 3.3 these conditions are discussed in detail.

Country	Fiji	Solomon Is
GDP per Capita	4,920	1,900
Population	850,000	640,000
Total Installed Power Capacity	237	27
Annual Generation GWh	900	87
Regulatory incentives for EV	Yes, import tax reduction of approx. 60%	none
EV and charging standards	none	none
Number of Vehicles	180,000	n.a.
% of RE in Generation Mix	48.0%	>1%
Road Network km	11,100	1,875
Fuel price petrol €/L	0.824	0.992
Applicable Electricity Tariff €/kWh	0.149	0.67
Landed Cost Reference EV Vehicle	29,321	34,701
Cost of Running Reference EV €/km	0.198	0.299
Carbon Emissions g/100 km	39.5	79.0
Recommended for Pilot	yes	no

3.3 Fiji

Energy and Electricity Supply

Fiji has currently no national energy policy. In 2013 the Department of Energy (DoE) developed a draft energy policy with support from GIZ. The policy was supposed to replace an out-dated policy of 2006 and was based on a vision for Fiji's energy sector, as set out in the Roadmap for Democracy and Sustainable Socio-Economic Development 2009-2014. It aimed for a resource efficient, cost effective, and environmentally sustainable energy sector, which should ensure that communities have secure access to affordable and reliable energy supplies. Despite wide national consultations on the policy, GoF, never approved it probably because of controversial statements with regard to power sector regulation that were rejected by FEA, the national power utility.

The backbone of Fiji energy sector are imported fuels. At present Fiji imports 260 million litres of diesel and HFO and 58 million litres of petrol, which is almost exclusively used in the transport sector. Diesel powers both road and maritime transport. 140 million litres of diesel and HFO are currently being used for power generation. Electricity is provided largely through the grid network of the FEA, a wholly government-owned commercial statutory authority that services the islands of Viti Levu, Vanua Levu, and Ovalau through its grid; the rest of the country's power requirements are provided

by small diesel generators, solar home systems, micro hydro installations, and biomass. FEA's transmission assets are concentrated in the Central and Western Divisions of Viti Levu where the population is concentrated.

Diesel power accounts for about 50% of FEA's total generation of about 900 GWh per year. The balance is mostly hydro with smaller contributions from biomass waste (bagasse) and wind. The 10 MW wind farm in Butoni has shown disappointing results as its output fell 50 % short of FEA's expectations' leading to the decision to stop pursuing wind projects in the future. Poor planning, overestimating the potential and lack of experience with the technology have been blamed for the poor results of the Butoni wind project. Focus on future renewable energy development is on hydro with the lower Ba project currently being studied in detail with a 4.5 million contribution from the EU and the EIB. Lower Ba, if realised, will have a capacity of 40 – 50 MW and will significantly increase the RE component in the generation mix of Viti Levu, Fiji's main island. There are also several renewable IPP projects under consideration that would – if only marginally – increase the RE share in FEA's generation. However, these RE contributions will be somewhat compensated for by increasing demand. Growth rates in recent years have been 4% for demand and 3% for number of FEA customers (FEA Annual Report 2015). Thus, it seems prudent to assume, that Fiji's generation mix will in the medium term not substantially deviate from todays situation where RE provides around 50% of the power consumed in the country.

The high share of hydro in FEA's mix allows the utility to sell power at tariff that is low in comparison with the other PIC. The tariffs relevant to EV are the domestic tariff (private vehicle wall charging) and the two commercial tariffs, which would apply to taxi and bus operators, should they employ EVs. There is also a means tested, domestic lifeline tariff that upon application by the customer subsidises the first 95 kWh per month down to 0.08 € per kWh. This tariff would, however, not apply to charging EV as this load would sit on top of the lifeline consumption of 3 kWh per day. The full schedule is displayed in Annex 1.

Table 3: Electricity Tariffs Fiji

	FEA Tariff €/kWh
Domestic	0.149
Commercial < 15 MWh/month	0.180
Commercial > 15 MWh/month	0.188

http://www.ppa.org.fj/wp-content/uploads/2016/01/FEA-Tariff-Rates-effective-from-1-Jan-2016-130116.pdf

GoF continues to support the development of additional renewable energy development and has created an enabling framework for the private sector to engage in IPP investments.

Transport Infrastructure

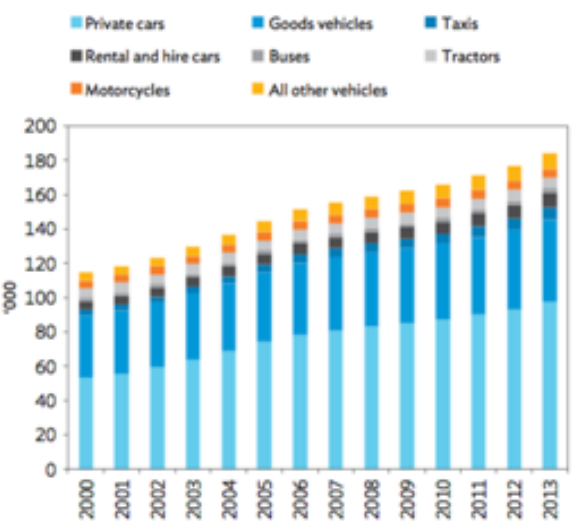
Fiji's geographic features make transport services vital in national and international connectivity. Transport links are particularly essential for connecting people and markets as well as delivering goods and services within and outside Fiji. Fiji transport infrastructure is well developed and comprises of a road network of 11,100 km roads (of which 13% are sealed) a number of ports and wharfs, navigable rivers, and two international and 10 domestic airports. In addition, there is also a narrow gauge railway line in north and west of Viti Levu and north Vanua Levu for transporting sugarcane from farm to the sugar mills.

Goods and people are moved between the islands by scheduled ferry service, the back bone of land transport are buses, mini buses and taxis. Although individual ownership of vehicles has increased significantly over the last decade, it is still less than 50% of households that own a car or a truck. Though poverty has declined in Fiji, nearly 30% of the population remains poor and high import taxes for vehicles (in the order of 70-80% of the CIF value remains a major barrier to car ownership. (ADB 2015). According to the ADB, the total number of registered vehicles has steadily increased in recent years from about 110,000 in 2000 to 180,000 in 2013. Two wheelers which offer a much cheaper and

more practical alternative, especially for short distance travel traditionally play a marginal role in the transport sector and account for less than 2% of the fleet. It is not clear why two wheel transport does not play a more prominent role, giving relatively short transport distances. Transport sector specialists have argued that the high probability of heavy rain falls. The capital city of Suva sees a copious amount of precipitation during the course of the year; with no month having an average rainfall below 60 mm. Suva averages 3,000 mm of precipitation annually with its driest month, July averaging 125 mm.

Figure 2: Number of Registered Vehicles in Fiji

Figure 2.24: Number of Vehicles Registered, 2000-2013



Notes: Goods vehicles include vans, trucks, pick-ups, ambulances, and fire engines. All other vehicles include trailers, cranes, loaders, forklifts, etc.
Source: Fiji Bureau of Statistics. various issues. Key Statistics. Suva. http://www.statsfiji.gov.fj/index.php/test-menu-item/51-publication/publication-releases/148-fbos-reports

Fiji's transport infrastructure compares favorably with those of other PIC but quality and service delivery have fallen over the years. The ADB has identified constraints in existing infrastructure and related services, particularly the inadequate upgrading and maintenance of roads. Fiji's road network deteriorated because (i) road maintenance has been historically underfunded, at least until recently; (ii) roads are vulnerable to natural hazards, which cause significant damage and leave the roads unusable during the wet months; and (iii) vehicles, particularly log trucks and sugarcane trucks, are overloaded and there is little monitoring of their axle weights, an oversight that leads to road damage and adds to road maintenance costs.

While setting up the Fiji Roads Authority and contracting an international firm to provide professional advisory services are seen as steps in the right direction, ADB strongly recommends measures in the transport sector that include:

- Continue to upgrade and rehabilitate Fiji's road network by encouraging greater private sector participation in road projects through various modalities
- Building capacity of domestic road contractors to reduce reliance on foreign private contractors, a measure that can also help reduce costs in the long run;
- Setting up a dedicated road fund to reduce the dependence of road projects on budgetary allocations for operation and maintenance and
- Ensuring sustainability of investments through better monitoring and enforcement of vehicle

loads.

Fiji is the largest market for vehicles in the region. Table 4 shows vehicle density in comparison with other small island countries.

Table 4 Vehicle Density Selected PIC

Country	Passenger Car per 1000 people	Motor Vehicle per 1000 people
Fiji	118.3	179
PNG	6	9
Vanuatu	16	n.a.
Samoa	39.2	76
Kiribati	99.4	144
FSM	16	37
Solomon Islands	n.a.	n.a.

Source:ADB 2015

A large portion of these vehicles are operated i) within the Suva-Nausori corridor, ii) in the Nadi-Lautoka corridor and iii) between these two centers. While private vehicle ownership has increased significantly over the last 15 years, the majority of Fiji's population still relies on public transport. This service is provided by private sector. It is estimated that currently approx. 60,000 taxis operate in Fiji, the vast majority within the urban centres where they are typically used for shorter trips. Both 15 seater minibuses and full size buses service longer distances. The number of full size buses is estimated at 6,000. There is also a significant market for rental cars, mostly used by tourists and visiting business people. The total number of rental is approx. 6,000 with Nadi (the location of the international airport) having the largest number of rental car companies. The rental market is shared between international rental agencies such as Avis and Hertz and numerous local rental companies of varying sizes. It is not known how many tourists hire rental vehicles, but at a total visitors' number of 770,000 in 2016, it is save to assume that the rental market in Fiji is significant.

Enabling Framework for EV

In Fiji an enabling framework for EV is emerging but still in its infancy. However, the efforts of the GoF to increase the share of renewable based power generation hold the potential to further decrease tariffs and thus bring EVs closer to financial viability. Time of use tariffs that incentivize off peak charging of EVs could further improve the existing enabling framework.

There are no standards for EV or charging infrastructure and there are no government supported pilot projects that would test and promote EV as an alternative. The GoF has, however, acknowledged the need to promote cleaner transport technologies. Fiji is the only PIC that has started to actively promote the use of cleaner road vehicles through an import tax relieve for EV and hybrid vehicles (HV). Normal import taxes (based on CIF value) for vehicles are: 32% fiscal duty (or F$ 5,350 if greater than 32%), 15% Import Excise and 15% VAT[3]. EV and HV only attract 9% VAT, but no fiscal duty or Excise. The total import tax for a vehicle with a CIF value of F$ 15,600 is therefore 71% while EV and HV attract only 9% VAT.

These rates also apply for electric mini buses, which are used for medium distance travel within or between urban centres. The standard bus is the Toyota Hiace. While heating is not needed in PIC, air conditioning is often used during the hot season from December until May.

While both EV and HV enjoy the same tax rating, only the HV market has taken off in Fiji as a result of these concessions. It is interesting to note, mostly taxi operators have started to shift to the Toyota Prius. Toyota is also the only international vehicle manufacturer that provides the special O&M

[3] http://www.frca.org.fj/customs-charges-and-duties/

services that HV require. Tebara Bus company has imported an electric bus[4] in 2015 and tries to also promote the Chinese three wheeler EV Zippee[5]. However, the uptake of EV in Fiji is currently inhibited by:

- Lack of charging infrastructure for electric vehicles
- Lack of subsidies beyond import tax waiver
- Pricing of fuels and electricity

From a consumer's perspective, buying an EV in Fiji under the existing framework conditions and GoF incentives cannot be considered a financially viable option. Levelized transport cost in € per kilometre for our eUp reference vehicle described above (travelling 20,000 km per year) is 0.198 €/km for the EV and 0.164 for the IC vehicle (at current prices for petrol and electricity at a 5% discount rate). Reducing the discount rate to 2% would advantage the EV (with its higher up-front cost) but not sufficiently to make the EV competitive. Details are provided in Annex 5.

Increasing annual travel distance from the standard 20,000 km for an individual car to 40,000 km, a distance most taxis in Fiji would travel per year, narrows the gap (0.98 €/km versus 0.093 €/km). What would create travel cost parity between the EV and the IC at 20,000 km per year is a combination of dropping electricity cost to 0.1 € per kWh and paying a subsidy of € 4,000 upon purchase of the vehicle (the subsidy that applies to EV in Germany). Wether such a subsidy can be justified on environmental grounds remains a political decision of GoF. What the calculation shows, is that economic conditions in Fiji do presently not favour EV (as in almost any other market in the world), but bring total cost sufficiently close to the IC to consider further GoF incentives promoting the technology. It appears that public service vehicles with their higher annual travel distance seem to be the market, where EV are closest to commercial viability.

It is also clear that the CO2 emissions of the EV given the generation mix in Fiji is significantly lower than the IC (101 g/km for the IC and 39.5 g/km for the EV). The EV would have even a positive impact, though much smaller, if all electricity would be generated by diesel only. In such a case the EV would emit 79 g/km, mainly due to the higher conversion efficiency of large-scale diesel in comparison to a small petrol engine and the high efficiency of the electric drive train of the EV. The IC vehicle uses the energy equivalent of 36.55 kWh per 100 km as compared to 11.7 kWh for the EV.

3.4 Solomon Islands

SI's socioeconomic situation is characterized by low per capita income growth, high unemployment, and one of the highest population growth rates in the world. The economy is based on primary commodities from agriculture, forestry, and fishing. Most production occurs in remote rural areas without adequate transport infrastructure and services. Connectivity between the six main islands and smaller island groups as a means to facilitate economic and social development via maritime transport is vital.

Energy and Electricity Supply

In the Solomon Islands (SI) electricity is provided to less than 20 % of the population and almost all generation is based on imported diesel fuel. Electricity consumption per capita and year is a mere 120 kWh the lowest value in PIC. Per capita consumption in Fiji is 1,060 kWh and 4,100 kWh in Palau. There are two reasons for the low uptake of electricity: Lack of access and one of the highest power tariffs in the world >0.5 €/kWh. Obviously, SI faces considerable challenges in the development of the energy sector, including maintaining a reliability of energy supply, ensuring commercial viability of the power utility SIEA, increasing access and improving energy security by

[4] http://fijione.tv/electric-buses-could-help-reduce-fuel-costs/

[5] http://www.fbc.com.fj/fiji/29841/fiji-launches-first-three-wheel-electric-car--zippee

reducing dependence on imported fossil fuels. Historically, the poor performance of the power industry has presented a major constraint to private sector development and economic growth.

Rural electrification coverage in the Solomon Islands is particularly limited. With few exceptions, electrification is confined to Honiara and the provincial centres. Outside of these centres, only about 5% of the rural population has access to electricity through a small number of off-grid and individual household systems. To develop the economic potential of villages and to provide social infrastructure to rural populations, greater emphasis on rural electrification is needed. However, a scaling-up of rural electrification services through expansion of existing grids and stand-alone systems is a substantial challenge. Though lack of funding is perhaps the dominant constraint, weaknesses in policy, legislation, regulation and the lack of feasible models that would allow the development of local, renewable energy resources also play their part in limiting the rate at which access to electricity services is improved for rural communities.

The current Government of the Solomon Islands (GoSI) recognises, that renewable energy, in particular hydropower remains an attractive alternative to diesel imports that have been burdening the economy and undermine energy security of a country characterized by a very high vulnerability to external shocks. While the development of the medium size Tina river hydro project (8MW) is currently under way for the Honiara system, smaller sites in the outer islands may also represent an opportunity to develop hydropower as a reliable and environmentally friendly alternative to diesel. Several smaller hydropower projects are under way supplying centers in outer islands. In total, the potential for renewable energy is estimated to include approx. 30 MW on Guadalcanal and 20 MW for the outer islands combined.

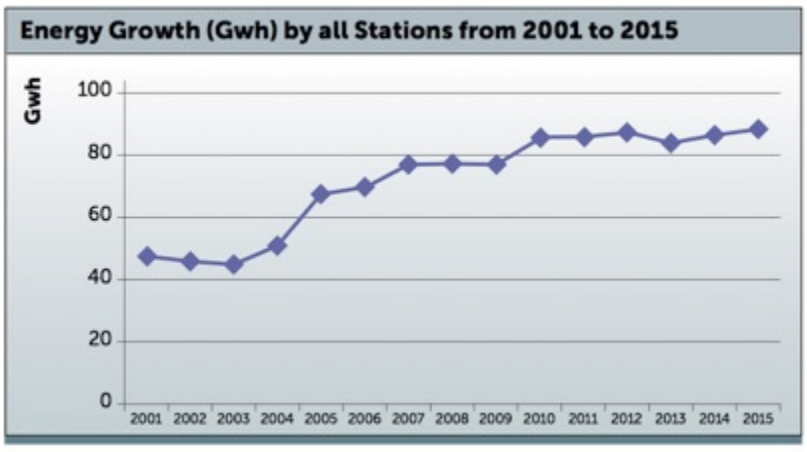
SIEA latest Annual Report for 2015 shows a total energy produced in the table below. Lungga and Honiara operations produced a total of 77.91Gwh (89.70%) whilst the Outstations, STP (IPP) and the Ranadi Solar produced 8.91Gwh (10.3%). There was no energy bought from Soltuna PPA during the year. Table 5 below summarizes the SI power sector:

Table 5: Summary SI Power Sector Production in GWh

	2014	2015
Honiara Diesel	77.3	77.91
Honiara Solar	0.03	0.07
Honiara STP (IPP)	0.59	1.36
Outstations	7.5	7.48
Soltuna Noro (IPP)	0.05	0
Total	**85.47**	**86.82**

Source: SIEA Annual Report 2015

Figure 3: Growth of Electricity Demand SIEA All Stations



Source: SIEA Annual Report

The Honiara Power System

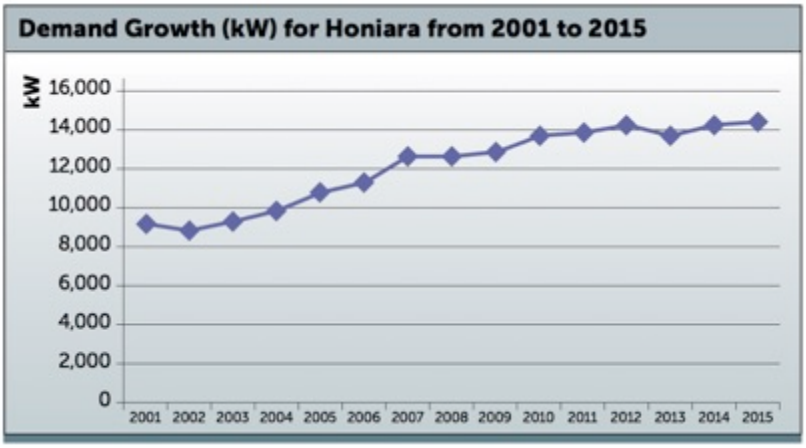
Honiara is Solomon Island's largest town and with a population of approximately 100,000 and a growth of around 4% p.a. Currently approximately 75% of the town population has access to electricity. With steep hills rising within 2 – 5 km from the coast the bulk of the population live along the coast. The coastal plains to the east and west of Honiara show rather low population density and little development. Population growth has mostly occurred in Honiara town itself. I.e. growth has manifested itself mostly by a significant increase in average household size. With almost all electricity in the outstations generated in small, inefficient diesel stations (Specific Fuel Consumption >3 kWh per litre) and frequent supply constraints due to lack of capacity, the only market for EV in SI would be Honiara.

Honiara's electricity supply consists of two SIEA diesel power stations, one located at Lungga, approximately 8 km east of the town centre (Lungga Power Station), and the other in the town center (Honiara Power Station). These two power stations are interconnected via two 33kV circuits, one of which is an overhead line and the other an underground cable. Each circuit is approximately 10km in length. These circuits both terminate at the Honiara Power Station. In addition to these transmission circuits, several 33kV underground distribution cables have recently been installed to supply new 33/11kV zone substations at East Honiara and White River.

The diesel engine generators currently installed at Lungga Power Station are a mixture of medium speed units (500, 750 and 1000rpm) duty. Honiara Power Station established as Honiara's power supply in the 50ies currently operates a single high speed Perkins 1500 kW unit de-rated to only 800 kW. Due to the open walled construction of Honiara Power Station and its location behind the town centre, residents have complaint about noise. SIEA intends decommission the station in the next few years. Operational generator units could be relocated to Lungga, leaving the station as a distribution substation only.

The latest available data show a total generation of 79.34 GWh and a peak demand of 14 MW.

Figure 4 Demand Growth in Honiara



Source: SIEA Annual Report 2015

In recent years power outages and load shedding have affected the Honiara system. The situation has improved as SIEA rehabilitated several of its diesel generators and is expected to improve further with the commissioning of a new 10 MW MAN diesel set. However, while the new generator will improve fuel efficiency, it will not fundamentally change the fact that SIEA tariffs are amongst the highest in the world.

Transport Infrastructure

In the SI transport sector, accurate data is scarce or simply unavailable. For instance, there are no current reliable estimates on numbers of passengers or vehicles on various road segments.

The nation's road network currently comprises 1,875km, of which 800 km of the road network are private plantation roads, which are not accessible to the general public. Only some 104km, or 6%, of

the roads in SI have a sealed surface. The remaining length of the road network is surfaced with gravel, coral or earth. The existing road network is not evenly distributed over the country. The islands of Guadalcanal, which includes Honiara, and Malaita collectively account for 1,230km, or 66%, of all the roads in the country. Even on these two islands with relatively high road density there are large areas with little or no access to road infrastructure such as Guadalcanal's weather coast and Malaita's east coast. As for other islands, such those in the provinces of Isabel, Central, Western and Choiseul, road density relative to both their geographical area and population illustrate that they are among the most poorly served in the country.

Despite the obvious importance of roads in facilitating the movement of people and cargo across the islands, many of the existing roads in the country have fallen into a poor state due to the fact that road maintenance is either substandard or wholly neglected. This neglect of maintenance in the road sector has undermined the effectiveness of the infrastructure investment to enhance the rate of social and economic development in the country. Transport sector planning, financing, and maintenance have long been inadequate, such that most facilities are in poor condition and need rehabilitation. Many locations lack suitable transport infrastructure and do not receive any regular transport services. Institutional capacity in the Ministry of Infrastructure Development (MID) is weak, resulting in poor sector governance. As Government's capacity to properly plan, implement, and operationally manage and maintain a portfolio of transport infrastructure assets is lacking, the ADB has launched a 80 million Euro support programme for the transport sector, that is expected to create new and rehabilitated transport infrastructure in the form of rural roads, airstrips, wharves and jetties. This is expected to improve safety and accessibility for economic and social activities, and increase productivity and reduce costs for service operators, leading to efficiency gains and greater frequency of service. Improved transport services will reduce barriers to market access and promote the growth of rural production. (ADB 2015).

While the above ADB programme is under way and has made significant progress, the land transport situation in SI indicates that there is only very limited opportunity to introduce EV. The market segment that is most interesting is the greater Honiara area where currently approx. 85,000 people live and where cash income of households is highest. At present transport services in the greater Honiara area is supplied by mini-bus and taxi and to a limited degree by private vehicle.

Enabling Framework for EV

At present, there is no enabling framework for EV in Solomon Islands. There are no standards or regulations and there is no charging infrastructure. The issue has not been discussed at any level mainly due to the shortage of power (load shedding and unplanned outages) that the Honiara has experienced in the past and due to the extraordinary high tariffs for electricity.

Table 6 summarizes the current tariff, the full schedule is displayed in Annex 2. The rationale behind this tariff is not evident as there are some anomalies: While domestic tariffs D1-D4 are increasing blocks, the commercial tariff has decreasing blocks. What is more surprising is the fact that prepaid customers are charged significantly more than those with regular meters. I.e. despite the up-front pre-consumption payment, these customers are penalized. Given the tariff structure displayed below, the most interesting market would be public transport where commercial operators would enjoy tariffs down to 0.65 €/kWh.

A plug in EV charged at its owner's residence would attract the domestic tariff D4 which means that a customer with a regular meter would be charges 6.03 $/kWh (0.72 €/kWh). A prepaid customer would even have to pay 8.68 $/kWh (1.02 €/kWh).

Table 6: SIEA Tariff S$/kWh

	Network Access	Fuel Charge	Nonfuel Charge	Total $/kWh
D1 Regular Meter <50	15.3	2.23	3.23	5.46
D1 Prepaid Meter <50	0	2.23	5.84	8.07
D2 Regular Meter 50-200	51	2.23	3.3	5.53
D2 Prepaid Meter 50-200	0	2.23	5.89	8.12

D3 Regular Meter 200-500	102	2.23	3.36	5.59
D3 Prepaid Meter 200-500	0	2.23	5.91	8.14
D4 Regular Meter >500	408	2.23	3.8	6.03
D4 Prepaid Meter >500	0	2.23	6.45	8.68
C1 Regular Meter <250	48.8	2.23	3.86	6.09
C1 Prepaid Meter <250	0	2.23	6.35	8.58
C2 Regular Meter 250-600	102	2.23	3.48	5.71
C2 Prepaid Meter 250-600	0	2.23	6.45	8.68
C3 Regular Meter 600-1300	204	2.23	3.2	5.43
C3 Prepaid Meter 600-1300	0	2.23	5.89	8.12

Import taxes on vehicles show little distinction in the tax code, only a small penalty of 5% applies to motorcycles in comparison with all other vehicles which attract a total of 29% import duties. Our reference vehicles eUp and Up TSI would thus cost € 34.701 for the EV and € 15,480 for the IC. At current fuel prices in Honiara are $ 8.27 for petrol and $8.75 for diesel[6]. Levelised cost of travel would be € 0.299 per km for the EV compared with € 0.140 for the conventional vehicle (See Annex 5 for details). It is obvious that at a cost penalty of 75% for the EV, there is at present no chance of introducing EV in SI.

There are high hopes in SI that the development of the Tina River Hydro Project will change the situation in the Honiara grid fundamentally. The project is estimated to cost 120 million Euro and would have a capacity of up to 20 MW, sufficient to supply the entire demand of Honiara[7].

The Green Climate Fund is now the second donor to announce its funding approval of US$86 million for Tina River Hydro, following a US$15 million commitment from the International Renewable Energy Agency (IRENA) in early January this year. The project is structured as an IPP, i.e. it is expected that the concessionary financing that has become available will be sufficient to attract private sector investors. While it is not yet clear what impact this project will eventually have on tariffs, it would at least shift the generation mix towards a high share of renewable energy, thus allowing to reap the full environmental benefits of electromobility.

Given that at least part of the project cost will be financed from concessionary loans and grants, it seems safe to assume that tariffs will decrease significantly after the commissioning of TRHP. Depending on the final capacity of the project, it could also – at least seasonally – lead to oversupply of electricity in the Honiara system and thus open the possibility of special tariffs and concessions for EV. The project is expected to come on stream by 2021 and at this point, the competitiveness of EV on Guadalcanal should be reviewed.

3.5 Analysis

Not surprisingly, the two case studies above show, that at present EVs are not a financial viable option for any of the PIC. It also shows that market conditions vary widely amongst PIC, with some countries such as Fiji coming close to proving an effective enabling environment (High RE in the energy mix, relatively low power tariffs, extensive road infrastructure and government import concessions for clean vehicles). Given these conditions, private sector players have stepped forward in the EV segment in order to position themselves for what is perceived as an interesting business opportunity[8].

[6] http://www.solomonstarnews.com/news/business/12337-fuel-prices-slightly-increase

[7] http://documents.worldbank.org/curated/en/843821468187806360/pdf/99704-ISDS-P152779-PUBLIC-Box393207B.pdf

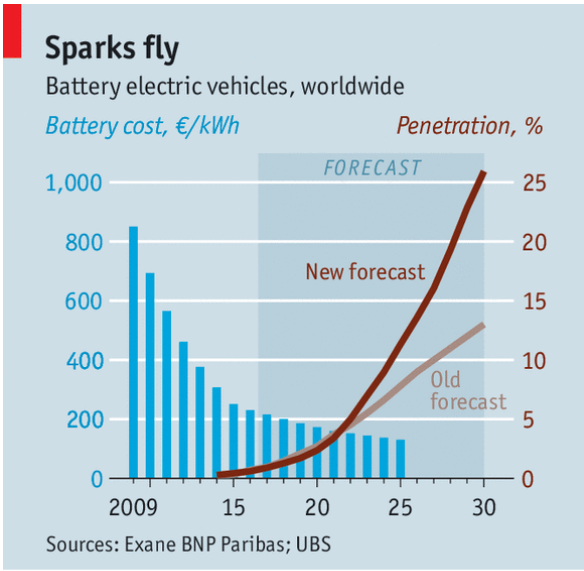
8 http://fijione.tv/electric-buses-could-help-reduce-fuel-costs/

At the other end of the scale ranks Solomon Islands with one of the highest electricity tariffs, no significant contribution from RE in any of the grids operated by SIEA, one of the smallest road networks and no government policies or concessions that favor the import of clean vehicles. In addition, SI is the poorest PIC, i.e. low disposable household income does prevent most families from procuring a private vehicle. In richer economies such as Fiji, re-prioritized household expenditure towards car ownership is driven by practical considerations but also by perceived benefits arising from increased status and 'being a member of modern society'.

Car ownership, however, would place enormous stresses on household budgets in SI as capital and on-going maintenance cost competes with more basic household requirements. The comparison of the two countries also shows, that in small island economies framework conditions for EV can change quite dynamically. A single hydro project (Tina River), which will supply most of the power needs of the country's largest power grid in the urban center of Honiara, can change the conditions from completely unfavorable to worth considering.

While technological development and investment cost for EV can be forecast with reasonable accuracy, forecasting the development of the world market for energy commodities is fraught with much more uncertainty. Figure 5 shows the results of studies performed by UBS and Paribas two large European investment Banks. The projection assumes a significant decrease in battery cost and –as a consequence- a rapid increase in worldwide market share of EV, reaching a penetration of 30% by 2030.

Figure 5: Market Projections EV



With regard to the other cost component driving EV market penetration – the price of fossil fuels – it seems prudent to follow the latest World Bank Commodity Markets Outlook9 for April 2017. The Bank is holding steady its crude oil price forecast for this year at $55 per barrel, increasing moderately to an average of $60 per barrel in 2018 and $75 in 2020. Rising oil prices, supported by production cutbacks by OPEC) and non-OPEC, will allow markets to gradually rebalance. The World Bank sees both upside and downside risks in its oil price forecasts: Upside price risks include greater-than-expected compliance by OPEC/non- OPEC producers and supply outages among some exporters, notably Libya and Nigeria. On the down- side, weak compliance with the OPEC agreement

[9] http://www.worldbank.org/en/news/press-release/2017/04/26/industrial-commodity-prices-to-rise-in-2017-world-bank?cid=ECR_E_NewsletterWeekly_EN_EXT

and rising output from a faster-than-expected rise in U.S. shale oil production could also affect the supply balance.

The projected moderate increase in world energy prices over the next three years would improve the competitiveness of EV, especially in markets where the viability gap between EV and conventional transport is already quite narrow. The World Bank expects a price level of approx. US$ 75 per barrel of oil in 2020. At this level, even SI becomes a potential market for EV, especially as the Tina Hydro River Project could become operational around this date changing the energy mix in the Honiara grid from almost 100% diesel to mostly hydro.

4. The Way Forward

4.1 Status of Electromobility in PIC

In China more than 400,000 pure EVs were sold in 2016, making it the world's biggest market. It is not known if a pure EV has been sold in PIC, but it is save to assume that the total numbers in the region would be below 10 and would be restricted to electric scooters and golf carts. From the previous sections it can be concluded that PIC are more or less **a green field** if it comes to EV. Lack of regulatory provisions, high cost of electricity, which is often generated from diesel fuel, lack of generation capacity, limited road networks and lack of vehicle affordability has so far inhibited attempts to embark upon the introduction of these new technologies. There is **neither charging infrastructure nor technical standards for EVs** and the infrastructure they need. The 15 PIC can be divided into three categories:

i) Countries with high share of RE and relatively low electricity tariffs (Fiji, PNG, Samoa),
ii) Countries where large scale investment in RE is pipelined and EV will become an option in the near future (Solomon Islands),
iii) Countries where a large share of electricity is generated from diesel oil and where tariffs are high. The rest of the PIC fall in this category. Some of these countries (Tonga, Cook Islands) have ambitious RE targets but are limited to solar and wind as resources. For these countries, the next generation of EVs may become an interesting option, i.e. vehicles that are able to communicate with smart grids and become active elements of the power systems.

Only Fiji has some regulatory provisions, which reduce the burden on imported EV and HV vehicles from 70% to 9%. Due to the lack of further incentives and relatively high electricity tariffs even in Fiji, the uptake of EV has been zero, while the tax incentive has boosted the market for Hybrids, in particular in the taxi business. Nevertheless, Fiji, which is often seen as a trend leader amongst PIC, offers conditions that **would allow pilot EV initiatives** that could provide a guidance for other PIC once their market conditions for EV have improved (Solomon Islands). In Fiji there is even private sector interest in taking up the promotion of EVs both in public and private transport and the issue of electromobility is already discussed in the local media.[10]. While PNG has a high share of RE in the generation mix, the structure of its transport sector (characterized by foot and boat transport its rural areas and by a limited road network and a very small number of vehicles per person) does currently not qualify PNG for detailed consideration.

It is thus recommended to initially focus interventions on Fiji together with the development of a data base for all PIC where relevant baseline data related to electromobility would be managed. A Pilot Project in Fiji would also generate data and knowledge, which would be highly relevant to other PIC.

4.2 Barriers to the Introduction of EV

Financial Barriers

In western countries, buyers of private EVs are typically multi-car upper middle class households that procure an electric vehicle as an option for short distance travel and as an expression of their concerns about the environment. This market segment does barely exist in PIC and under present conditions; EVs are financially not viable even under the best market conditions (Fiji) found in the region. Additional government subsidies – similar to those in the USA, Germany, or other European countries would be required to render EV financially viable. Assuming that governments would show the political will and the fiscal ability to subsidies EVs, the question remains if such subsidies would be an **efficient allocation of scarce capital**.

[10] http://www.fijitimes.com/story.aspx?id=380402

It should be noted, that PIC governments would not have the incentive of governments (like Germany and China) that aim to promote their own EV industries while struggling for leadership in an emerging market and where the transport sector is well advanced, with challenges more related to environmental issues and achieving low-emission transport. In contrast, in developing PIC economies the development of the transport sector is at a different stage. Because of the high cost of vehicles in general (due to high vehicle tax rates), a large part of the population cannot afford to buy a car. As the public urban transport system also has not yet been well developed, urban mobility in PIC is still a primary issue. Providing access to safe, reliable, efficient, and affordable transport services for a large parts of the PIC's urban population remains a key challenge.

Against this background it seems prudent to focus publicly funded interventions on the **public transport** market segment. In this segment subsidies would benefit the general public rather than individual EV owners. Another possibility to bring down cost of EV ownership would be **innovative financing mechanisms** such as the packaging and bulk sale of certified emission credits accumulated through the replacement of fossil fuels by cleaner electricity.

Weak Power Systems

Most power systems in PIC are weak with little or no spare capacity. Perhaps the most serious concern utilities have is controlling when EV charging load is applied to their grid without any utility control. A high percentage of consumers would instinctively charge their EVs when they get home from work. This is also the time when grids experience their evening peak and the absence of load management would likely have a de- stabilizing effect on the grid.

Before significant additional load is put on these small systems, the capacity of the systems need to be determined. This must go beyond a simple comparison between new expected loads and the maximum capacity of the systems but should include full-scale power system analysis. This analysis need to determine the impact on the grid of installing any new equipment—new conventional generation, new renewable energy plant, new consumer categories (such as EV) storage, etc. There are three main analyses: load flow analysis, short-circuit analysis, and transient analysis (system stability analysis). **The Pacific Power Association** (PPA) has assisted several PIC in performing this type of analysis and would be the right partner when it comes to determine the impact of EV dissemination in PIC. While the larger power utilities (Fiji, PNG) as well as the only private power utility in PIC (UNELCO of Vanuatu) do have these capabilities in-house, it would still be beneficial to involve PPA as a regional organization in order to create regional knowledge that can be shared amongst the PIC.

EVs can soak up excess renewables and thereby allow for a higher percentage of renewables in the overall mix than would otherwise be the case. A deliberate policy environment (time of use pricing and facilitating technology environment - such as the availability **of smart grid applications** - can have significant impact on total GHG emissions of an energy system such as Fiji's. Over longer planning horizons, EV and their ability to not only draw electricity but also to act as distributed storage units could become important parameters when **determining the expansion of RE generation**.

Lack of Charging Infrastructure

One of the largest barriers to the introduction of EVs is "range anxiety". Our reference EV eUp has a range of 120- 150 km. While this would be sufficient for moving around in an urbanised centre such as the Suva-Nausori corridor, the vehicle would not be able to travel between the two main centers of Viti Levu: Lautoka and Suva without being charged. It is obvious that a minimum of public charging stations would be required in order to support EV introduction. One of the most debated aspects of the EV industry is the infrastructure. The three main issues are: What type? How much? To which standards?

The first question typically addresses the mix of home versus public charging and the mix of slow versus fast charging. There is no single answer as the type of vehicles, the level of urbanization, and government policies all play a major role. However, a pilot project should carefully analyse infrastructure requirements and perhaps support investments in this infrastructure. There are three

stakeholders that could get involved in this endeavour: i) Power utility, ii) Petrol Stations, iii) Private sector businesses such as the leading retail chains Superfresh and Cost you Less. In Europe the oil companies Shell and Total have started to invest in fast charging stations at their petrol pumps. **Total,** a relatively new and dynamic player in the PIC fuel business could be a key stakeholder, but so could be the **power utility FEA**. If a pilot project is focussed on electric public busses, battery swapping as practiced by the Beijing Bus Pilot would be an alternative to fast charging stations.

The EV industry in general is struggling with the issue of EV charging standards. As with many industries in their infancy, there are a multitude of standards emerging. For example, the Society of Automotive Engineers (SAE) has undertaken development of the primary standards for the charging-related wired and wireless interfaces such as J1772, which governs the physical interface ("the plug") that connects to the vehicle. In Europe, the manufacturers have selected a different plug that is often referred to as the Mennekes plug, after the manufacturer. It can support 240V and 360V charging. They have different numbers of connectors, and vary in size. It is clear that PIC would be too small as markets to support multiple standards for charging. Thus, **the selection of a standard would have significant implications with regard to specific manufacturers' access to the market**. The full set of standards that connects the vehicle to the grid, including **safety and power grid standards**, have to be considered in creating an integrated solution.

4.3 Determining Urban Development Policy Priorities

Electromobility in PIC needs to be seen in a context of numerous challenges that urban development phases in PIC. The following statement is an excerpt from the Outcome Statement of a regional meeting on the New Pacific Urban Agenda, Nadi, Fiji, March 2015. It summarizes the multiple priority areas which efforts to improve the living conditions of the urban population in PIC face.

"The specific needs of the Pacific in the process of urbanization must be recognized and adequately addressed in the post-2015 development agenda. Key priorities include upgrading of informal settlements and access to safe and affordable housing for all, land, provision of basic infrastructure and services, building urban resilience to climate risks and other shocks, enhancing rural–urban linkages, addressing gender inequalities, job creation and strengthening capacity for urban governance, planning, management, and data collection and analysis. Continuing the 'business as usual' approach to the development of cities and urban areas will not be enough to manage the pressures of rapid urban growth."

Given the multiple challenges PIC face in their urban development, it will be important to determine through comprehensive policy dialogue **where an intervention to promote electromobility would rank in the individual countries**. Experience with intervention of development partners in PIC has consistently shown, that local stakeholder ownership of projects is paramount to their success.

4.4 Stakeholders

The implementation of any EV program requires careful planning, awareness raising, policy incentives, and investments to develop the market, while building on global technology developments, government fiscal capacity, and travelers' behavior. It is obvious that the national authorities charged with transport, urban and regional development, the energy administration, the power utilities and the private sector would be the main stakeholders in any initiative promoting electromobility. These should be consulted at the earliest opportunity. In addition the finance ministries would have to be involved if PIC governments decide to subsidies EV. Apart from stakeholders at the national level, there are several regional and multilateral organisations that are potential stakeholders that should be involved in developing electromobility strategies for PIC and should therefore be included in the consultations.

This can be achieved through a dialogue with the individual governments supported by meaningful discussions with regional organisations (SPC, SPREP and PPA) and development partners such as ADB and World Bank. The dialogue could be initiated with a circular letter and followed up by

discussions on regional meetings such as the Regional Energy Ministers Meeting[11]. The following table lists stakeholders for Fiji, the country where initial activities should be focussed:

- The **Ministry of Works, Transport and Public Utilities** hosts the DoE and the transport department and has some role of overseeing FEA as a public utility. As this ministry holds the portfolio for both electricity and transport, it would be the most important partner.

- The **Department of Transport.** Is in charge of transport sector policy development and transport sector planning.

- The **Department of Energy (DoE)** is responsible for energy policies and plans, energy efficiency and conservation, renewable energy (RE) and rural electrification.

- The **Ministry of Foreign Affairs and International Cooperation** maintains a climate change unit, which is Fiji's Designated National Authority (DNA) for the Clean Development Mechanism. The ministry is also in charge of coordinating development partners.

- The **Commerce Commission** is established with a statutory mandate to independently authorise adjustments to the tariff and oversees non-discriminatory access to FEA's grid. It also regulates maximum prices for petroleum products throughout the various divisions of the country.

- The **Ministry of Public Enterprises & Tourism** overseas business performance of FEA as a state owned enterprise. It also scrutinises FEA's corporate plan and statement of corporate intent.

- The **FEA** is the national utility responsible for urban, peri-urban and rural grid electricity supply. FEA is a key stakeholder in electromobility as it has to provide the additional capacity and the energy that would be used by EV. In the medium and long term it would also be the main player in developing smart grid solutions and integration of EVs into the power systems.

- Major Development Partners such as the Asian Development Bank (leading supporter in the transport sector), EU, (leading supporter of clean energy in PIC), World Bank (energy sector), AusAid, NZAid, GIZ (leading bilateral development partners).

- **Private sector interest** such as taxi and bus companies, the leading lenders (ANZ Bank, Westpac bank), and concerns operating the countries leading retail chains.

4.5 Market Segments for EVs in PIC

The high cost of introducing EV as a new green technology to achieve carbon, environmental, and health benefits is a common trade-off faced by all countries including PIC. Falling cost of batteries will make the cost of owning and running an EV the same as that of a traditionally powered car in the most favorable markets in PIC (Fiji) probably by the early 2020s, even without the hefty government subsidies that many rich countries use to make EV attractive for the private consumer. While it could be argued just to wait until market conditions are conducive in PIC, there is also a strong argument to prepare these markets for an early adaptation of the technology.

When the local PIC market is developed at a pace consistent with global market trends, an EV program can benefit from ongoing improvements in EV technology and resulting cost decreases in the global market. Technological improvements in terms of better and less expensive batteries, additional range, new product offerings, and availability of affordable EV models will increase the attractiveness and financial competitiveness of EVs. These improvements in the global market will allow for an increase in EV uptake in the medium term with less financial support from the

[11] Unfortunately, it will not be possible to include the subject in this years meeting which is held in Tonga end of April, but certainly at next years meeting.

government. Successful EV programs focus on target groups, as different segments of a country's vehicle market may not be similarly suited for a switch to EVs.

For Fiji the following market segments are listed in order of priority and seem to be particularly attractive for pilot activities. First generation pilot projects in these market segments would have two main objectives: i) Collect reliable data on the operation of EVs under real world conditions in PIC and ii) demonstrate the viability of EVs to operators in the relevant markets segments and to the general public.

Government Fleets

In many countries where EV use has grown in recent years, governmental fleets have been the pioneers of EV market development. A focus on a government run pilot in Fiji would thus be recommendable. By switching the government fleet to EVs, the government supports the development of the market and demonstrates to the wider market that EVs are feasible for regular use. GoF has control over its own procurement processes; i.e. it is relatively easy to include EVs in the fleet provided funding is available. Moreover, charging and parking locations can be organized at government offices; the average daily distances traveled with government vehicles is less than 100 kilometers per day, which fits well with the use of EVs.

Government vehicles that can most easily be transitioned to EVs are those that have only a limited operating area, typically in the Suva-Nausori corridor and do not carry heavy loads. This includes vehicles used for local inspection teams, courier services, local police, street cleaning, and light garbage collection. Especially, the state owned power utility FEA should be considered to run an EV pilot project as this agency operates a large vehicle fleet and would become an important stakeholder in electromobility. FEA should also have a vital interest to acquire knowledge about a technology that has the potential to reshape electricity markets. FEA would also become a key player in the design and planning of charging infrastructure and would be responsible for adjustments/expansion of its power system.

A government run pilot project in Fiji should include the following features:

- Operate a highly visible, small fleet of government vehicles in a confined area (Suva Nausori corridor)
- A dedicated charging infrastructure that allows the technology a fair trail
- Training of drivers in order to familiarize them with the features of EVs
- A monitoring program, that allows collection and analysis of critical data such as total distances travelled, driver experience, total cost, charging cycles etc.
- Document, publish and exchange experiences with the public.

NGO and Development Partners

This target market is similar to the government fleets. Agencies such as, UN, GIZ, ADB operate sizable fleets in Fiji where EVs could be piloted. These agencies also control their vehicle procurement and use professional drivers that can be trained to become active in monitoring and recording experiences. A project could consist of visible agency charging stations and clearly market vehicles that could contribute to build confidence with regard to the practicability of electromobility. In such a project, innovative technologies such as electric scooters could also be pioneered. In this context, it is interesting to note that two wheeler transport has never been taken up in PIC[12], at least not nearly as much as in Asian countries where small motorbikes and scooters are often the most popular of low cost transport. Promoting two-wheel transport would also contribute to ease the traffic congestion and the pressure on parking limited spaces.

[12] Cook Island and Niue seem to be exceptions as both countries have sizable two wheeler fleets used for short distance commuting

Including technical assistance agencies and NGOs as pilot users of EVs would also allow to monitor trials and collect valuable data on the suitability of EVs to meet the specific transport needs of company or agency fleets.

Public Transport: Buses

Public transport is a possible future target group, with conventional diesel buses switching to electric buses. Tabara bus company of Suva has already piloted an electric bus imported from China[13], i.e. there is interest in the private sector for innovative transport solutions including EV. EVs in Public transport will directly serve those lower-income users who have no other choice than to use public transport. Supporting public transport would result in a pro-poor distributive impact because mainly the poor and vulnerable groups use public transport. Electromobility should be promoted as one element of improved public transport that is designed to service travelers and would result in welfare benefits (savings in time and expenses) along with significant environmental benefits. Low-income travellers in Fiji use buses, which operate, throughout the islands of Viti Levu, Vanua Levu and Taveuni.

Only Viti Levu currently shows favorable conditions for electric buses and activities should focus in the Suva Nausori area, which has by far the highest density of public bus transport in the country. The generation mix with high shares of diesel generation on the other islands is not conducive to EVs.

Public Transport: Taxi

There are 76 registered taxi companies in Fiji. Together with the buses described above, they are the backbone of Fiji's urban public transport. Taxi fares are government controlled and taxi operators are extremely conscious of opportunities to cut cost. The taxi fleet in Fiji is an attractive market for EVs because of their high mileage and large cost-saving potential in the medium and long term. Taxis in Fiji are mostly used for short distances within urban centres, which matches the capacity of EVs. On the other hand, urban taxi trips, because of their frequent starts and stops, will typically use more energy than long distance trips travelled at a constant speed. The high daily mileage of taxis, however, can also be a large disadvantage because of the need to charge the vehicle's battery several times a day. In addition, luggage space and loading capacity could be a problem, depending on the vehicle type and the transport needs of the taxi client.

A pilot project involving private sector taxi companies could help to generate the data required to underpin technical and commercial feasibility of EVs as taxis. Key questions of taxi operators would certainly relate to range, charging time and total cost of operation. Although commercially available EV all have published ranges these are only theoretical numbers determined in a test of the vehicle under ideal conditions. International experience and studies have shown that actual driving range depends on the characteristics of the vehicle, the size and effectiveness of the battery, the effectiveness of the drive train, the aerodynamic quality and tires (pressure size). In addition, outside temperature, driving style, speed, topography, and the use of air conditioning play a role.

All this matters much more to a taxi operator than to the average owner of a private car as Fiji's taxi fleet has to operate in a highly competitive environment producing only thin profit margins of for the operators. It would be important to find the right partner (taxi company) for an EV trial in Fiji. The capability of EVs as taxis has to fit a user's required driving pattern to allow a smooth transition. While a delivery company with services within the Suva city area can easily accommodate the limited range of an EV, a taxi drivers operating on long-distance routes (Suva-Nadi-Lautoka) will not be able to offer the same services when long charging times have to be taken into account.

If a detailed analysis of operational data from a taxi trial can demonstrate that a combination of government incentives (waiver of import tax and excise) and attractive power tariffs reduce overall

13 Tabara imported a Wuzhoulong FDG6110EV2

vehicle operating cost for a typical taxi operator, this market would take off. Incentives that were provided for LPG powered vehicles 10 years ago had seen the same enthusiastic up-take of the new technology by taxi operators as could be observed when the tax exemption for hybrids and EVs were introduced. All data collected during a taxi trial would of course be relevant to the future market for private EV.

Medium and long term Options

Over longer planning horizons, and as technology develops, the market for EV technology could expand beyond the key target markets described above. The shift EV technologies provides a unique opportunity to rethink mobility issues within urban centers in PIC and foster the introduction of a new generation of mobility options that reflects innovation both in terms of technology and business models relative to the current mobility standards. Small electric vehicle sharing and parking facilities could be developed at transit hubs and other major destinations around an urban area. Vehicles automatically recharge while at these facilities and could be easily picked up paying per card. Information on vehicle availability could be shared through widely available wireless networking systems.

More importantly, the energy for such smart vehicles could be generated within solar-friendly, wind-friendly, fuel-cell-friendly smart electrical grids. General Motors has introduce the concept of a "electric networked vehicle," a small lightweight EV conceptually envisioned to be integrated with public transport and power grid development. The GM EV[14] has full **smart grid** capability and can both draw and supply electricity within a smart grid. Such technologies would open markets such as Tonga and Cook Islands, countries that have energy policies with high renewable energy targets that can only be achieved by investing heavily in storage technology as their only viable RE resources are solar and wind. It is clear that even low levels of EV adoption can have a significant impact on an utility and its network. Smart grid technology can help utilities manage this impact by enabling smarter charging. By providing intelligent monitoring and communications capabilities to an electricity network, a smart grid gives utilities much greater control over all aspects of operations, from generation and distribution to metering and billing. As a result, utilities can carefully manage when and how EV charging occurs, collect EV specific meter data, apply specific tariffs for EV charging, engage consumers with information on EV charging status and bill impacts, and collect data for emission reduction credits.

The medium to long term prospects for change in PIC rest on a combination of technological and business innovation— building mobility-on-demand systems using smaller, well-designed, and more efficient lightweight electric vehicles, such as mini cars, scooters, and electric bicycles that are effectively integrated with public transport systems and focus on providing neighborhood-level access to key services and destinations.

[14] http://www.pcworld.com/article/2603609/chevrolet-en-v-2-0-concept-looks-like-a-motorized-ladybug-with-autonomous-talents.html

Bibliography

1) The China New Energy Vehicles Program, Challenges and Opportunities, World Bank April 2011.

2) http://www.frca.org.fj/wp-content/uploads/2012/11/incentive-layout-adjusted.pdf

3) Hjorthol, R. 2013. Attitudes, Ownership and Use of Electric Vehicles; Oslo, Norway: Institute of Transport Economics, 2013.

4) The emergence of pacific urban villages: Urbanization trends in the Pacific islands. Mandaluyong City, Philippines: Asian Development Bank, 2016.

5) 2017 Commodity Markets Outlook, April. World Bank, Washington, DC.

6) Preparing the Solomon Island Sector development project. ADB TA 7335-SOL October 2010

7) Myanmar transport sector policy note: Urban transport. Mandaluyong City, Philippines: Asian Development Bank, 2016.

8) Finding balance: Benchmarking the performance of state-owned enterprises in island countries. Mandaluyong City, Philippines: Asian Development Bank, 2016.

9) Energy storage in grids with high penetration of variable generation. Mandaluyong City, Philippines: Asian Development Bank, 2017.

10) The Bhutan Electric Vehicle Initiative: Scenarios, Implications, and Economic Impact, World Bank 2016.

11) The Economics of Electric Vehicles, University of Chicago, Energy and Energy Policy, December 2015

Annex 1: FEA Tariff

FIJI ELECTRICITY AUTHORITY CUSTOMER SERVICE CENTRES: For billing enquires and disconnection due to late payment please call in to the following offices:-

	CENTRAL	WESTERN	NORTHERN	NADI	PAYMENT AGENCIES
	Marlow Rd, Suva.	Tukani St, Lautoka.	Park Street, Labasa.	Vunavou Lane	All MH Branches
OFFICE HOURS:	Mon-Thur 7.30am-4.30pm 4.30pm Fri 7.30am-4pm.	Mon-Thur 7.30am- Fri 7.30am-4pm.	Mon-Thur-8am-4.30pm Fri-8am-4pm.	Mon-Thur 8am-4.30pm Fri-8am-4pm.	
CASHIER HOURS:	Mon - Thur: 7.30am - 4pm. Fri: 7.30am - 3.30pm.	Mon - Thur: 7.30am - 4pm. Fri: 7.30am - 3.30pm.	Mon - Thur: 8am - 3.30pm. Fri: 8am - 3pm.		

OR CONTACT:
Telephone: 132 333 Email: customer.services@fea.com.fj Website: www.fea.com.fj

EMERGENCY ONLY: 913

CREDIT POLICY

- All bills must be paid on or before the due date as noted on the invoice.
- **Fea** is not obliged to issue reminder notices if your bill remains unpaid after the due date and in such an event, it is empowered to disconnect your electricity supply without further notice.
- If you do not receive your bill around the usual time within the month, please contact our Customer Service Centre on 132 333.
- If you do not pay your bill by the due date your account automatically becomes overdue.
- Overdue bills will result in the disconnection of your electricity supply without further notice.
- To reconnect your electricity supply, you must pay the amount overdue on your bill and a reconnection fee (conditions apply).
- **Fea** may re-assess your security deposit in accordance with Regulation 62(1) of the Electricity Act and you may be required to pay an additional amount to the existing security deposit.
- The fee for reconnections shall be $9.50 (VIP) during working hours and $14.20 (VIP) outside these hours.

Tariff Categories	Approved Tariff Rates (cents/unit) Effective 1st Jan 2016
Domestic Category	
Domestic Tariff -Cents per unit. Less than or equal to (<=) 95 kWh per month, & Combined household income is (<=) $30,000.00, if customer has registered, and entitled for new government subsidy.	**33.10 cents** (15.90 cents/unit will be subsidized by the Government)
Domestic Tariff- domestic customers who do not qualify for Government subsidy. All consumption will be charged at the rate of 33.10 c/unit.	**33.10 cents**
Commercial & Industrial Category Commercial and Industrial Tariff	
Cents per unit – for units up to 14,999kWh per month	**39.90 cents**
Cents per unit – for units in excess of 14,999kWh per month	**41.80 cents**
Maximum Demand Tariff	
(i)Demand > 1000kW	**$38.19/kW**
Demand Charge $ per kW per month Energy Charge in cents per kWh	**31.83 cents**
(ii)Demand > 500kW to 1000kW Demand Charge $ per kW per month	**$36.57/kW**
Energy Charge in cents per kWh	**29.45 cents**
(iii)Demand between 75kW to 500kW Demand Charge $ per kW per	**$34.39/kW**
month Energy Charge in cents per kWh	**27.07 cents**
Excess Reactive Energy	
Excess Reactive Energy penalty fee in cents per kVarh	**41.80 cents**
Institution Tariff c/kWh	
An Institution is defined as a Primary School, Secondary School and a Place of Worship (Church, Temple and Mosque)	**33.10 cents**
Energy Charge in cents per kWh.	
Primary Schools and Secondary Schools	**33.10 cents**
Energy Charge in cents per kWh – for units up to 200 kWh per month	(12.51 cents/unit will be subsidized by the Government)
Primary Schools and Secondary Schools	
Energy Charge in cents per kWh - for units in excess of 200 kWh per month. (12.51 cents/unit will be subsidized by the Government and hence in effect, the customer will pay only 20.59 cents/unit)	**33.10 cents**
Street Light Tariff c/kWh	
Energy Charge in cents per kWh	**33.10 cents**

Notes:

1. **Maximum Demand**
   (a) The maximum demand meters will be reset after the meter reading for that month.
   (b) The maximum demand tariff is available to all Commercial and Industrial customers with a maximum demand in excess of 75kW.
   (c) Maximum demand customers whose demand falls below 75kW in any month will be deemed to have used 75kW in that month and will be charged accordingly.
   (d) **Fea** is not under any obligation whatsoever to offer the maximum demand tariff to any consumer. It is the consumer's responsibility to request this tariff from **fea**.
2. **High Voltage Supply**
   For maximum demand and commercial and industrial consumers who elect to take a supply at high voltage direct from **fea**'s mains, a reduction of 4% in the monthly accounts on this tariff will be allowed.

PRINT RECEIPT HERE

3. **Excess Reactive Energy Penalty Rate**
   Consumers are required to maintain a power factor of not less than 0.85 and fea reserves the right, if a consumer's power factor as determined by **fea**'s recording instruments is less than 0.85, to charge for all excess reactive units of kVarh a t 41.80 cents per unit.
   This charge for reactive units will be in addition to the charge for ordinary kWh units used.
4. **Institution Tariff**
   Cents per unit 33.10 cents
   For premises used wholly or principally as:
   (i) Schools owned and operated by a Management Board
   (ii) Churches, temples and mosques
5. **The applicable tariff for each billing period will be determined in relation only to units used in that billing period.**
6. **All electricity tariffs above are subject to 15% Value Added Tax.**
7. **Determination of Rate**
   In the event where more than one tariff is applicable to an installation the decision of **fea's** Chief Executive shall be final and conclusive.
8. All fees and charges are subject to change by fea pursuant to the provision of the Electricity Act.

Annex 2: SIEA Tariff

SIEA TRADING AS SOLOMON POWER

TARIFF ADJUSTMENTS FOR APRIL 2017

In accordance with **The Electricity Act (Cap 128)** and **The Electricity Tariff (Base Tariff and Tariff Adjustment) Regulations 2016**, the electricity Tariffs have been reviewed and the following new Tariffs will apply with effect from 1st April, 2017.

Tariffs: The Tariffs effective 1st April 2017 will be as follows:

Regular Customer with Kwh Meters

Customer Categories	Network Access Charge SBD/Month	Fuel Charge SBD/kWh	Non-Fuel Charge SBD/kWh
D1 < 50 kWh	15.30	2.23	3.23
D2 50 - 200 kWh	51.00	2.23	3.30
D3 200 - 500 kWh	102.00	2.23	3.36
D4 > 500 kWh	204.00	2.23	3.80
C1 < 250 kWh	40.80	2.23	3.86
C2 250 - 600 kWh	102.00	2.23	3.48
C3 600 - 1300 kWh	204.00	2.23	3.20
C4 1300 - 2500 kWh	408.00	2.23	2.88
C5 > 2500 kWh	1,530.00	2.23	2.74
I1 < 1300 kWh	102.00	2.23	3.54
I2 1300 - 6000 kWh	408.00	2.23	3.05
I3 > 6000 kWh	3,060.00	2.23	2.71

Regular Customer with Cashpower Meters

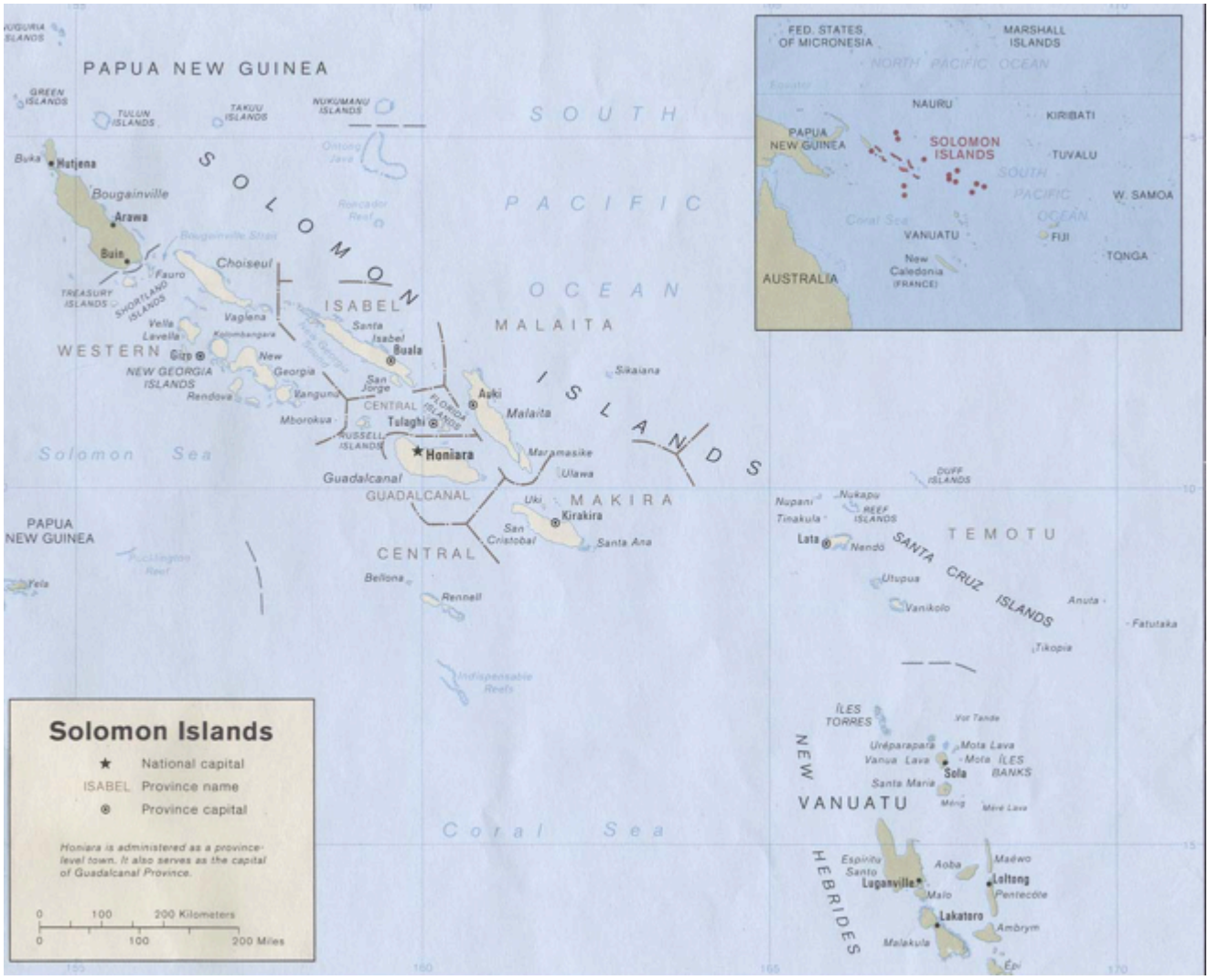
Customer Categories	Non-Fuel Charge SBD/kWh	Fuel Charge SBD/kWh	Energy Charge SBD/kWh
D1 < 50 kWh	3.61	2.23	5.84
D2 50 - 200 kWh	3.66	2.23	5.89
D3 200 - 500 kWh	3.68	2.23	5.91
D4 > 500 kWh	4.22	2.23	6.45
C1 < 250 kWh	4.12	2.23	6.35
C2 250 - 600 kWh	3.75	2.23	5.98
C3 600 - 1300 kWh	3.46	2.23	5.69
C4 1300 - 2500 kWh	3.33	2.23	5.56
C5 > 2500 kWh	2.94	2.23	5.17
I1 < 1300 kWh	4.00	2.23	6.23
I2 1300 - 6000 kWh	3.94	2.23	6.17
I3 > 6000 kWh	2.88	2.23	5.11

Non - Regular Customers

Customer Categories	Network Access Charge SBD/Month	Fuel Charge SBD/kWh	Demand Charge SBD/kW/Month
Domestic	102.00	2.23	558.66
Commercial	408.00	2.23	917.62
Industrial	408.00	2.23	772.28

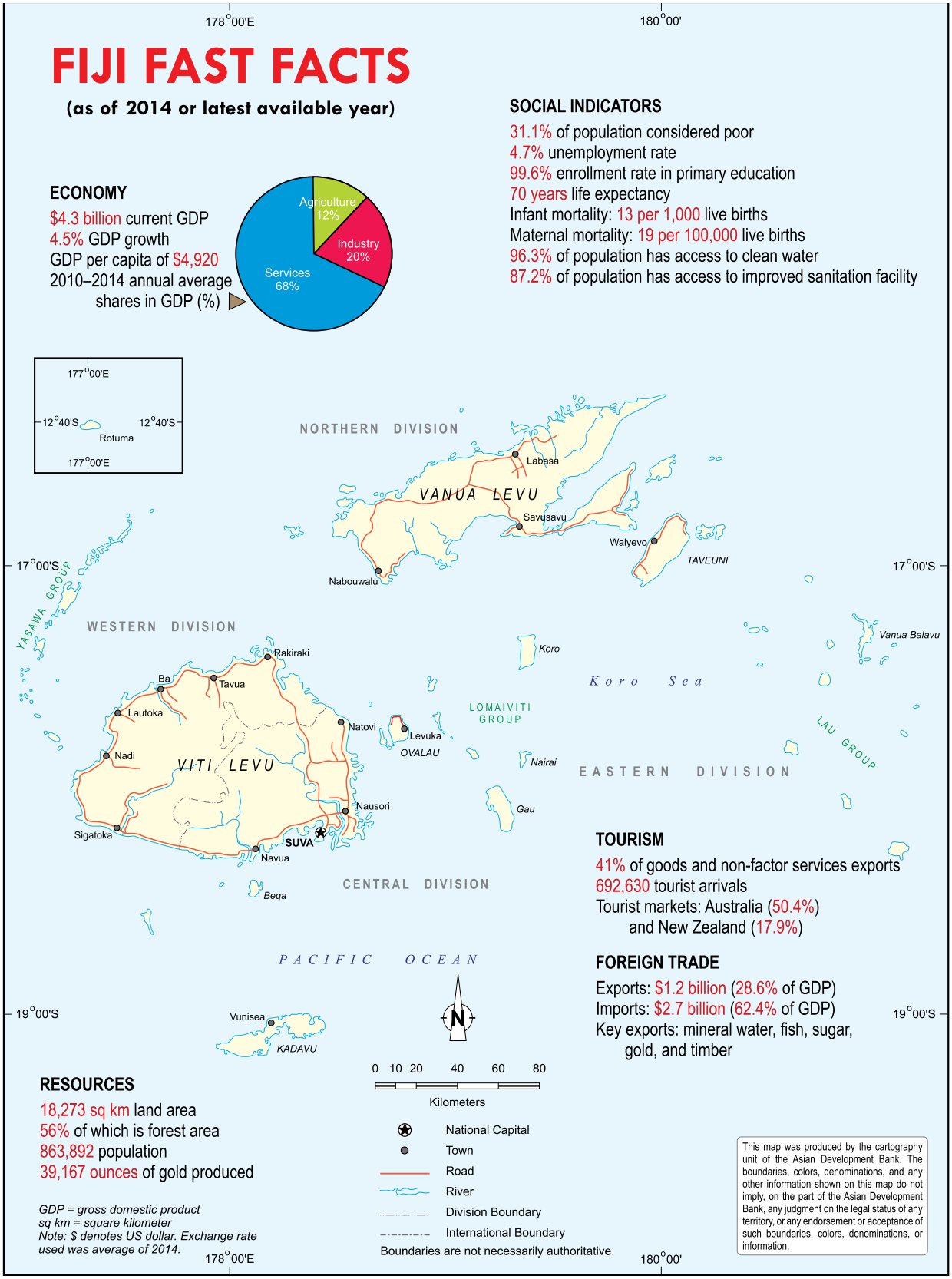
Solomon Islands Electricity Authority (SIEA) trading as Solomon Power

Annex 3: Map Solomon Islands



Source: Wikipedia

Annex 4: Map Fiji Islands



Source: ADB

Annex 5 Levelised Transport Cost

Solomon Islands

		Fuel Cost Euro/L			0.992	Discount Rate		5%
		Annual Milage km			20,000			
		Electricity Cost Euro/kWh			0.6708			
		Distance km			20,000			
Milage	Year	E-Up	Fuel	Total	Up TSI	Fuel		Total
20,000	1	34,701	1693.2	36,394	15,480	893.16		16,373
20,000	2		1693.2	1693.224		893.16		893
20,000	3		1693.2	1693.224		893.16		893
20,000	4		1693.2	1693.224		893.16		893
20,000	5		1693.2	1693.224		893.16		893
20,000	6		1693.2	1693.224		893.16		893
20,000	7		1693.2	1693.224		893.16		893
20,000	8		1693.2	1693.224		893.16		893
20,000	9		1693.2	1693.224		893.16		893
20,000	10		1693.2	1693.224		893.16		893
154,435				46,123				21,640
			Euro/km	0.299				0.140

Fiji

		Fuel Cost Euro/L			0.824			
		Annual Milage km			20,000			
		Electricity Cost Euro/kWh			0.149	Discount Rate		5%
		Distance km			20,000			
	Year	E-Up	Fuel	Total	Up TSI	Fuel		Total
20,000	1	29,321	348.66	29,670	20,520	741.15		21,261
20,000	2		348.66	348.66		741.15		741
20,000	3		348.66	348.66		741.15		741
20,000	4		348.66	348.66		741.15		741
20,000	5		348.66	348.66		741.15		741
20,000	6		348.66	348.66		741.15		741
20,000	7		348.66	348.66		741.15		741
20,000	8		348.66	348.66		741.15		741
20,000	9		348.66	348.66		741.15		741
20,000	10		348.66	348.66		741.15		741
154,435				30,617				25,266
			Euro/km	0.198				0.164