Republic of Fiji

Sustainable Energy for All (SE4All):

Rapid Assessment and Gap Analysis

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This is a publication of the Government of Fiji.

This document was prepared by the National Energy Policy Review Advisory Committee, chaired by the Department of Energy, with the assistance of Economic Consulting Associates Limited and SMEC.

The National Energy Policy Review Advisory Committee was made up of the Department of Energy and the Department of Transport of the Ministry of Transport, Works and Public Utilities, the Ministry of Strategic Planning, National Development and Statistics, the Climate Change Unit of the Ministry of Foreign Affairs, the Reserve Bank of Fiji, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the United Nations Development Programme (UNDP).

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DEPARTMENT
OF ENERGY

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Abbreviations and Acronyms

ACP	Africa Caribbean Pacific Organization
ADB	Asian Development Bank
APEC	Asia Pacific Economic Cooperation
CCCPIR	Coping with Climate Change in the Pacific Island Region programme jointly implemented by the SPC and GIZ
CNO	Coconut Oil
CROP	Council of Regional Organizations in the Pacific
DAC	Development Assistance Committee
DFI	Development Finance Institution
DoE	Fiji Department of Energy
EC	European Commission
EEZs	Exclusive Economic Zones
EE	Energy Efficiency
EIB	European Investment Bank
EU	European Union
EDF	European Development Fund
FAO	Food and Agriculture Organisation of the United Nations
FBoS	Fiji Bureau of Statistics
FCC	Fiji Commerce Commission
FDI	Foreign Direct Investment
FEA	Fiji Electricity Authority
FJD	Fiji Dollar
FSC	Fiji Sugar Corporation
FREPP	Fiji Renewable Energy Power Project (GEF)
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIZ	German Agency for International Cooperation
GIS	Geographical Information System
GoF	Government of Fiji
IPP	Independent Power Producer (private single purpose investor)
MoF	Fiji Ministry of Finance
NEP	National Energy Policy
NEF	National Energy Forum
OECD	Organisation for Economic Co-operation and Development
PIC	Pacific Island Country
PPA	Pacific Power Association / Power Purchase Agreement
PPI	Private Participation in Infrastructure
PPP	Public Private Partnership
PCCPP	Peoples Charter for Change, Peace and Progress
PSD	Private Sector Development
RBF	Reserve Bank of Fiji
RESCO	Renewable Energy Service Company
RDSSED	Roadmap for Democracy and Sustainable Socio - Economic Development
SAIDI	System Average Outage Duration
SAIFI	System Average Interruption Frequency Index
SE4ALL	Sustainable Energy for ALL (UN Initiative)
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Regional Environment Programme
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USP	University of the South Pacific
TA	Technical Assistance
WB	World Bank
WTO	World Trade Organisation

Minister's Foreword

The Sustainable Energy for All (SE4All): Rapid Assessment and Gap Analysis report lays out Fiji's targets and requirements for achieving sustainable energy for all Fijians. It presents a comprehensive analysis of the overall energy situation in Fiji and subsequently identified the key gaps and support needed for achieving the three intertwined objectives of SE4All:

i. ensure universal access to modern energy services

ii. double the global rate of improvements in energy efficiency

iii. double the share of renewable energy in the global energy mix.

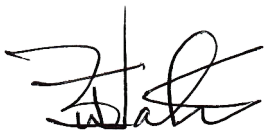
The Government's aim to provide all Fijians with access to modern energy services which are also affordable, clean and reliable is well supported by the SE4All initiative which provides further impetus to the 'Green Growth' development model pursued by the nation. Therefore, this SE4All report is reflective of Fiji's efforts towards realizing the United Nation's vision of 'Sustainable Energy for All'.

Targets for the Fiji SE4All initiatives with commitments in the short-medium term (2020) as well as in the long term up to 2030 are closely aligned with the National Energy Policy (NEP) and in common with the SE4All initiative, Energy Efficiency and Renewable Energy are also amongst the key strategic areas identified in the NEP. Therefore, implementation of the NEP and the related Strategic Action Plan will compliment works towards achieving the objectives of the SE4All. The Department of Energy will be the lead implementing agency for NEP and SE4All initiatives.

Furthermore, in view of our high dependency on imported mineral fuels coupled with the escalating fuel prices, the global SE4All initiative offers the challenge as well as the opportunity to collaborate at the global front and also seek support and cooperation for greater utilisation of indigenous renewable energy resources. Thus, with the completion of the SE4All analysis for Fiji, the nation stands prepared to continue working closely with the United Nations for the betterment of the lives of all Fijians.

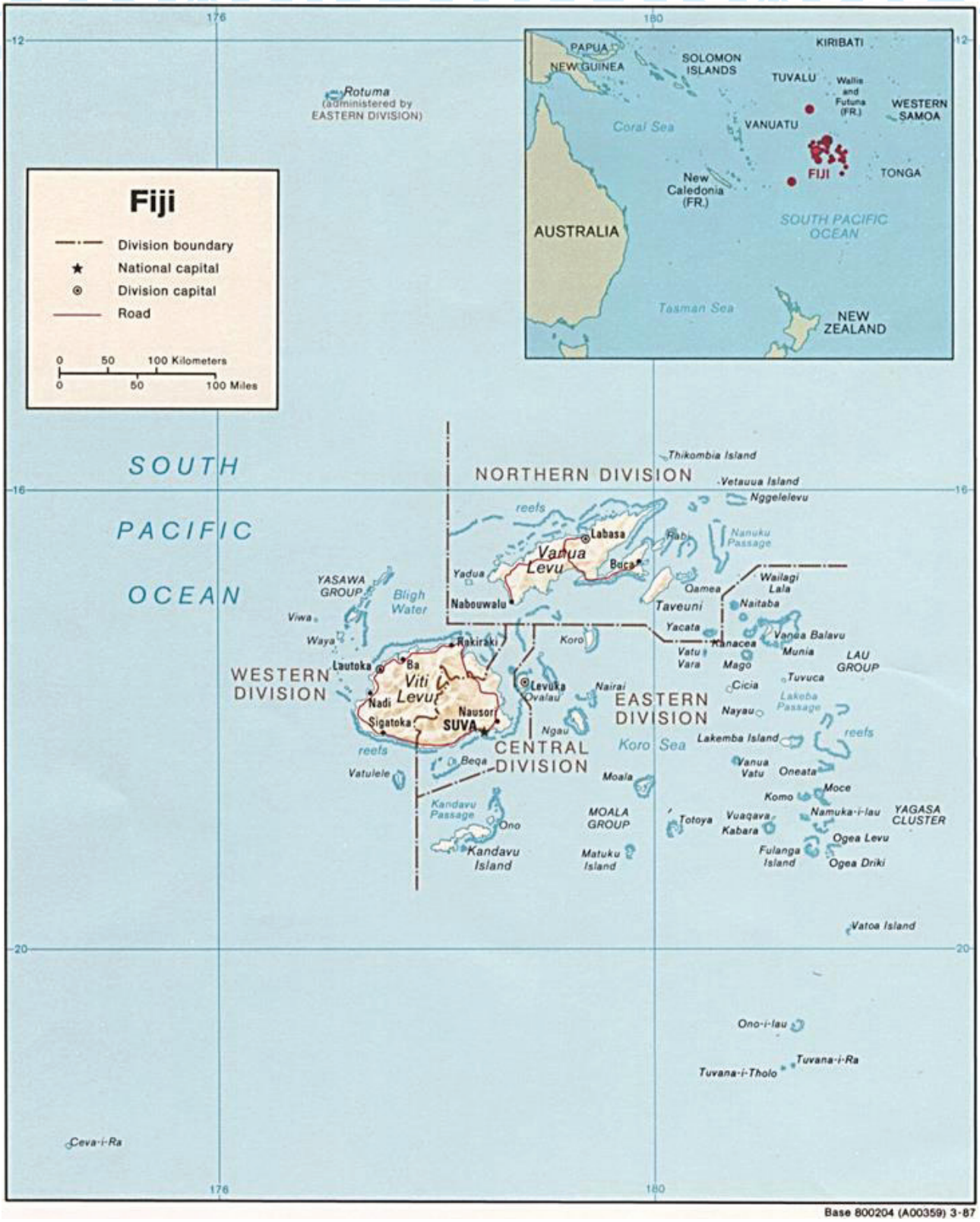
Finally, the outstanding feature in the consolidation of this important document has been the active involvement of all stakeholders through an open, transparent and inclusive consultative process. On the same note, I extend my sincerest appreciation to all stakeholders for their valuable inputs and I laud the tremendous contributions of the National Advisory Committee. My thanks are also due to our development partners and funding organisations the Deutsche Gesellschaft für Internationale Zusammenarbeit (German Technical Cooperation - GIZ), the German Government and the United Nations Development Programme (UNDP) for their support.

I entrust the SE4All initiative will enhance our efforts towards securing a resource efficient, cost effective and sustainable energy future for Fiji.



Timoci Lesikivatukoula Natuva
Minister for Works, Transport and Public Utilities

Map of Fiji


Fiji
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SOLOMON ISLANDS
KIRIBATI
TUVALU
Wallis and Futuna (FR.)
WESTERN SAMOA
VANUATU
Coral Sea
FIJI
TONGA
New Caledonia (FR.)
AUSTRALIA
SOUTH PACIFIC OCEAN
Tasman Sea
NEW ZEALAND
Rotuma (administered by EASTERN DIVISION)
SOUTH PACIFIC OCEAN
NORTHERN DIVISION
WESTERN DIVISION
CENTRAL DIVISION
EASTERN DIVISION
Koro Sea
Thikombia Island
Vetauua Island
Nggelelevu
reefs
Labasa
Vanua Levu
Yadua
Buca
Nabouwalu
Bligh Water
YASAWA GROUP
Viwa
Waya
Rakiraki
Koro
Taveuni
Qamea
Wailagi
Lala
Naitaba
Yacata
Kanacea
Vanea Balavu
Munia
LAU GROUP
Vatu Vara
Mago
Tuvuca
Cicia
Lakeba Passage
Nayau
Lakemba Island
Vanua Vatu
Oneata
Moce
Komo
Namuka-i-lau
YAGASA CLUSTER
Ogea Levu
Ogea Driki
Fulanga Island
Totoya
Vuaqava
Kabara
MOALA GROUP
Matuku Island
Moala
Lautoka
Ba
Viti Levu
Nadi
Sigatoka
Nausori
SUVA
Levuka
Ovalau
Nairai
Ngau
Beqa
Vatulele
Kandavu Passage
Ono
Kandavu Island
Vatoa Island
Ono-i-lau
Tuvana-i-Ra
Tuvana-i-Tholo
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Executive Summary

The Sustainable Energy for All (SE4ALL) is a global initiative aimed to mobilise actions from all sectors of society to achieve the three objectives below by 2030:

- ❑ Ensure ***universal access*** to modern energy services
- ❑ Double the global rate of improvements in ***energy efficiency***
- ❑ Double the share of ***renewable energy*** in the global energy mix.

Fiji has seen significant progress over the last ten years, especially in the area of access to modern energy and in increasing the share of renewable energy sources in electricity generation. New bio-fuel, wind, solar and hydropower plants have been installed, rural electrification has advanced, energy efficiency promotion has been conducted by the Department of Energy and some incentives to replace inefficient vehicles and appliances are in place, amongst other activities in the energy sector.

As a small island nation in the Pacific, one of the main issues in Fiji's energy sector is the high reliance on imported fuels. The impact of the energy sector on Fiji's macro-economy through high and volatile fuel prices and high import payments is significant. The need to reduce reliance on imported fuels and thus safeguard foreign reserves is considered key in ensuring macro-economic stability for Fiji. This provides a natural drive for Fiji to find alternative fuels in the form of renewable and indigenous fuels.

Current situation

Universal access

Fiji is making progress in providing access to modern energy services. Of the rural population, approximately 82% has access to electricity (2007), which reflects a marked improvement – rural electrification was approximately 69% in 2003 – but it is still significantly less than the 96% of the urban population with access to electricity (as at 2007).

Access to modern cooking fuels is almost universal for all urban and peri-urban areas while in rural areas the use of biomass is still common. The situation in rural areas is perhaps due to issues of affordability of modern fuels and supply chain gaps. However, there are significant data gaps on rural energy consumption, which constrain long term planning. Under the new draft 2014 National Energy Policy (NEP), provisions have been made to address these data constraints. Once sufficient data has been collected and analysed, it will be possible to effectively devise measures aimed at improving the situation of those rural dwellers that still use biomass fuels.

Energy efficiency

In the 2006 NEP the Government committed itself to facilitating greater energy efficiency in the industrial and other sectors. The Department of Energy (DoE) has established a Demand Side Management (DSM) unit which is responsible, among others, for the implementation of the Energy Conservation and Efficiency Programme. At present the DSM unit is staffed by six officers. Fiji is also the only Pacific Island Country (PIC) to date to have introduced mandatory minimum energy performance standards and appliance labelling for freezers and refrigerators with the DoE planning to expand this system to cover other appliances in the next few years.

Apart from DoE, the Fiji Electricity Authority (FEA) also maintains a DSM unit. FEA is committed to assist its customers to become more energy efficient, and use energy responsibly. FEA's DSM unit is responsible for providing technical assistance and also for spreading awareness of energy efficiency.

The draft 2014 NEP includes a quantifiable energy efficiency target for both fuel and electricity.

Renewable energy

The FEA has been performing relatively well in comparison with other PIC utilities in the region. However, it has been unable to achieve its own renewable energy target of reaching 90% renewable energy electricity by 2012 (FEA, 2010). Nevertheless, the electricity sector still has the potential to transform Fiji's energy sector. By utilising the considerable local

renewable energy resources particularly geothermal energy and an almost untapped solar potential, the power sector could replace its own fossil fuel use worth approximately 100 million FJD per annum. Fiji's NEP 2006 had set a goal to achieve 50% renewable energy in all sectors by 2015. Currently, the main contributor to renewable energy is power generation, with 60% of grid electricity generated using renewable energy sources (FEA, 2011). It is clear that renewable energy needs to be promoted as a replacement of fuels in other sectors as well, in particular the land and maritime transport sectors.

In the transport sector, the 2006 NEPstated that 30% of transport fuel should be from alternative sources such as LPG and bio-fuels by 2010. This has not been achieved, as in 2012, only 2% of land transport used alternative sources. There are opportunities for replacing fossil fuels used in land transport through the use of bio-fuels, hybrid and electric vehicles. However, in the case of the latter, this assumes that the increase in electricity generation needed to support land transport could be met through renewable energy generation. In addition, according to research conducted at the University of the South Pacific (USP), there is a considerable potential to reduce fossil fuel consumption in maritime transport. Options include the use of renewable energies (bio-fuel, solar and wind) and improved efficiency of vessels and engines.

Main challenges and gaps

One of the main challenges in the power sector is institutional in nature: there is no effective Independent Power Producer (IPP) framework in place that would attract the urgently needed private capital into renewable energy based power generation. FEA has operated since 1966 as a State-owned Enterprise (SOE) without effective regulatory oversight. Hence, FEA has determined the conditions for potential private sector participants. For example, power purchase tariffs offered by FEA to date have not been sufficient to attract private investors or IPPs and power generation project selection criteria are not clear. FEA currently offers an IPP tariff that is 11.5% under the minimum IPP tariff of 25.65 FJD cents/kWh set by Fiji's price regulator the Fiji Commerce Commission (FCC)[1].

Whilst planning for restructuring of FEA is under way, another constraint in attracting private sector investment into energy projects is the challenging business environment in Fiji (WB, 2012). Although the commercial banking sector has an unprecedented liquidity, access to capital for energy sector investment is difficult. For private sector investment to take off, these and other gaps needed to be closed. The World Bank (WB) supported Sustainable Energy Finance Project (SEFP) implemented by DoE addresses small-scale financing, but does not have the resources to support financing of larger IPP projects.

An enabling framework for private sector participation would also have to address the barriers that currently exist with regards to small-scale decentralised grid-connected renewable energy based generation. At present there are no feed-in tariffs, net metering provisions or incentive programmes that would promote such generation by households and Small and Medium Enterprises (SMEs). DoE has launched a new project with support from GEF and UNDP: The Fiji Renewable Energy Power Project (FREPP) which aims to address some of the constraints in these areas.

Therefore, gaps in existing policies relating to expanding the grid and renewable generation supplying the grid include, amongst others, a need for:

- ❑ a Power Development Plan (PDP) that is updated on an annual or biannual basis, building on the present PDP developed by FEA;
- ❑ a regular review of the costs and resource availability for different generation technology options (this could be a component of the PDP;
- ❑ a grid asset management plan detailing the operation and maintenance programme and costs for managing the grid and associated generation. This will facilitate that on one hand the grid is not being run down and on the other there is no "gold plating". Additionally, this plan (that defines the operations and maintenance costs for the existing grid and generation) will also assist in setting the electricity tariff basis;
- ❑ a transparent IPP framework for the competitive procurement of large-scale generation;
- ❑ a clearly defined framework for connecting small scale Renewable Energy (RE) technologies to the grid. This would encourage rooftop solar and other forms of small-scale renewable generation; and
- ❑ the transfer of technical regulatory functions to an existing Government entity or the establishment of an independent regulator.

1 The IPP tariff was set by the Fiji Commerce Commission determination of 2012.

In terms of the energy sector in general, numerous recent energy sector studies in Fiji and the wider Pacific region have identified the poor quality of national and regional energy sector data as a constraint on the effective analyses of issues. Reliable time series data is lacking and critical information is often not disclosed by key public and private sector stakeholders. This limits opportunities for policy, planning, rational decision-making and future performance improvement. In particular, there is a considerable data gap with regard to the use of firewood or other biomass as a traditional fuel source and in the electricity sector there is limited reliable, consistent, up-to-date information on resources, fuel use, and technical and economic performance of the power utility.

Targets

Fiji's targets for the energy sector as laid out in the draft 2014 NEP, given below, are aligned with the Sustainable Energy for All (SE4ALL) initiative of the United Nations[2].

Indicator	Baseline	Targets		
		2015	2020	2030
Access to modern energy services				
Percentage of population with electricity access	89%[3] (2007)	90%	100%	100%
Percentage of population with primary reliance on wood fuels for cooking	20%[4] (2004)	18%	12%	<1%
Improving energy efficiency[5]				
Energy intensity (consumption of imported fuel per unit of GDP in MJ/FJD)	2.89[6] (2011)	2.89 (0%)	2.86 (-1%)	2.73 (-5.5%)
Energy intensity (power consumption per unit of GDP in kWh/FJD)	0.23 (2011)	0.219 (-4.7%)	0.215 (-6.15%)	0.209 (-9.1%)
Share of renewable energy				
Renewable energy share in electricity generation	60%[7] (2011)	67%	81%	100%
Renewable energy share in total energy consumption	13%[8] (2011)	15%	18%	25%[9]

Priority policies

The drafting of this report and the development of the 2014 NEP have been closely coordinated in order to ensure that targets, policies and strategic actions are aligned and consistent. Summaries of the priority policies for each key area of Fiji's energy sector are provided below. These priority policies have been chosen on the basis that they have the most potential to achieve the objectives and targets for the energy sector. For all the other policies please refer to the 2014 NEP.

Grid-based power supply:

- ❑ Increase private sector investment in large-scale electricity generation., by establishing a transparent process for procurement of new large-scale capacity from Independent Power Producers (from both renewable and non-renewable energy sources), pricing and other principles to be applied in all new Power Purchase Agreements, and grid-connection standards.
- ❑ Increase private sector investment in small-scale grid-connected renewable generation, by establishing economically justified feed-in tariffs or similar mechanisms to give incentives and reduce the risks for electricity production from small-scale renewable sources that are connected to the grid (including by providing investors an adequate return

2 These targets will be further developed and refined over time as energy information becomes available.
3 Preliminary data from 2007 Census, Fiji Islands Bureau of Statistics.
4 2002-03 Household Income and Expenditure Survey, Fiji Islands Bureau of Statistics. Reliance on wood fuels as the main fuel for cooking.
5 Based on 15% fuel substitution to local fuels and a 3% annual efficiency improvement.
6 Fiji Islands Bureau of Statistics based on average 36 MJ per litre of fuel.
7 Annual Report 2011, FEA.
8 Based on total energy consumption of 16,500 TJ (Fiji Islands Bureau of Statistics) and 60% power generation from renewables (FEA). .
9 Based on 99% renewable power and 25,000 KL of biofuel.

on capital). These mechanisms should not disadvantage either FEA or investors and the implementation of such mechanisms should not add unduly to the overall cost of electricity supply in Fiji. This will be accompanied by net metering arrangements that give electricity consumers incentives to invest in on-site small-scale renewable energy generation.

- ❑ Strengthen transparency and effectiveness of the regulation of the electricity industry. This includes establishing a formal regulatory contract with Fiji Electricity Authority (FEA) that sets out a process for regularly reviewing the efficient costs of electricity supply and setting tariffs to recover these, and making all forms of electricity subsidy transparent including to energy consumers. It also includes ensuring the technical and economic regulatory functions (including licensing and defining frameworks for encouraging Independent Power Producers) are carried out by the DoE and the Fiji Commerce Commission.

Rural electrification:

- ❑ Develop a national electrification master plan, showing how each un-electrified area of Fiji will be served with least cost solutions. Technological solutions to be considered in consultation with communities will include grid extension, diesel and hybrid mini-grids, and solar home systems. The plan will also clearly define a minimum level of service which qualifies as 'electrification'.
- ❑ Establish a dedicated electrification fund and an associated framework that will be used to provide capital subsidies for electrification projects. The electrification fund will facilitate the implementation of the national electrification master plan. The fund framework should consider how to facilitate equitable electricity access taking into account gender aspects and vulnerable groups. Going forward, funding being provided by the Government for the implementation of rural electrification projects will be channelled into this fund, thereby making subsidies more transparent and easier to monitor and evaluate. Subsidies will leverage capital contributions from beneficiaries and project promoters as far as possible and will be provided as once-off capital contributions for viable projects. Recurrent costs will not be subsidised.

Renewable energy:

- ❑ Maintain a comprehensive assessment of Fiji's renewable energy resources, including hydro, wind, biomass, solar, and geothermal resources. This assessment will include an inventory of available sites and technologies, their technical and economic viability, and social and environmental impacts.
- ❑ Make all data on renewable energy resources available to the public and prospective investors through a single national repository at the Department of Energy. This will ensure that a lack of information on resource potential does not continue to be an impediment to private sector and other relevant project developers.
- ❑ Conduct further investigations into geothermal energy resources with a view to identifying a pilot project for development. This recognises the contribution that geothermal energy can make to diversifying the energy mix, providing base load generation and thereby reducing the reliance on hydropower and petroleum imports.

Transport:

- ❑ Promote the fuel efficiency of imported motor vehicles in order to reduce petroleum consumption. This includes continuing to enforce age limits for second hand vehicles and provide import tax incentives. It may also include introducing new measures such as labelling for vehicle fuel economy of imported land transport vehicles.
- ❑ Investigate the potential and cost-effectiveness of energy efficiency and renewable energy solutions for sea vessels, including biofuels, solar and sail-assisted sea transport and efficient motors, vessel design, and improved maintenance models to improve the overall efficiency and reduce fuel consumption in sea transport within Fiji.
- ❑ Support the development and implementation of the Department of Transport's land and marine transport policies that encourage a shift towards more energy efficient forms of land and sea transport.

Petroleum and bio-fuels:

- ❑ Reduce the cost of imported petroleum products by negotiating directly with fuel suppliers and reviewing the pricing templates for petroleum products. Also continue to explore the costs, potential benefits and risks of bulk procurement of petroleum, building on existing studies and initiatives in this regard. This may include regional cooperation or the creation of a single (bulk) buyer to improve bargaining power.

- ❑ Improve the transparency of petroleum supply, including collecting data on fuel quantity imports, re-exports, consumption, and pricing and making this data publicly available.
- ❑ Continue research to explore the potential for increased production and use of bio-fuels. This includes encouraging the production of coconut oil in remote islands and the use of locally produced molasses for ethanol production. Any actions for the widespread development of bio-fuels in Fiji should be based on rigorous analysis showing that it is both technically and economically feasible and should be mindful of the risks, in particular the trade-offs between production of crops suitable for conversion to bio-fuels and production of food and cash crops.

Energy efficiency:

- ❑ Continue to increase public education and awareness of energy efficiency by providing targeted information to end-users on the range of energy saving technologies and options available. This should include encouraging businesses to undertake energy audits and to factor in the operating costs of energy use as well as the capital costs when investing. Public awareness campaigns should be informed by analysis of energy consumption patterns and market research of appliance purchases. Education and awareness campaigns should target specific groups.
- ❑ Extend the current system of energy labelling and minimum energy performance standards to all widely imported electrical appliances and industrial equipment that contribute substantially to energy demand. A system will be put in place to prevent and protect consumers from the use of false energy rating labels.
- ❑ Develop and implement an energy information database, so that demand side data is collected and analysed and a verifiable data trail is created upon which energy savings can be verified. Where possible this data should be disaggregated by rural and urban users, sex and socio-economic groups. This database will be integrated with other supply-side energy information databases where possible.

1 Introduction

1.1 Country Overview

1.1.1 Physical Characteristics[10]

Fiji lies between 177° E and 178° W Longitude and 12° to 22° S Latitude with a land area of 18,333 km^2. This includes 320 islands of which about a third are inhabited. The majority of the land is on continental-like volcanic islands that rise to well over 1,000 metres in elevation. Over 87% of the land is concentrated in the islands of Viti Levu and Vanua Levu. Fiji's climate is tropical, averaging 26°C with annual rainfall ranging from 1800 to 2600 mm. It is considerably richer in natural resources than its Polynesian and Micronesian neighbours with extensive timber, rich soils, mineral deposits and fish. The country is subject to earthquakes, landslides, cyclones, flooding, and storm surges.

1.1.2 Population

The latest census was undertaken in 2007. The Fiji population by geographic sector is presented in the Table 1[11].

Table 1 Fiji population by geographic sector

Geographic Sector	Population Size
Urban	424,846
Rural	412,425
Total Fiji	837,271

Source: Fiji Island Bureau of Statistics, 2008

The population increased during the 1996-2007 intercensal period by 62,194 persons. This increase amounts to an average intercensal rate of growth of 0.7% per year, compared to 0.8 % per year during the previous 1986-1996 intercensal period. In other words, during the last two decades, the national population growth rate has remained almost the same. During the 1996-2007 intercensal period, urbanization continued: in 2007 the urban population was larger than the rural population. The urban population is now about 51% of the total population. Given continuation of the present growth rates for the different ethnic groups, it is estimated that the population of Fiji will reach the one million mark in 2030and that by 2030, 61% of the population will be urban.

1.1.3 The Economy

The World Bank classifies Fiji as a lower middle-income economy.[12] Table 2 below shows gross domestic products (GDP) per capita in US$ for the period 2008-2011. As can be seen per capita GDP in 2011 was US$ 4,397. Fiji's growth has been extremely volatile as a result of a series of external and internal shocks. These include a series of natural disasters (cyclones in 1985, 1992, 1993, 2009, and 2010); two global oil shocks (in 1979 and in 1981–1982); effects of coups (1987, 2000, and 2006); the Asian financial crisis (1997); spikes in food and fuel prices (2008); the global economic crisis (2009 and 2010); and, more recently, severe flooding in the Western and Northern Divisions of the country (January 2012 and late March 2012) followed by Tropical Cyclone Evan in December 2012 (ADB, 2012).

10 Pacific Regional Energy Assessment 2004 – Fiji National Report, SPREP, pp. vii, 2005.
11 Census 2007 Results: Population Size, Growth, Structure and Distribution, Fiji Islands Bureau of Statistics, Statistical News No 45, pp. 1-2 & p. 4, 2008.
12 http://data.worldbank.org/country/fiji

Table 2 GDP per capita 2008 – 2011

Year	GDP Per Capita (US$)
2008	4,255
2009	3,377
2010	3,687
2011	4,397

Source: World Development Indicators, World Bank

Fiji is one of the most developed of the PIC economies, though still with a large subsistence sector.[13] Services are by far the major contributor to GDP.[14] Fiji's economy is relatively well diversified and has experienced significant structural changes in recent years. The services sector currently accounts for more than half of GDP, with the balance provided by primary production (13%), manufacturing and mining (14%), and utilities (4%). Structural change is occurring, both within and between sectors, as urban-based services and manufacturing activity become relatively more important, and as the agriculture and forestry sectors declines (ADB 2012).

The services sector has steadily grown and has increased between 1970 and 2009 from 32% of GDP to 69%. Rapid growth in the services sector has been the result of a steady expansion in tourism-related services, finance, communications, wholesale and retail trade, and public services. The share of the agriculture, forestry, and fisheries sector in GDP has declined steadily over the past decade. Within the agriculture sector, large shifts have occurred—the share of sugar to agricultural GDP began to fall after 1999 while non-sugar output has climbed. In 2011, real GDP increased by 2.7%, but this reflects primarily a bounce-back in agricultural output from the natural disasters in 2009 and 2010. Real GDP growth was 1.7% in 2012 and is forecast at 3.6% for 2013[15].

Almost all Fiji's raw materials (including fuels), intermediate and capital inputs are imported.[16] International trade and investment are vital to Fiji given its small domestic market and limited natural resources. According to ADB near-term growth is expected to be driven by tourism and public infrastructure investments and longer-term economic prospects are likely to be influenced by political as well as economic developments.[17] Fiji's economy is forecast to grow by 3.6% in 2013[18], driven mainly by tourism and higher public capital expenditure. Higher consumption, combined with public infrastructure work, election-related expenditure, and continued expansion in tourism in line with an improving global economy, underpin a GDP projection of 3.0% in 2014[19]. Barriers to higher growth include limited fiscal flexibility under current debt levels and a challenging business environment, as well as a longstanding need for structural reform in some sectors, particularly in the sugar sector.[20]

The latest ADB economic report[21] concludes that Fiji's private sector operates below its potential due to constraints in factor markets[22], the extensive role played by state-owned enterprises, poor quality infrastructure, overregulation, and gaps in the commercial legal framework. This situation is exemplified by the poor participation of the private sector in power generation. The lack of a clear regulatory framework for independent power producers (IPP)[23] has prevented potential private sector investors from bringing their IPP projects to closure. Since 2006 foreign direct investment (FDI) projects implemented have declined significantly. Using foreign investment as a proxy for the quality of the private sector investment regime, the recent trend in FDI thus reflects weaknesses in the investment climate.

In contrast to other PICs, external aid plays a relatively modest role in Fiji. Between 2008 and 2010, Fiji received an amount equivalent to 2% of GDP, from the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) countries. In 2008, for example, Fiji received a total of $40 million in net official development assistance, of which $28.6 million was in the form of bilateral grants and $11.8 million was multilateral assistance. The main traditional bilateral donors are Australia, Japan, and New Zealand, with France and the United States (US) also providing aid in some years. Multilateral aid flows are, among others, from ADB, the European Union (EU), the United Nations (UN), and the World Bank (WB). Non-traditional donors have been providing significant external credits since

13 Republic of Fiji – Poverty Trends, Profiles and Small Area Estimation (Poverty Maps) in Republic of Fiji (2003-2009), World Bank, p. 2, September 2011.
14 Fiji Trade Policy Review - Report by the Secretariat, World Trade Organization (WTO) Secretariat, p. vii, 18 February 2009.
15 Republic of Fiji - Economic and Fiscal Update: Supplement to the 2014 Budget Address, Ministry of Finance, 8th November 2013.
16 Fiji Trade Policy Review - Report by the Secretariat, World Trade Organization (WTO) Secretariat, p. viii, 18 February 2009.
17 Asian Development Outlook 2013 – Asia's Energy Challenge, ADB, pp. 260-261, 2013.
18 Republic of Fiji - Economic and Fiscal Update: Supplement to the 2014 Budget Address, Ministry of Finance, 8th November 2013.
19 Ibid
20 Asian Development Outlook 2013 – Asia's Energy Challenge, ADB, p. 262, 2013.
21 Fiji 2012: Revitalising the Fiji economy, Asian Development Bank.
22 A factor market is a market used to exchange the services of a factor of production: labour, capital, land and entrepreneurship. Factor markets, also termed resource markets, exchange the services of factors, not the factors themselves which are exchanged through product markets. Capital and land are two resources than can be and are legally exchanged through product markets. The services of these resources, however, are exchanged through factor markets (see also Economic Glossary http://glossary.econguru.com/).
23 The World Bank Definition for IPP is used here: A long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility (Reference Guide PPP, World Bank, 2012 p11).

2008. The ratio of aid to GDP ranged from 2.4% of GDP to almost 5% of GDP in the 1990s, but it has fallen to about 2% of GDP in 2008–2010. In 2006, the EU suspended new aid programmes while the WB and ADB halted new lending. New sources of foreign borrowing have been tapped to offset the decline in financing from Fiji's traditional donors, with official loans for infrastructure development provided by a number of new development partners, including the People's Republic of China and Malaysia.

1.1.4 Poverty

According to the Fiji Bureau of Statistics poverty report from 2012 in 2008/09 31% of the Fijian population lived in poverty. While this number is high, the overall national incidence of poverty declined from 35% in 2002/03. While there has been considerable improvement in urban areas over the six years (a decline in poverty from 28% to 19%), rural areas showed increased poverty from 40% to 43% largely attributed to the declining agricultural activities, particularly the sugar industry, and under-developed infrastructure and utilities. [24]

These aggregated national poverty levels disguise a large sub-national variation in poverty. In Fiji the Northern division comes out as poorest (47%), followed by the Eastern Division (35%). In contrast, the Central division (21%) is the least poor division. Among urban areas, the best performers are the Eastern (30%), Central (16%) and Western (17%) divisions. Among rural areas the highest incidence of poverty was recorded in the Northern division (50%), followed by Western (43%), Eastern (39%) and Central division (35%). Poverty in Fiji is driven by multiple factors. Poverty varies considerably by household and individual characteristics. Of these characteristics, old age, number of children, education and employment of household-heads have particularly strong links to poverty. [25]

Development indicators are also generally the highest for the capital city of Suva and surrounding provinces, as well as the more remote outer islands that have benefited from relatively high levels of financial support over an extended period. Indicators in general are lower on Vanua Levu (the Northern Division) compared to the main island of Viti Levu, and are also usually lower in inland areas compared with coastal areas (ADB, 2012).

1.1.5 Human Development including Progress on the MDG

Fiji is classified by UNDP as a medium human development country[26] with a life expectancy at birth at 69.4 years and mean years of schooling of adults being 10.7 years. Although the country has strong social indicators, Fiji's human development ranking dropped from 66th place in 1998 (out of 174 countries) to 100th (out of 187 countries) in 2011 and moved to rank 96 in 2012. Fiji recorded the highest value and ranking in Human Development Index (HDI) among the Pacific island countries in the 1990s, but fell behind Tonga and Samoa in the HDI rankings by 2005.

Since the signing of the Millennium Declaration in 2000, Fiji has made

> "…great achievements towards reaching the MDG targets, particularly in achieving universal basic education, reducing child and maternal mortality, ensuring environmental sustainability, reducing external debt, and making available the benefits of new technology especially in the telecommunications industry".[27]

However according to the second MDG national progress report from 2010, Fiji is unlikely to achieve MDG 1: Eliminate Extreme Poverty and Hunger, MDG 3: Promote Gender Equality and Empower Women; and MDG 6: Combat HIV/AIDS and Other Diseases.

24 Fiji Bureau of Statistics, Poverty in Fiji, 2012
25 Asian Development Bank - Fiji 2012: Revitalising the Fiji economy, Mandaluyong City, Philippines (ADB 2012) & Ministry of Strategic Planning, National Development and Statistics, 2013
26 Human Development Report 2013 - The Rise of the South: Human Progress in a Diverse World, UNDP, 2013.
27 Millennium Development Goals - 2nd Report (1990-2009) for the Fiji Islands, Ministry of National Planning, Government of Fiji, p. ii, September 2010.

1.2 Energy Situation

1.2.1 Energy Policy

In the Roadmap for Democracy and Sustainable Socio - Economic Development (RDSSED) 2010 – 2014 which is aligned to the Peoples Charter for Change, Peace and Progress (PCCPP), the government of Fiji sets out a framework to achieve sustainable democracy, good and just governance, socio-economic development and national unity. The key foundation of the Roadmap is the PCCPP, which was compiled through a nationwide consultation process, involving a wide range of stakeholders. The objective of the Roadmap is to implement policies to achieve the Vision of "A Better Fiji for All", which is consistent with the Peoples Charter. To achieve this vision, the overarching objective is to rebuild Fiji into a non-racial, culturally vibrant and united, well-governed, truly democratic nation that seeks progress and prosperity through merit-based equality of opportunity and peace.

In the Roadmap, the Fiji Government sets the energy sector goal as "***To facilitate the development of a resource-efficient, cost effective and environmentally – sustainable energy sector***". In view of the developments since the formulation of Fiji's first energy policy in 2006 the Government of Fiji has recently undertaken a review of the national energy policy and the accompanying strategic action plan. The present rapid assessment and gap analysis exercise to establish the baseline for the three objectives of SE4ALL[28] and to identify gaps and support needed has been undertaken as part of the energy policy review process. An analysis of the existing legislative framework and recommendations for any possible legislative changes to facilitate the future development of the energy sector for the benefit of the nation was also undertaken as part of this review process.[29]

The energy policy review exercise was carried out with full consultation and participation of key actors (private sector, public institutions, NGOs, financial institutions, development partners, civil society representatives) within relevant sectors. A major National Energy Forum was held in Suva on April 3rd and 4th 2013, to kick-start the consultation process, which was followed by one-on-one interviews with key stakeholders. The event attracted more than 100 participants representing all key stakeholder groups and was characterized by open and productive discussions on gaps, opportunities and key actions required to boost sustainable development of Fiji's energy sector[30]. Additional consultations were held at a National Energy Policy Workshop held on 21st August 2013 in Suva. At this workshop high-level SE4ALL targets were discussed together with the policies suggested for the new NEP. Finally on the 16th October 2013, a Seminar was held where the final draft version of the new draft NEP was presented.

1.2.2 Energy Supply

Primary energy sources

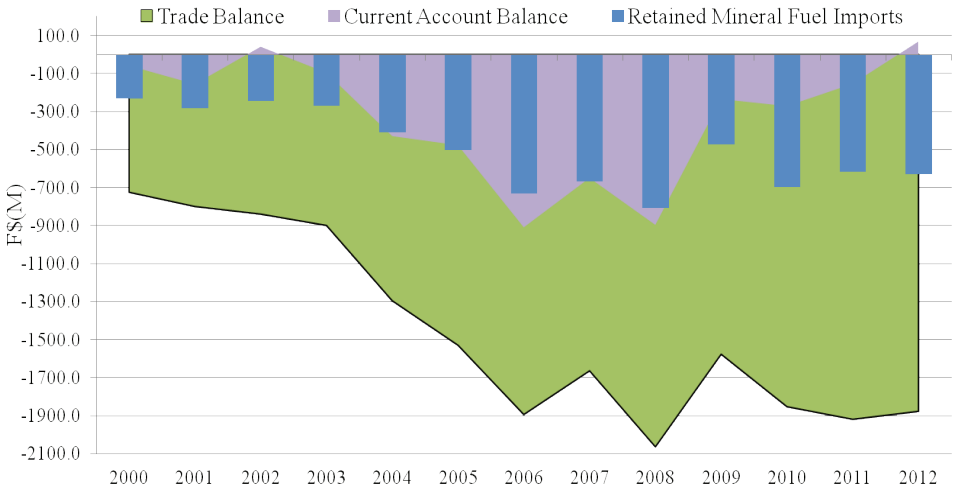
Energy in Fiji is supplied in three main forms: i) biomass/wood for cooking in rural areas and to a lesser extent for power co-generation in the wood and sugar industries; ii) as imported fossil fuels and iii) as electricity, of which a significant share is generated from hydropower with much smaller contributions from wind and solar energy.

There is little known about the quantities of traditional biomass fuels (wood and agricultural waste such as coconut husks and shells) used in Fiji. The Pacific Island Renewable Energy Project (PIREP) report of 2004 estimated the total supply of fuelwood to be 250,000 tonnes per annum. Approximately 500,000 tonnes of bagasse are currently burned in Fiji's sugar industry to generate steam and electricity. Tropic Woods, a woodchip manufacturer supplying the pulp and paper markets also generates steam and electricity using their biomass wastes.

Total retained imports of the three major liquid fossil fuels amounted to 364 million litres in 2011 representing a value of 583 million FJD. In addition approximately 11,000 tonnes of LPG was imported in 2011. Fuel imports account for 30 % of total import value. Fuel imports have a significant impact on the current account and trade deficits as shown in Figure 1. In addition, there is a significant risk of fuel supply interruptions.

28 The three of objectives of SE4ALL by 2030 are: 1) Ensuring universal access to modern energy services; 2) Doubling the global rate of improvement in energy efficiency; and, 3) Doubling the share of renewable energy in the global energy mix.
29 See also www.fdoe.gov.fj/review
30 ECA/SMEG – Report on National Energy Forum, April 2013.

Figure 1 Retained fuel imports and current account



Source: Reserve Bank of Fiji 2012 (data is provisional)

The latest import statistics for the main liquid fuels as displayed in Table 3 below shows the dominance of diesel fuel accounting for 76% of all imports.

The data shows no distinct pattern in terms of volumes with large changes from year to year (e.g. the huge drop in reported aviation turbine fuel volumes from 121 million litres in 2010 to 17 million litres in 2011). This may reflect changing GDP growth but it is more likely a reflection of the lack of reliable data on petroleum imports and consequently, inconsistent data reporting from year to year. For example, visitor arrival figures suggest that the tourism sector expanded from 2010 to 2011, which might be expected to lead to increased aviation fuel use.

These anomalies in the fuel data demonstrate one of the weaknesses in energy sector management: the unreliable and inaccurate data for fuel supply and use. DoE has made concerted efforts to obtain fuel data from the three oil companies operating in Fiji and has offered to sign a Memorandum of Understanding (MoU) which assures that the government would acknowledge commercial confidentiality of the data. However, only the French multinational Total has signed the MoU, but is yet to supply any data to DoE.

Table 3 Fossil fuel supply (retained imports)

	Motor Spirit		Aviation Turbine		Diesel		TOTAL	
Year	Quantity (million litres)	Value (F$M)	Quantity (million litres)	Value (F$M)	Quantity (million litres)	Value (F$M)	Quantity (million litres)	Value (F$M)
2008	43	71	103	307	248	390	394	768
2009	45	58	82	126	189	218	316	402
2010	78	100	121	133	318	366	517	599
2011	70	99	17	17	276	410	363	526
2012	69	101	19	14	264	402	352	517

Source: Fiji Bureau of Statistics / Reserve Bank of Fiji 2012. (Data is provisional)

Power sector

In the power sector, total installed capacity of FEA is 256 MW, comprising 83 MW in the Monasavu Hydro Scheme, 42 MW in the Nadarivatu Hydro Scheme in Viti Levu and approximately another 10 MW in smaller schemes in Viti Levu and Vanua Levu, 10 MW of wind turbines and about 111 MW of diesel capacity in 10 stations on the three main islands (FEA, 2011 & 2012). Of the total diesel capacity 88 MW is installed on the main island of Viti Levu where diesel is supplementing the hydro schemes (FEA, 2011 & 2012). Total generation of FEA in 2012 was 970 GWh with more than 90% of this total

supplied on the main island of Viti Levu (FEA, 2012). Table 4 shows peak demand and total generation for the three islands supplied by FEA.

Table 4 Electricity supply by FEA

Year	Viti Levu Peak MW	Energy GWh	Vanua Levu Peak MW	Energy GWh	Ovalau Peak MW	Energy GWh	TOTAL Peak MW	Energy GWh
2011	152.3	822.1	12.4	61.8	2.8	14.7	167.5	898.6
2012	162.5	873	16.1	79.8	3	15.9	181.6	968.7

Source: FEA Annual Reports 2011 & 2012

More than 500 small diesel powered village mini-grids[31] also supply power in rural areas. These grids have been installed under the government's rural electrification programme and are operated by the communities they supply or by the Ministry of Works. It is estimated that the current total installed capacity of these diesel mini-grid schemes is approximately 14 MW. It is however not known how many of the schemes are operational at present. There are also two community mini-hydro schemes of 30 and 100 kW. Total supply of PV solar home systems (SHS) to rural communities currently stands at 430 kWp and a total of 3,700 systems. These systems have been provided under DoE's rural electrification programme and are typically located in remote areas and outer islands.

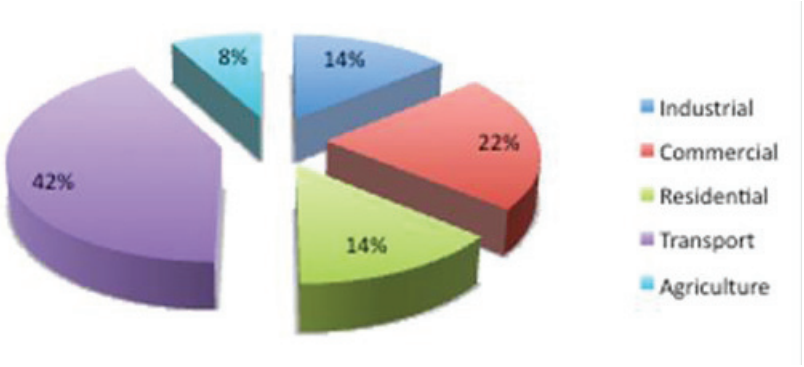
Fiji has very good renewable energy endowments (solar, biomass, wind, geothermal and hydro) and considerable energy efficiency potential. With significant decreases in the cost of some renewable energy technologies, renewable energy has become a least-cost option in many cases for both increasing access to electricity for rural households and businesses and grid-connected electricity generation. Energy efficiency improvement can also contribute to reducing energy import costs.

1.2.3 Energy Demand

Fiji's energy demand is driven by household consumption of electricity and transport fuels and by the need of its major industries, i.e. agriculture and forestry, fisheries, tourism and mining. Unfortunately, there is little data on the demand side of the energy balance. Disaggregated data of demand for fuels are not reported by the oil industry and demand surveys are not performed on a regular basis. A future priority for DoE is to increase its capacity in energy use data collection and conduct energy demand surveys on a regular basis.

The Climate Change Unit of the Ministry for Foreign Affairs and International Cooperation provides a breakdown of energy demand by sectors as shown in Figure 2 (Fiji Ministry of Foreign Affairs, 2012). The break down shows a dominance of the transport sector, which consumes 42% of all modern energy in Fiji. The transport sector includes land, marine and aviation and essentially uses motor spirit in cars, diesel in cars, trucks busses and marine vessels while the aviation sector uses multi-purpose kerosene.

Figure 2 Energy demand by sector (2012)



Source: Fiji Bureau of Statistics and Fiji Department of Energy, 2004

[31] DoE, 2013.

Fiji's industrial energy consumption is dominated by the Vatukoula Gold Mine, which generates its own electricity using diesel fuel. Energy demand in the mining sector has been stagnant in recent years. However, mining development could potentially have a substantial impact on Fiji's energy demand. Several new mining projects, including bauxite mining in Nawailevu in Bua are at various stages of development. Investment to date in the Namosi copper mine project is around $80 million, and planned capital investment in this project is currently estimated at approximately $1 billion with production due to commence in 2014, at the earliest. It is estimated that the Namosi copper mine would require approximately 100 MW of power. Other smaller gold mining projects, in Mount Kasi, Wainivesi, and Tuvatu, were at various stages of preparation in 2012.

The speed of mining development will be a major driver of energy demand in Fiji. However, the mining sector is associated with many uncertainties. In addition to global market conditions, the viability of new mining projects will ultimately depend on several factors that include security of tenure, political stability, access to affordable sources of energy, local attitudes toward mining, and the licensing and taxation regime in place (ADB 2012).

The DoE has estimated industrial petroleum fuel use from 1993-2000 incorporating information extrapolated from the *Census of Building and Industry* (1993-1994), which included detailed information on expenditures for fuel use disaggregated by industry and type of fuel (Table 5). DoE converted money values into physical units of energy. Industrial census data are two decades old, and the structure of the Fiji economy has since changed so this method is probably not an accurate indication of business and industrial energy use today. However, there are no better data available. The large quantity of Industrial Diesel Oil (IDO) reported under mining and manufacturing is attributed to the Vatukoula Gold mine, which not only operates heavy machinery but also generates its own power using an installed capacity of 30 MW.

Table 5 Estimated consumption of petroleum in Fiji by industry (kilolitres) 2000

Industrial sector	Petrol	ADO	IDO	RFO	Kerosene	LPG
Mining & quarrying	287	151	10,508	11	0	0
Food manufacture	1535	1418	1395	1692	43	288
Clothing & footwear	1209	74	547	4	4	269
Wood products	165	248	182	643	240	4
Paper & printing	460	45	175	20	2	133
Chemical products	305	40	55	3	11	0
Building & construction	787	1651	85	883	1	33
Other industry	734	533	1,118	71	0	10
Total	5,482	4,160	14,065	3,327	300	737

Source: PIREP Report Fiji 2004

The projected overall electricity demand is increasing, as shown in Table 6, reflecting: a) population growth; and b) expansion of electricity service coverage area through rural electrification. There also seems to be a trend to replace traditional biomass fuels with modern cooking fuels such LPG.

Table 6 Electricity demand projection 2013 – 2020

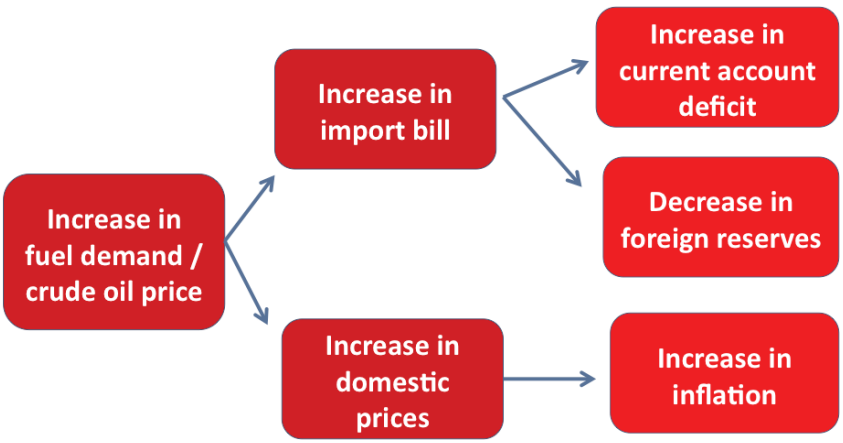
Year	Viti Levu Integrated System (VLIS)		Vanua Levu System		Ovalau System	
	Peak Demand (MW)	Energy Demand (GWh)	Peak Demand (MW)	Energy Demand (GWh)	Peak Demand (MW)	Energy Demand (GWh)
2013	172.2	921.8	19.6	97.1	3.1	16.1
2014	181.6	969.5	22.3	110.1	3.3	17.2
2015	189.6	1011.0	24.5	120.9	3.6	18.7
2016	195.5	1042.5	26.6	131.0	3.9	20.3
2017	201.3	1073.4	28.1	138.0	4.2	21.9
2018	207.2	1105.1	29.5	145.1	4.29	22.2
2019	213.3	1137.5	30.9	152.0	4.34	22.6
2020	219.5	1170.8	32.2	158.4	4.4	23.0

Source: FEA Power Development Plan for Fiji (2011 to 2020), 2010

1.2.4 Energy and Economic Development

Price and demand developments in the energy sector impact economic development in Fiji in a major way. The Reserve Bank of Fiji (RBF) is concerned with the negative impact of rising fuel import cost and the macro-economic linkages that are evident in Fiji. In Figure 3 these linkages are displayed.

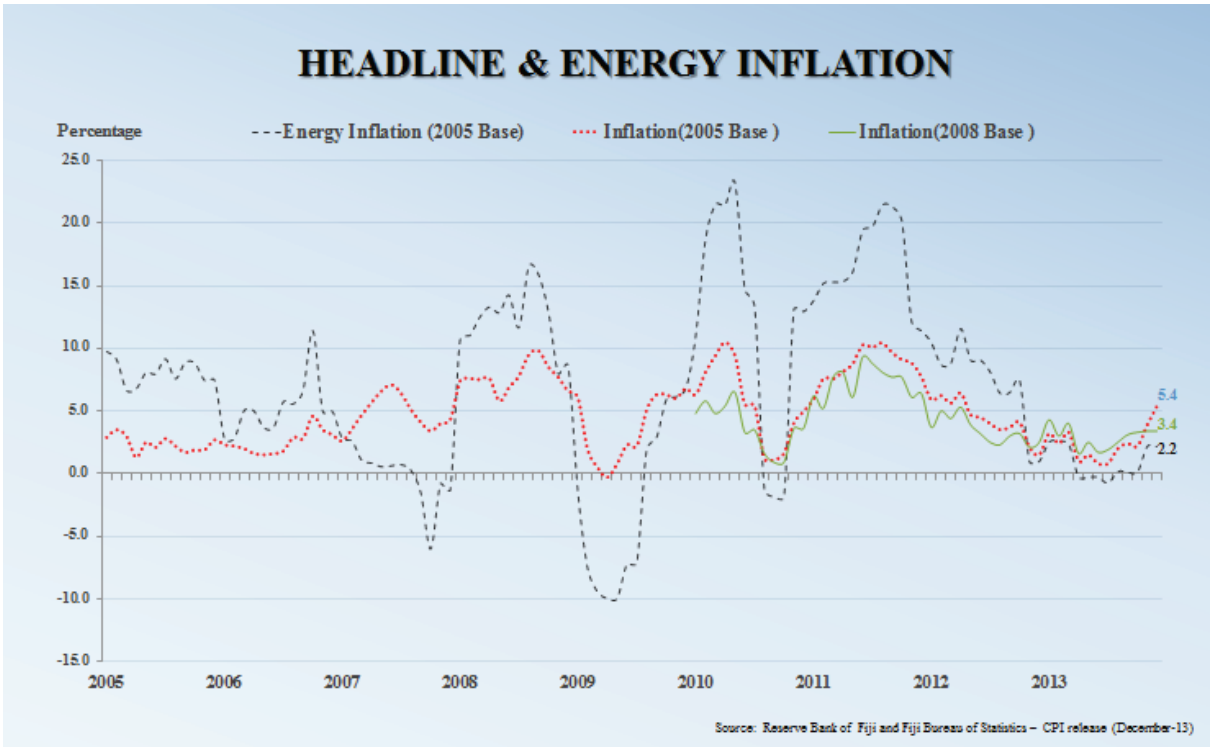
Figure 3 Macroeconomic linkages of energy imports



Source: Reserve Bank of Fiji

As at 2012, Fiji used almost 8.8 % of its total GDP of around 7 billion FJD to import fuel for domestic use. While RBF is concerned with the impact of fuel imports on inflation as depicted in Figure 4, the share of GDP that has to be used in Fiji to import fuels is low in comparison with some neighbouring countries. The share of GDP to be used for fuel imports is 27% in Cook Islands, 26% in Marshall Islands and 17% in Samoa. PNG and Vanuatu are in a better position using 6%of their GDP for fuel imports. While some of the other PICs are even more exposed to energy market volatility, the high share of fuel imports and the associated vulnerability of Fiji's economy is still a concern for the Fiji government and key stakeholders.

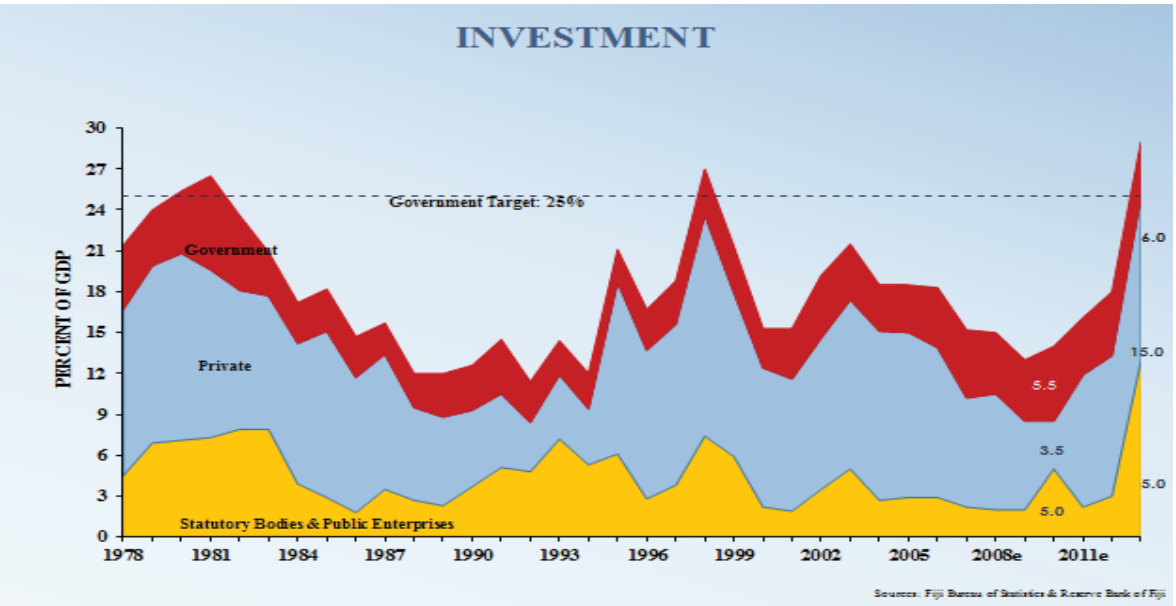
Figure 4 Headline inflation and energy inflation (percentage)



Source: Reserve Bank of Fiji, 2013

One of the key questions with regard to future economic development and its impact on energy supply and demand is whether the government's investment target of 25% of GDP can be achieved in the foreseeable future. The trend of total investment in Fiji's economy since 2003 is negative as shown in Figure 5. A decline in private investment explains most of the reduction in Fiji's total investment levels. On the other hand, public and state-owned enterprises investments including power sector development have remained relatively stable at 10%–12% of GDP since 2000.

Figure 5 Investment as percentage of nominal GDP



Source: Fiji Bureau of Statistics and Reserve Bank of Fiji, 2013

As the above graph shows, the trend of declining investments has been reversed in 2012. This is partly due to investments in new wide body aircraft by the national airline, Fiji Airways as well as the general pick-up in economic activity.

1.2.5 Energy Strategy and Relevant Targets

In November 2006, the Fiji Government endorsed its first National Energy Policy (NEP) and associated strategic action plan, which has since guided the work of the Department of Energy (DoE). The stated objectives of this policy were to:

- ❑ Strengthen the capacity for energy planning through appropriate policy, regulatory and implementation frameworks and effective and efficient management;
- ❑ Enhance energy security through greater participation and collaboration within the industry;
- ❑ Increase access to affordable and reliable electricity services;
- ❑ Research, promotion and utilisation of renewable energy applications.

Under each stated objective, a policy framework describes the strategic actions the Fiji Government intended to make in order to develop and expand the country's energy sector. The policy was accompanied by a detailed strategic action plan that listed numerous activities all geared towards achieving the above objectives.

In March 2013, the government began a review of the policy framework and associated strategy, tapping into technical assistance from GIZ and UNDP. The preparation of this report and the development of the new NEP have been coordinated in order to ensure that targets, policies and strategic actions are aligned and consistent. Summaries of the key priority policies in the draft 2014 NEP for each area of Fiji's energy sector are provided below. The priority policies listed below have been chosen on the basis that they can be readily implemented and have the most potential to achieve the objectives and targets for the energy sector. For all other policies please refer to the draft 2014 NEP.

Grid-based power supply:

- ❑ Increase private sector investment in large-scale electricity generation., by establishing a transparent process for procurement of new large-scale capacity from Independent Power Producers (from both renewable and non-renewable energy sources), pricing and other principles to be applied in all new Power Purchase Agreements, and grid-connection standards.
- ❑ Increase private sector investment in small-scale grid-connected renewable generation, by establishing economically justified feed-in tariffs or similar mechanisms to give incentives and reduce the risks for electricity production from small-scale renewable sources that are connected to the grid (including by providing investors an adequate return

on capital). These mechanisms should not disadvantage either FEA or investors and the implementation of such mechanisms should not add unduly to the overall cost of electricity supply in Fiji. This will be accompanied by net metering arrangements that give electricity consumers incentives to invest in on-site small-scale renewable energy generation.

- ❑ Strengthen transparency and effectiveness of the regulation of the electricity industry. This includes establishing a formal regulatory contract with Fiji Electricity Authority (FEA) that sets out a process for regularly reviewing the efficient costs of electricity supply and setting tariffs to recover these, and making all forms of electricity subsidy transparent including to energy consumers. It also includes ensuring the technical and economic regulatory functions (including licensing and defining frameworks for encouraging Independent Power Producers) are carried out by the DoE and the Fiji Commerce Commission.

Rural electrification:

- ❑ Develop a national electrification master plan, showing how each un-electrified area of Fiji will be served with least cost solutions. Technological solutions to be considered in consultation with communities will include grid extension, diesel and hybrid mini-grids, and solar home systems. The plan will also clearly define a minimum level of service which qualifies as 'electrification'.
- ❑ Establish a dedicated electrification fund and an associated framework that will be used to provide capital subsidies for electrification projects. The electrification fund will facilitate the implementation of the national electrification master plan. The fund framework should consider how to facilitate equitable electricity access taking into account gender aspects and vulnerable groups. Going forward, funding being provided by the Government for the implementation of rural electrification projects will be channelled into this fund, thereby making subsidies more transparent and easier to monitor and evaluate. Subsidies will leverage capital contributions from beneficiaries and project promoters as far as possible and will be provided as once-off capital contributions for viable projects. Recurrent costs will not be subsidised.

Renewable energy:

- ❑ Maintain a comprehensive assessment of Fiji's renewable energy resources, including hydro, wind, biomass, solar, and geothermal resources. This assessment will include an inventory of available sites and technologies, their technical and economic viability, and social and environmental impacts.
- ❑ Make all data on renewable energy resources available to the public and prospective investors through a single national repository at the Department of Energy. This will ensure that a lack of information on resource potential does not continue to be an impediment to private sector and other relevant project developers.
- ❑ Conduct further investigations into geothermal energy resources with a view to identifying a pilot project for development. This recognises the contribution that geothermal energy can make to diversifying the energy mix, providing base load generation and thereby reducing the reliance on hydropower and petroleum imports.

Transport:

- ❑ Promote the fuel efficiency of imported motor vehicles in order to reduce petroleum consumption. This includes continuing to enforce age limits for second hand vehicles and provide import tax incentives. It may also include introducing new measures such as labelling for vehicle fuel economy of imported land transport vehicles.
- ❑ Investigate the potential and cost-effectiveness of energy efficiency and renewable energy solutions for sea vessels, including biofuels, solar and sail-assisted sea transport and efficient motors, vessel design, and improved maintenance models to improve the overall efficiency and reduce fuel consumption in sea transport within Fiji.
- ❑ Support the development and implementation of the Department of Transport's land and marine transport policies that encourage a shift towards more energy efficient forms of land and sea transport.

Petroleum and bio-fuels:

- ❑ Reduce the cost of imported petroleum products by negotiating directly with fuel suppliers and reviewing the pricing templates for petroleum products. Also continue to explore the costs, potential benefits and risks of bulk procurement of petroleum, building on existing studies and initiatives in this regard. This may include regional cooperation or the creation of a single (bulk) buyer to improve bargaining power.

- ❑ Improve the transparency of petroleum supply, including collecting data on fuel quantity imports, re-exports, consumption, and pricing and making this data publicly available.
- ❑ Continue research to explore the potential for increased production and use of bio-fuels. This includes encouraging the production of coconut oil in remote islands and the use of locally produced molasses for ethanol production. Any actions for the widespread development of bio-fuels in Fiji should be based on rigorous analysis showing that it is both technically and economically feasible and should be mindful of the risks, in particular the trade-offs between production of crops suitable for conversion to bio-fuels and production of food and cash crops.

Energy efficiency:

- ❑ Continue to increase public education and awareness of energy efficiency by providing targeted information to end-users on the range of energy saving technologies and options available. This should include encouraging businesses to undertake energy audits and to factor in the operating costs of energy use as well as the capital costs when investing. Public awareness campaigns should be informed by analysis of energy consumption patterns and market research of appliance purchases. Education and awareness campaigns should target specific groups.
- ❑ Extend the current system of energy labelling and minimum energy performance standards to all widely imported electrical appliances and industrial equipment that contribute substantially to energy demand. A system will be put in place to prevent and protect consumers from the use of false energy rating labels.
- ❑ Develop and implement an energy information database, so that demand side data is collected and analysed and a verifiable data trail is created upon which energy savings can be verified. Where possible this data should be disaggregated by rural and urban users, sex and socio-economic groups. This database will be integrated with other supply-side energy information databases where possible.

The draft 2014 NEP is also accompanied by a strategic action plan which lays out the key activities to be carried out to achieve the objectives of the NEP. The energy sector targets under the draft 2014 NEP were developed in parallel with and are identical to those presented in this SE4ALL report.

In addition to targets in the new NEP, the national power utility has its own renewable energy target. By 2015, FEA plans to supply 90% of its power from local, renewable energy resources. FEA initially had intended to meet a 100% renewable energy target by 2011, but had to revise its timeline due to lack of IPP investments[32].

32 FEA Annual Report 2008: 'We aim to provide all energy through renewable resources by 2011'.

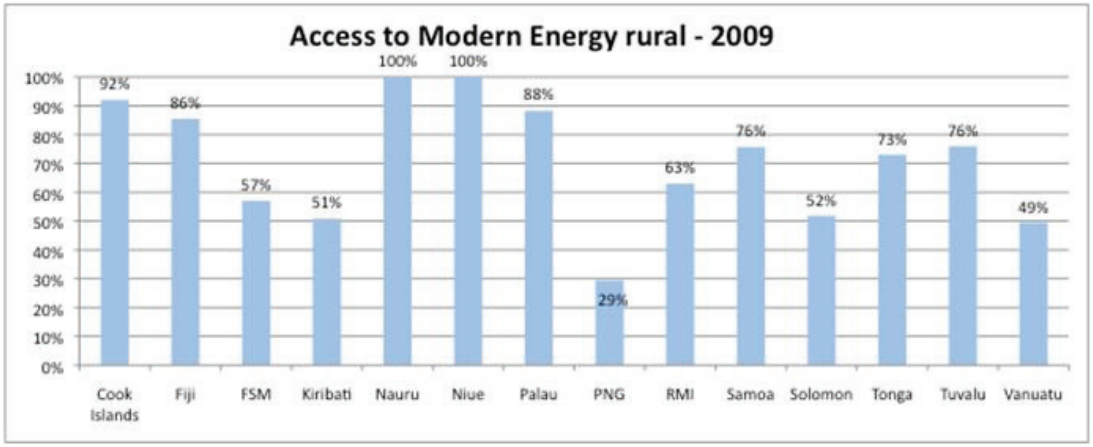
2 Current Situation with regards to SE4ALL Goals

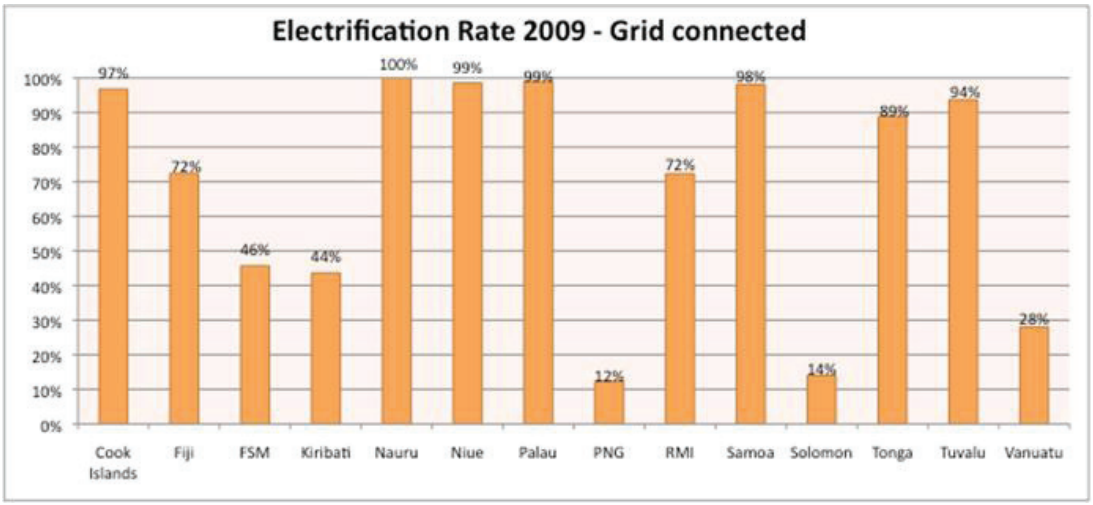
2.1 Energy Access vis-à-vis Goal of SE4ALL

2.1.1 Overview and Assessment

Energy access in Fiji is better than in most developing countries including its Melanesian neighbours, but below the high access rates in some of the Polynesian PICs, as shown in Figure 6. In general, access has improved dramatically in recent years, partly due to rural-urban migration, partly through expansion of services into rural areas.

Figure 6 Access to modern energy and electrification rates PIC





Source: SPC Regional Security Indicator Database

The table below displays relative position with regard to energy access for grid electricity and modern fuels and show that Fiji ranks above average for all access categories.

Table 7 Access to grid electricity and modern fuels

	Fiji	Average 14 PICs
Electrification Rate (grid-connected)	72%	23%
Access to Small Scale Power Rural	12%	8%
Access to Modern Energy Rural	86%	36%
Access to Modern Energy Urban	96%	77%

Source: SPC Energy Security Indicators, 2008/09 HIES

It should be noted that Table 7 displays data from SPC giving an electrification rate of 84% (grid-connected and small-scale power rural added together). The Fiji national data from the 2007 Census found an electrification rate of 89% overall (96% urban and 82% rural). The 89% figure is the baseline used in the 2014 NEP and in this report.

2.1.2 Modern Energy for Thermal Applications

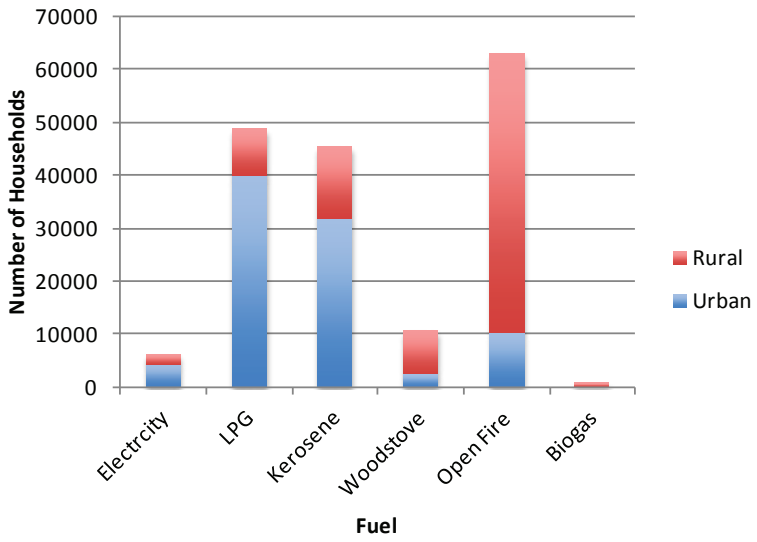
Physical access

The latest Household Income and Expenditure Survey (HIES) 2008/09 reveals that 96 % of urban and 86 % of rural households have access to and use modern fuels such as LPG and kerosene for cooking. The 2007 Census results show that urban and rural households are distinct with regard to the main cooking fuel they use (see Figure 7).

The census showed that LPG is the main cooking fuel in urban households (45% of urban households), while only 10% of rural households report that LPG is their main cooking fuel. For kerosene the picture looks similar, with 36% of urban households reporting kerosene as the main cooking fuel, against only 16% of rural households. Woodstoves and open fires were the main cooking fuel for 71% of rural households and 14% of urban households. Electricity was the main source of energy for cooking for only 4.7% of urban households and 2.2 % of rural households. Biogas was a minor fuel source for cooking in households in 2007 with less than 1 % of both urban and rural population using this source as their main cooking fuel.

It should be noted that heating is normally not required in Fiji. Electricity for cooking is mostly used in urban households, but electric kettles are also popular in rural areas where electricity is provided. The use of different cooking fuels is not only determined by availability and price, but also by household preferences. Many of Fiji's households use wood and other biomass such as coconut shells for traditional earth oven (lovo) cooking, irrespective of their location and/or income level.

Figure 7 Main fuel used for cooking in households 2007



Source: Census 2007, Fiji Bureau of Statistics

Availability

While kerosene and LPG are readily available in urban and peri-urban areas of the main islands, remote small islands sometimes experience supply chain disruptions due to irregular and unreliable local shipping services. The supply of petroleum products in Fiji are provided by three oil companies and two gas (LPG) companies but shipping of fuels to outer islands is often undertaken by smaller companies and fuel retailers.

Affordability

Modern household fuels such as LPG and kerosene are price regulated throughout Fiji. The Fiji Commerce Commission (FCC) adjusts maximum retail prices regularly in response to market developments. Unlike power tariffs, which are uniform throughout the country, the price regulation for fossil fuels takes supply cost at a given location into consideration. For example, in remote rural areas these fuels are more expensive as the long supply chain increases transport cost to these locations. It is interesting to note that while for LPG only two price levels are distinguished, there are six schedules for the other price controlled fuels, depending on the remoteness of the respective location.

Table 8 shows regulated maximum retail prices for all controlled fuels as of April 2013. The price determination by the Fiji Commerce Commission can be accessed on their webpage (http://www.commcomm.gov.fj). The Fiji Commerce Commission considers the submissions of oil and gas companies and uses the lowest values submitted to determine Maximum Retail and Maximum Wholesale Prices (MRP, MWP). The issue of reducing the cost of fuel imports by changing the current procurement model to competitive tendering has been repeatedly raised in Fiji. Samoa for instance has consistently enjoyed lower supply cost although fuels are actually supplied through Fiji.

Table 8 also shows specific energy cost taking the heating value of the various fuels into consideration. This shows that LPG is the most expensive fuel considering energy content. However, volumes imported are significantly lower than for other petroleum products which increases landed cost. The table does not show the locational variations (schedules) the FCC allows. Household kerosene for instance has a MRP of 1.86 FJD/litre in Suva can cost up to 1.93 FJD/litre in a schedule 6 region where the highest prices are allowed. For diesel the difference is 2.29 FJD/litre for schedule 1 and 2.32 FJD/litre for schedule 6. While the price regulation according to location sends the right signal to the markets (higher supply cost = higher price) it disadvantages remoter locations, which are typically poorer than the urban areas on the main islands.

Table 8 Maximum retail prices for fuels April 2013

Product	FJD/litre	FJD/Ton	FJD/MJ	MJ/litre
LPG	2.14	3820	0.084	25.5
ULP	2.58	3510	0.076	34
Diesel	2.29	2726	0.059	38.6
Kerosene	2.54	3215	0.069	36.6
Premix	1.86	2548	0.055	34

Source: Fiji Commerce Commission

2.1.3 Access to Electricity

Physical access

There are four main types of electrification in Fiji: The national grid operated by FEA, village grids operated by the respective communities, Ministry of Works' grids operated at Government stations which sell excess electricity to nearby residents, and solar home systems. The FEA is undertaking investments to upgrade its generation and transmission systems to augment the existing network to enhance security of supply and incorporating the first level of redundancy (N-1).[33]

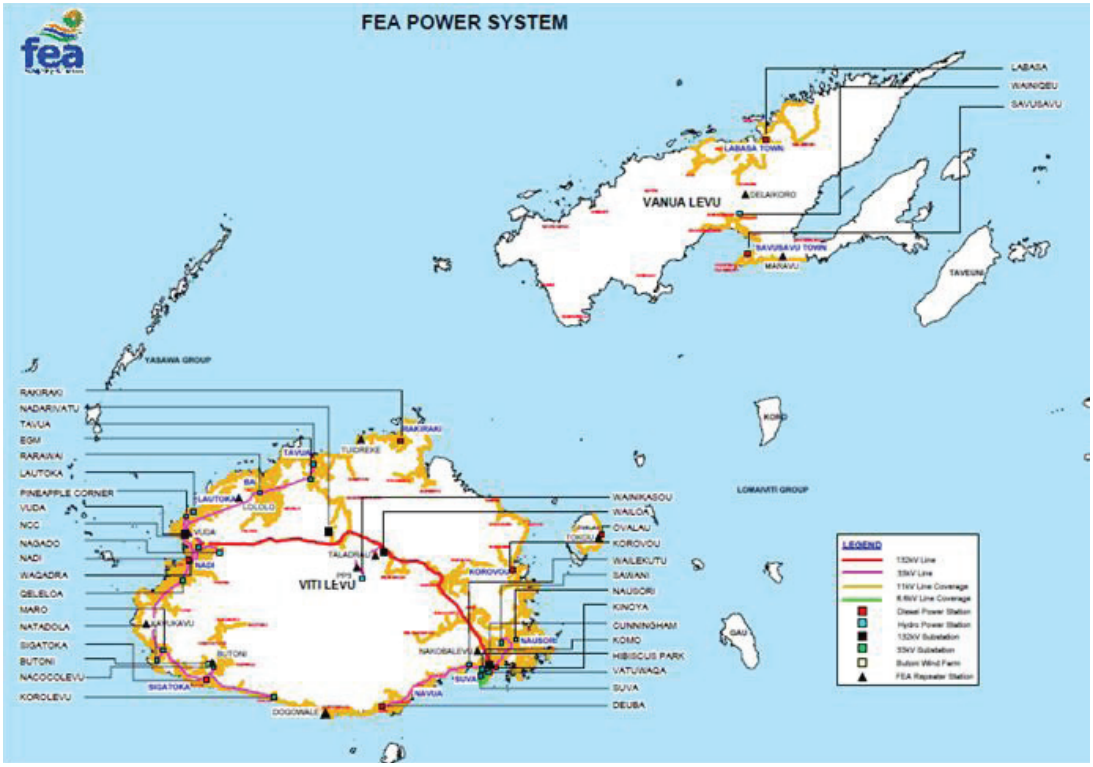
In recent years the FEA grid has been extended to cover more rural settlements but there are physical and cost limits to full coverage. Figure 8 shows the location of the FEA power grid.

Large parts of the two main islands still remain outside grid supply areas, but these parts often hold only very small populations and are not accessible by roads. Fiji's third largest island of Taveuni is currently only served by community

33 Energy experts commonly use N-1 (or N-x) to describe the resilience of an energy system against failure of one of its major components. If N is the number of major transmission lines serving a region's demand, N-1 redundancy means that the system still works if 1 of these transmission lines fails. The same applies for power plants, oil pipelines etc. N-1 is normally considered a minimum requirement in energy system planning; however, systems in industrialised countries usually use higher protection (N-2). This takes into

mini-grids, private generation and PV SHSs, although its large size, significant demand in its tourism sector and its hydro potential indicate that grid based electrification of the island could be an economically viable option.

Figure 8 FEA grid coverage



Source: FEA, 2012

Data and estimates on electrification rates vary. While the 2008/09 HIES indicates a total FEA grid electrification rate of 72%, the more comprehensive census data of 2007 indicates that 88.9 % of the population had access to grid power (see Table 9), either through FEA or through a mini-grid system. The 88.9% figure is more or less consistent with a reported FEA electrification rate of 72%.

Table 9 Access to grid electricity

Year	Rural	Urban	Total
1986	30.6	75.5	48.5
1996	48.9	87.1	66.8
2003	69	92	80
2007	82	96	88.9

Source: GoF Census Data 2007, UNDP

Rural consumers connected to small village grids do not enjoy the high level of availability FEA customers can rely on. There are always a significant number of systems that are not functioning and awaiting spare parts and repair. The remote location and the large number of these systems (more than 500) render management and monitoring of these systems challenging. In most communities supply is restricted to a few hours a day (typically between 6 p.m. and 10 p.m.). This restriction forces business and productive power users to operate their own generators during working hours. It has also been observed that many of the diesel sets installed under the government's rural electrification programme are oversized and run at very low load levels relative to their installed capacities. This leads to: a) higher than necessary capital cost due to oversize; b) higher than necessary specific fuel consumption; and c) increased maintenance and repair cost due to constant under loading of the engines. Increasingly, DoE therefore promotes solar solutions for basic rural electrification and communities often choose solar electrification over diesel.

The DoE manages the Government's rural electrification programme using both diesel based village grids and solar systems in remote locations. The Government also subsidises FEA's grid-extension rural electrification programme, which has resulted

in a total of 1500 grid extensions since its inception in 1994. Table 10 shows the number and capacity of various rural generation technologies. As the diesel systems frequently experience break downs and fuel supply shortages, DoE aims to shift more towards solar electrification as the costs for solar systems have come down significantly during the last 2 years.

Table 10 Number and capacity of various rural generation technologies

	Number	Capacity KW	Total KW
Solar Systems 100	2400	0.1	240
Solar Systems 270	700	0.27	189
Mini Hydro	1	100	100
Mini Hydro	1	30	30
Biofuel 20/80	4	30	120
Diesel Units	500	22.3	14071
FEA Grid Extensions	1500	n.a.	n.a

Source: DoE master list of rural projects, 2013

Availability and reliability of supply

The FEA reports on reliability and outages of the main electricity grids in its annual reports. An additional source of information on comparative reliability of supply in the four grids operated by FEA is the Pacific Power Association (PPA) Benchmarking Study of 2011. The results of the benchmarking can be utilised by the power utilities to formulate performance improvement programmes (PIPs) to improve the overall performance of the utilities. This process is to be taken up by the utilities themselves once benchmarking has been mainstreamed into the utility operations. The study includes five indicators that provide information on reliability/availability of power in the benchmarked utilities, including FEA: Availability factor, forced outages, planned outages, System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI).

In 2010 FEA reported an availability factor of 98% corresponding with the average value of all investigated members of PPA. No forced outages were reported and planned outages were reported to be less than 2%.

SAIDI is the sum of individual customer outages (minutes) divided by the average number of customer during the analysed period, typically a year. FEA reported a SAIDI of 1,008 for 2010, significantly higher than the region's average or median levels, which were 530 and 139 respectively. Best practices for SAIDI are below 50 minutes.

SAIFI is also commonly used as a reliability indicator by electric power utilities. SAIFI is the average number of interruptions that a customer would experience, and is calculated as: Total Number of Customer Interruptions/Total number of customers served. In 2011 FEA's SAIFI was reported as 21, i.e. the average consumer experienced 21 outages in this year. As with the SAIDI indicator, FEA's SAIFI number is significantly higher than the rest of the Pacific region which reported an average SAIFI of 8.2 and a median value of 3.8. The international best practice value for SAIFI is below 2.

With regard to power quality, legislation commits FEA to maintain distribution voltage levels within ± 6% of the nominal voltage and frequency fluctuations below ±2%. It is, however, not known if these power quality levels are being maintained in all parts of the grids.

In addition to the benchmark indicators, FEA also reports the average time that a customer is without power per interruption. This index is the Customer Average Interruption Duration Index (CAIDI). This index was reported to be 91 minutes in 2007, 71 minutes in 2008 (FEA, 2008) and 74 minutes in 2012 (FEA, 2012).

Affordability

In terms of electricity tariffs, Fiji compares very well with its Pacific neighbours. Fiji currently has an average tariff of 0.374 FJD/kWh. All other PICs have significantly higher power tariffs (PNG 0.6 FJD/kWh, Samoa 0.59 FJD/kWh, Vanuatu 0.93 FJD/kWh, Solomon Islands 1.48 FJD/kWh, Cook Islands 0.935 FJD/kWh).[34] Fiji has a lifeline tariff fixed at 75 kWh per billing period. This tariff is subsidised by the government and consumers only pay 0.172 FJD/kWh, with the government paying the balance to FEA.

34 Pacific Power Association, *Performance benchmarking for pacific power utilities, Benchmarking Report*, March 2013.

Comparing household income with cost of electricity indicates that as long as a household stays close to the lifeline limit of 75 kWh, its relative expenditure for power is low. The 2008/09 HIES survey indicates an average rural household income of 967 FJD per month. The consumption of 75 kWh would cost 1.3% of this income. The Ministry of Works, in its rural supply areas meters and charges its customers at the standard FEA tariff (no lifeline tariff is used). The village systems, installed under the DoE rural electrification programme are free to determine how they collect the revenue required for the operation of their systems.

In December 2012, the tariff regulator, the FCC, reduced the weighted average tariff of FEA from FJD 0.394 to FJD 0.365. The FCC notes in its determination of the new tariff:

> "Based on computations of primary data, the unit cost of generating electricity from diesel could stand at 48 cents. Taking a transmission, distribution and retailing (TDR) unit cost of 13 cents, the final unit cost of diesel stands at 61 cents. With regard to hydro-electricity, the unit generation stands at 11.5 cents. With TDR cost of 13 cents the final unit cost for hydro-electricity could approximate 24.5 cents. With different ratios of hydro and diesel power, the unit cost would vary. At a 60/40 hydro/diesel ration the unit cost approximate 39.1 cents. At a 40/60 hydro/diesel ratio the computed unit cost could approximate 46.4 cents. FEA in their final submissions calculated 40.78 for hydro and 59.91 for diesel based on a 25% return on equity"

The new tariffs determined by the FCC do not seem to be sustainable in the long term as they do not cover the estimated cost of supply, even on the FCC's own figures.

Table 11 shows the current tariff as set by the FCC in 2012. As mentioned above, it is not clear on which basis the FCC ruled that tariffs had to be reduced, but the decrease in tariffs will make it more difficult for FEA to finance its power development programme.

Table 11 Current FEA tariff valid since January 2013

Tariff Categories	Existing tariff rates	Revised Tariff rate	Increase /(Decrease)
Domestic Category			
Domestic Tariff (<=75 kWh per month) c/kWh	34.84*	33.10	(1.74)
Domestic Other Tariff (>75 kWh per month) c/kWh	34.84	33.10	(1.74)
Commercial & Industrial Category			
Commercial & Industrial Tariff –up to 14,999 kWh per month, c/kWh	42.00	39.90	(2.10)
Commercial & Industrial Tariff – in excess of 14,999 kWh per month, c/kWh	44.00	41.80	(2.20)
Maximum Demand Tariff			
(1) Demand > 1000kW			
Demand charge $ per kW per month	40.20	38.19	(2.01)
Energy charge c/kWh	33.50	31.83	(1.68)
(2) Demand 500 - 1000kW			
Demand charge $ per kW per month	38.50	36.57	(1.92)
Energy charge c/kWh	31.00	29.45	(1.55)
(3) Demand 75 - 500kW			
Demand charge $ per kW per month	36.20	34.39	(1.81)
Energy charge c/kWh	28.50	27.07	(1.42)
For Maximum Demand and Commercial & Industrial consumers who elect to take a power supply directly at the high voltage, a discount of 4% is allowed.			
Excess Reactive Energy penalty fee c/kWh	44.00	41.80	(2.20)
Institution Tariff c/kWh	34.84	33.10	(1.74)
Street Light Tariff c/kWh	34.84	33.10	(1.74)

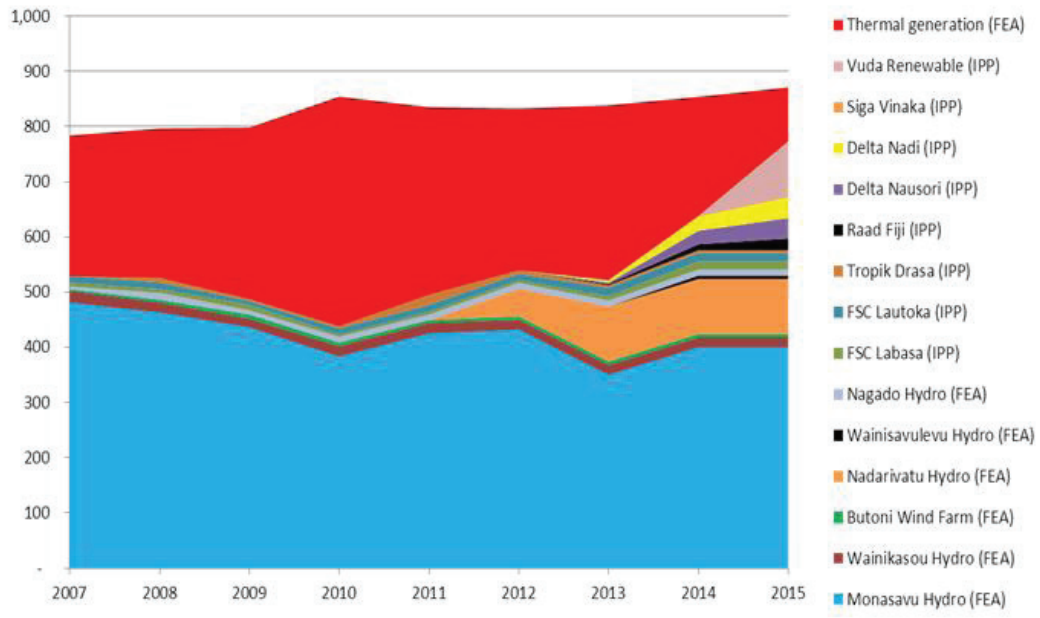
** The customer will pay only 17.20 cents /unit and the rest will be subsidized by the government*

Source: Fiji Commerce Commission, 2013

Sustainability

In 2012, FEA generated 810 GWh of which 60% came from renewable resources, mainly hydro resources. Smaller shares were produced by wind and biomass waste co-generation at Tropic Woods and Fiji Sugar Corporation (FSC) as displayed in Figure 9 below. FEA's power development plan aims to generate 90% of all its electricity from renewable resources by 2015. FEA estimates this would require an investment of 800 million FJD of which FEA intends to finance 450 million FJD with the rest being provided by private sector IPP investment.

Figure 9 Recent, Current and Estimated Generation mix FEA (GWh)



Source: FEA Presentation at National Energy Forum, April 2013

While the 90% renewable energy target may be physically achievable, the mobilization of IPP investment in the order of FJD 350 million will be more challenging. It must be noted that discussions for IPP projects in Fiji have been underway for over 20 years, however none of the numerous projects proposed have reached financial closure to date.

Table 12 lists the major projects in FEA's investment pipeline.

Table 12 Major planned FEA renewable energy projects

Project Name	Installed MW	Annual GWh	Investment Million US$	Status
Qaliwana Hydro	17	39	90	Feasibility completed, looking for an IPP to develop & sell to FEA under a Power Purchase Agreement
Wailoa Downstream Hydro	28.6	135.7	227	Feasibility completed, looking for an IPP to develop and sell to FEA under a PPA
Upper Navua River hydro	Data not available	Data not available	Data not available	Currently working with Meteorology Office to install rainfall gauges and monitor this for 5 years before undertaking any feasibility studies
Naboro Waste to Energy	Data not available	Data not available	Data not available	FEA jointly with the DOE is currently preparing to undertake a Feasibility Study. Once completed IPP to develop this Energy Plant via Expressions of Interest
Waibutasavu Hydro	4.4	13.2	22.4	Feasibility completed. FEA is considering developing this hydro project which is within the existing Monasavu lease

Source: FEA Power Sector Development Plan, 2011

2.1.4 Modern Energy for Productive Uses

Energy needs and access

Nearly all commercial operations in Fiji have access to modern energy. Only a limited number of remotely located subsistence farms still operate without any modern energy input. Fiji's main industries use diesel oil as boiler fuel as well as electricity for their mechanical operations. In rural areas wood and biomass wastes (coconut husks and shells) are used for crop drying, mostly copra. For many of these small-scale remote operations the cost of modern fuels would be prohibitive.

The FSC and the wood chip manufacturer Tropik Woods also use waste to generate steam and electricity for their own consumption and export to the FEA grid.

With regard to productive uses of electricity, an indicator is the share of commercial and industrial use of electricity in total supply. FEA sells most of its electricity to commercial and industrial consumers, which use power for the manufacturing of goods or the supply of services.

A household energy survey from 2005 found that few rural households in Fiji use electricity for income generation.35 Of rural households with access to 24-hours of main grid quality power only 10% reported that they use electricity for income generation and the figure for rural households with access to limited hours of main grid quality power from diesel mini-grids was less than 5%. Close to 0% of rural households with power from solar PV SHSs reported that they use electricity for income generation activities.

Availability

Although petroleum fuels are shipped throughout Fiji, for remote islands there are sometimes periods of unavailability due to inadequate shipping and local storage capacity. For example, on a regular basis this is the situation in Rotuma Island and islands in the Lau Group.

In Fiji there are in general no supply constraints with regard to technologies for productive uses. Any machinery, electric motors, internal combustion engines and industrial equipment can be locally purchased or ordered. Its position as the country among the PICs with the lowest electricity cost is one key input conducive to productive use of electricity.

Access to capital

Access to capital seems to be posing serious problems to some businesses. From 2009 to 2011, a build-up of excess liquidity, a decline in the loan-to-deposit ratio, a build-up of excess reserves, and a modest decline in domestic interest rates characterized Fiji's commercial banking system. Excess liquidity in the banking system among others was attributed to what the commercial banks perceive to be limited bankable projects and to lower credit demand as risk perceptions increased after 2006 and the beginning of the global economic crisis (ADB 2012). In recent years serious efforts have been made to boost access to financial services. Government is collaborating and working with stakeholders in bringing about financial inclusion through the provision of accessible, affordable and appropriate financial services.

Mobile banking has been encouraged, and has spread rapidly through the two main mobile phone service providers, Vodafone and Digicel. The RBF has introduced a small and medium-sized enterprises loan guarantee scheme, established sector lending ratios, especially with regard to renewable energy and expanded its import substitution and export finance scheme to spur lending. At present commercial banks are required to lend 2% of their total deposits and similar liabilities to renewable energy projects. While this ratio is currently achieved for the entire commercial banking sector through a large FEA loan for hydro development, it remains to be seen if the achievement of this lending requirement will be sustained by the banks.

35 *Rural Electrification Survey Report*, Department of Energy, Government of Fiji, 2006.

2.2 Energy Efficiency vis-à-vis Goal of SE4ALL

2.2.1 Overview and Assessment

Under the general theme of energy security, the overall strategy in the 2006 NEP addressing energy efficiency was: Increase efforts to create energy efficiency and conservation awareness and encourage energy-efficiency in all sectors. The strategic action formulated under the efficiency strategy required developing and implementing an energy efficiency and conservation programme with quantifiable targets covering all sectors. The energy efficiency programme was planned to include:

- ❑ Public awareness and education programme on energy conservation/efficiency;
- ❑ Introducing incentives for importation and use of energy efficient equipment and appliances and efficient vehicles;
- ❑ Implementing Minimum Energy Performance Standards (MEPS) and energy labelling programme for households and industrial appliances;
- ❑ Reviewing existing building codes to include energy efficiency concepts; and,
- ❑ Energy audits, energy efficiency research, introducing Energy Efficiency Service Companies.

Measured against these planning parameters the targets for energy efficiency and conservation have only been partly fulfilled. In the 2006 NEP the Government commits itself to facilitate greater energy efficiency in the industrial and other sectors; however the emphasis to date has been in the residential sector. The Department of Energy (DoE) has established a Demand Side Management unit to implement the Energy Conservation and Efficiency Programme. At present the DSM unit is staffed by six officers.

In the transport sector, some changes in the import rules for vehicles have been introduced with the aim to increase energy efficiency. In the Prime Minister's 2010 revised budget address the following measures to increase energy efficiency in the transport sector were announced[36]:

- ❑ ***Motor Vehicles***

  To assist low and middle income earners in purchasing new fuel efficient motor vehicles, the fiscal duty on new motor cars and other passenger vehicles with capacity not exceeding 1500cc was reduced from 32%to 15%. The vehicle age limit for used or reconditioned motor vehicles imports was reduced from 8 to 5 years. These measures will also assist in reducing fossil fuel imports and minimize pollution.

- ❑ ***New Buses***

  Duty concessions are currently available for all buses with Euro4 and Euro3 engines and for LPG taxis. To improve quality and safety of public service transport, the fiscal duty on new buses for the transport of 23 persons or more was reduced from 32% to 5% and import excise was reduced from 15%to 5%. All bus proprietors were encouraged to take advantage of this reduction as soon as possible in order to reduce fuel consumption in public transport.

- ❑ ***New Trucks***

  To facilitate availability of affordable transport for commerce, the fiscal duty on new trucks of gross vehicle weight not exceeding 3 tonnes was reduced from 32%to 15%. Fiscal duty on new trucks of gross vehicle weight not exceeding 3 tonnes was reduced from 32% to 5%.

There is no information available on how many more efficient vehicles have been imported into Fiji since these new measures were introduced, it is however safe to assume that these concessions will eventually have an impact on specific fuel use in the land transport sector. There are some hybrid vehicles (124 hybrid vehicles were registered in December 2012), and the Department of Transport (DoT) has shown interest in providing more incentives for more importation of hybrid vehicles. The DoT is currently considering non-motorised transport options for Fiji in the form of bicycles. Close coordination with local city and town councils is needed to pursue this initiative.

36 GoF – Revised Budget Address 2010.

Another option would be to increase land transport sector efficiency by introducing electric vehicles. Fiji is endowed with sufficient local, renewable energy resources (geothermal, hydro, solar, wind, biomass) to generate a very large percentage of its electricity requirements. One of the key problems the country faces is financing a rapid development of these renewable energy resources. However, if an investment into sufficient electricity generation from renewables could be realised, it would likely be feasible to enhance transport sector efficiency by introducing electric vehicles for both public and individual land transport.

The Government has also launched a Bio-fuel Development Programme and has introduced standards for E10 (10/90% anhydrous ethanol petrol blend) and B5 (5/95% blend of vegetable oil ester and diesel).

2.2.2 Energy Intensity of National Economy

Fiji's economy shows a fluctuating energy intensity in recent years that is more driven by significant changes in the importation of fuels than by changes in GDP.

Table 13 below shows the estimated energy intensities for the last four years. It is clear that an unexplained spike in fuel imports in 2010 creates a spike in energy intensity for that year, with the other two parameters (GDP and Power Generation) remaining more or less constant. It is possible that the 2010 figures for retained petroleum imports have been misreported. The table shows relatively low energy intensity for Fiji's economy reflecting the dominance of the service sector, which has steadily outperformed the other sectors.

Rapid growth in the services sector has been the result of a steady expansion in tourism-related services, finance, communications, wholesale and retail trade, and public services. In other words Fiji economy is moving towards a less energy intensive output mix with a service sector that shows significantly more growth than the other sectors.

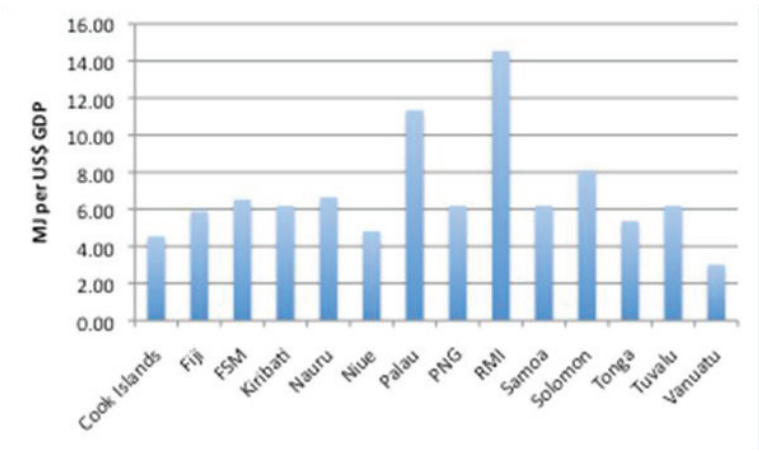
Table 13 Estimated Energy intensity in Fiji

	Power		Fuel	Total	GDP	Energy intensity	
Year	GWh	TJ	TJ	TJ	FJD mill	MJ/FJD	MJ/USD
2008	732	2,635	14,184	16,819	4,415	3.81	6.93
2009	767	2,761	11,376	14,137	4,357	3.24	5.90
2010	835	3,007	18,612	21,619	4,364	4.95	9.01
2011	865	3,114	13,104	16,218	4,445	3.65	6.63

Note: Calculated from Bureau of Statistics Retained Fuel Imports, FEA Annual Reports and RSB real GDP figures, average heating value for fuels assumed to be 36 MJ/litre, intensity in US$ based on current exchange rate of 0.55.

It is interesting to compare energy intensity of other economies in the Pacific region. The Secretariat of the Pacific Community (SPC) energy security indicator database tracks energy intensity in the region. The latest data available were compiled in 2012 using a 2009 baseline; however, it should be noted that some of the data included in the 2009 baseline are from other years due to unavailability of data specifically for 2009. The SPC compiled data are shown in Figure 10.

Figure 10 Energy intensity in Pacific Island Countries



Source: SPC Energy Security Indicator Database 2009, SPC 2012

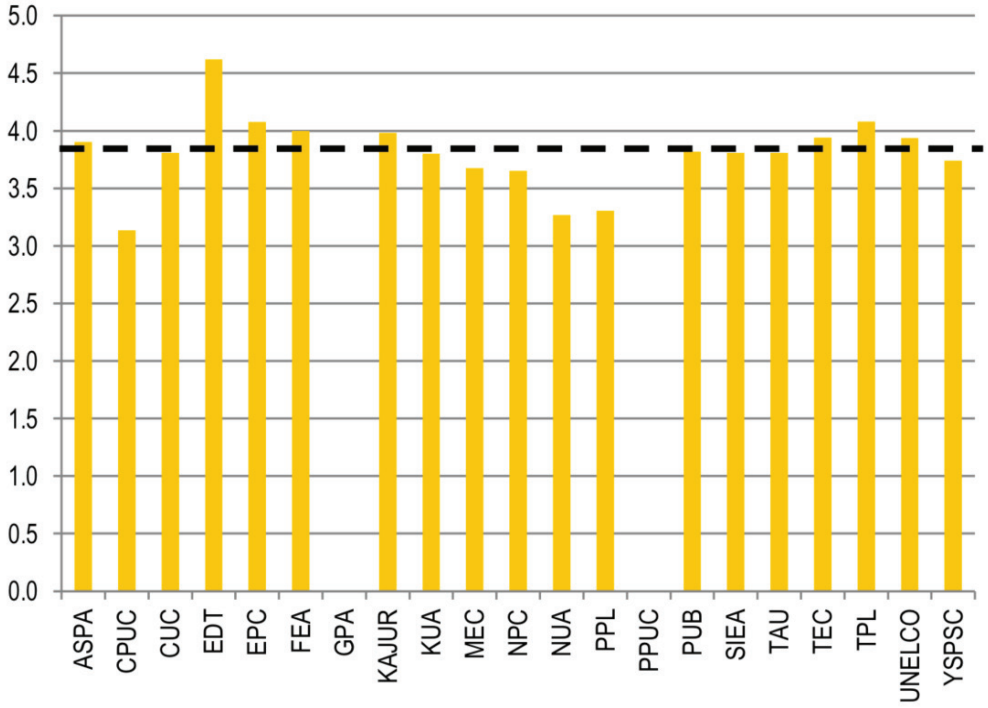
Fiji's energy intensity is below average of the 14 PIC, while the Republic of the Marshall Islands (RMI) and Palau show an energy intensity that is more than twice as high as Fiji's.

Power sector

The efficiency of the supply side of electricity has been benchmarked in the PPA study mentioned previously. FEA scores well in comparison with other PIC utilities. Two indicators are relevant with regard to the supply side efficiency of power supply: a) specific fuel consumption (the number of units generated from 1 litre of diesel fuel) and b) the technical losses of the transmission and distribution systems.

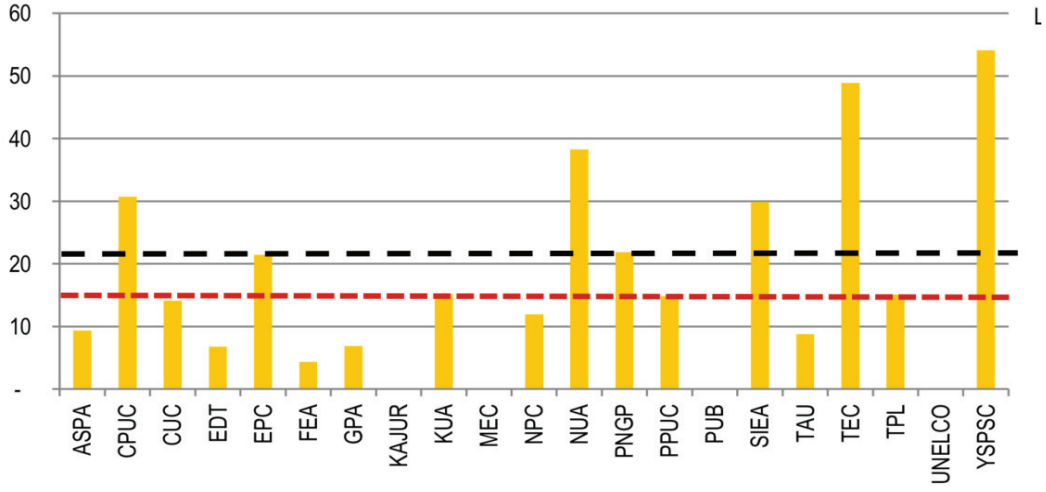
FEA reports a specific fuel consumption of 4 kWh per litre of fuel and is therefore better than the regional average and median which is 3.8 kWh per litre for both measures, as shown in Figure 11. Figure 12 displays a comparison of total distribution and transmission losses. Again FEA scores best with a total loss of approximately 6% against a regional average of 21% and a median value of 15%. The FEA values are close to best practice values for small utilities worldwide and leave little room for improvement.

Figure 11 Specific fuel consumption Pacific Utilities (kWh/l), 2010



Source: PPA, December 2011

Figure 12 Transmission and distribution losses Pacific Utilities (percentage), 2010



Source: PPA, December 2011

Transport sector

Significant increases in energy efficiency are possible in particular in the land transport sector. While maritime transport may also offer some interesting opportunities, the aviation sector does not leave much room for interventions. Fiji Airways (formerly Air Pacific) recently has replaced its old Boeing 747 fleet with more efficient Airbus 330 aircraft and the international carriers visiting Fiji are outside Fiji's regulatory control.

Research undertaken by the University of the South Pacific (USP) indicates that the national and regional maritime transport sector offers the potential to reduce fuel consumption through both increased efficiency and the use of renewable energies. A range of energy efficiency and renewable energy technology solutions appear available or emergent at relatively low cost and research and trialling of commercially viable models could advance this sector. The greatest immediate potential for use of renewable energy is for small scale domestic sea transport, which tends to serve the most marginal routes and needs. While these routes may not give the greatest overall quantity of savings, they are the ones that place the greatest pressure on the public funds and are likely to benefit the communities with the greatest need.[37]

Households

DoE started to work on energy efficiency in 2007 and in 2011 established a Demand Side Management unit consisting of 6 staff and has focussed its activities on appliance labelling for domestic refrigeration technology and the development of training material for an energy efficiency school programme. DSM activities have been constrained by low funding levels (approximately 200,000 FJD p.a.), but funding is expected to increase in the near future.

FEA also maintains a DSM unit. FEA is committed to assist its customers to become more energy efficient. FEA's DSM unit is responsible for providing technical assistance and also for spreading awareness of energy efficiency.

2.3 Renewable Energy vis-à-vis Goal of SE4ALL

2.3.1 Overview and Assessment

Fiji stands out in the region with its diversified power generation and its high use of renewable energy (60%, 2011) in its generation mix. However, the power sector is exposed to droughts and climate change, as almost all renewable energy is hydropower based. While a shift towards renewable resources other than hydro would be desirable, in particular towards geothermal for baseload power plants and solar for embedded, decentralised generation, the power sector does not pose the major challenge in achieving a low carbon energy economy in Fiji. DoE is currently investigating the potential for wind and biomass energy and it is expected that a comprehensive picture of viable renewable energy resources is emerging. It is the transport sector that consumes the majority share of the fossil fuels used in Fiji and boosting the renewable energy share in this sector is the main challenge.

In rural areas, traditional, renewable biomass fuels still play a major role with more than 70% of rural households using wood as the main cooking fuel.[38] While most of the biomass use can be considered renewable, there are considerable negative health impacts of cooking on open fires or wood stoves. In order to mitigate these problems DoE has supported the installation of pilot biogas digesters which generate methane, a clean burning gas that can be used for cooking and lighting.

2.3.2 On-grid and Off-grid renewable energy

Renewable sources are being used in three main forms of electrification in Fiji: i) the main FEA grids with a average renewable energy generation of 60% (2011); ii) the DoE and Ministry of Works mini-grids most of which are powered by diesel with a handful of exceptions where mini-hydropower and bio-fuel (CNO-Diesel mix at 20/80 ratio) contribute to the grids; and iii) the DoE led SHS programme that currently consists of 4600 systems with a total installed capacity of 700 kWp. PV solar system suppliers have indicated that in addition there are numerous solar systems that households have purchased on the open market without any external support.

The ongoing DoE SHS programme promotes the use of SHS within rural communities. It commenced in 2000 and has to date installed around 4600 SHS in communities. The installations were initially mainly in the island of Vanua Levu, however, the programme has been expanded and now covers islands in Lau, Kadavu, Rotuma, Taveuni, Lomaiviti and even

37 Submission to DoE by P. Nuttall, USP, July 2013.
38 2007 Census results, Fiji Bureau of Statistics.

some villages in the western side of Viti Levu. With the high number of requests coming from rural communities and outer islands, an additional 15,000 SHS is proposed to be installed with a total cost of US$25 million. Funding this ambitious programme will be challenging. The Sustainable Energy Financing Project (SEFP), which offers World Bank supported concessionary loans through ANZ and FDB has funded some solar systems but its resources are limited. The Government of Fiji is also in negotiations with other development partners to support its solar electrification programme.

2.3.3 Use of Renewable Energy Sources (RES) for Thermal Applications

There is no significant use of non-traditional fuels for thermal applications in Fiji. The only renewable cooking and heating fuels are wood, biogas and agricultural wastes. According to the Fiji Department of Forestry there is evidence that in some cases fuelwood is harvested in non-sustainable ways, in particular in mangrove areas that surround towns and villages.[39]

Biogas technology has been proven in developing countries especially in some Asian regions in terms of addressing the needs for cooking at domestic level in rural communities. In Fiji, the technology was introduced over fifteen years ago. Since then the Department of Agriculture and DoE have installed a number of digesters for dairy and piggery farmers in the Central, Northern and Western divisions. Recently, DoE has been involved in a number of installations mainly at the Central division. Due to, among others, improper management structures, time allocation and lack of stakeholder commitment to the programme, not all projects have been successful.

The biogas programme contributes to energy and food security, waste management, reduction in deforestation and importantly improving the health of women in rural areas by reducing smoke exposure emitted from wood fires. Women also save time and can engage in other activities including income generation, as they would not have to collect firewood. Biogas production also generates a valuable fertilizer as a by-product. The DoE programme has installed 20 digester units and it is ongoing. There seems not to have been a comprehensive assessment of the market potential for this technology, i.e. it is difficult to predict what quantitative role anaerobic digestion of wastes could have in Fiji. It would be timely to carry out an assessment of the biogas programme, including collection of information available on the technical performance, economics and competitiveness of the units, market potential and levelized cost in order to determine the merits of the technology for Fiji in the medium to long-term.

2.3.4 Use of RES for Productive Activities

DoE has piloted some projects which aim at using renewable energy sources for productive uses. One example is the Driti solar project initiated in 2003 with funding assistance from the Canadian Government and technical assistance provided by USP and SPC. The project consisted of six fresh water ponds managed by women in the village. Fish raised in the ponds was harvested three times a year and sold to nearby villagers. To add value to the project DoE installed a Solar Refrigeration System in Driti Village. The Solar Refrigerator System consisted of four 100 Watts solar panels and six 200 Amp hour batteries. The DoE also facilitated the establishment of a committee that looked after the operations and maintenance of the solar system. Also as part of an agreement signed with Driti Village, the DOE was responsible for the maintenance and operation of the solar system for a period of five years after which the project was handed over to the village.

While this project is an example of how renewable energy can be used for productive purposes, such undertakings remain largely isolated pilot projects, which do not seem to be replicated without external assistance including from donors. As mentioned above a household energy survey from 2005 found that few rural households in Fiji use electricity for income generation. Thus it would appear that an integrated approach would be required including energy services to be provided in conjunction with other development activities – e.g. savings and credit facilities, transport infrastructure, entrepreneurship development programmes, etc.

The Government of Fiji sees promising prospects in the development of a bio-fuel industry as a means to increase productive uses of renewable energy. It has taken several steps to promote both biodiesel and ethanol production from molasses. Fuel standards have been established and significant tax concessions are available for bio-fuel producers. There is also a bio-fuel steering committee which aims at promoting projects in this sector. It was expected that private investors would take up the opportunity to buy molasses from FSC and convert it into ethanol. However, the financial viability of ethanol production is highly sensitive to a consistent supply of feedstock and investors would scrutinize the feedstock resource and project availability into the future based on trends established in the past. Recently, the Government has invested heavily in the sugar industry and it is hoped that the industry will experience revitalization, including an expansion into ethanol production. The state-owned FSC has now taken the initiative including commissioned a new feasibility study on ethanol production from molasses. An 80 million FJD investment is suggested by FSC, which would finance the project with loans from both local and overseas sources.

39 Fiji Forestry Outlook Study, UN FAO, 2010.

2.4 Consolidated Summary

While Fiji has made significant progress in the three SE4ALL target areas a lot remains to be done in order to ensure a sustainable energy supply for all residents of Fiji. In Table 14 below a summary of the current situation and barriers vis-à-vis the three SE4ALL goals is provided.

Table 14 Summary of current situation and barriers to SE4ALL goals

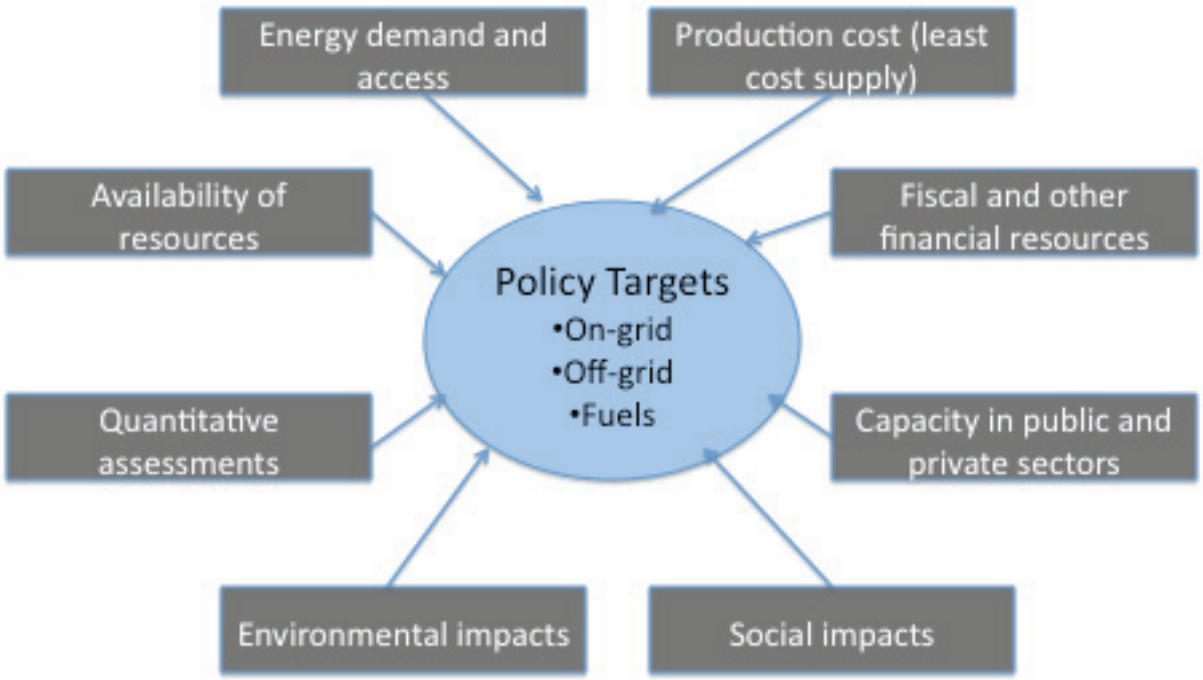
SE4ALL goals	Current status in Fiji	Main barriers/challenges
Ensure universal access to modern energy services	Modern energy for thermal applications 96% of urban and 86% of rural households have access to modern cooking fuels - LPG, kerosene & electricity – (2008/09), there is preference to use fuelwood for cooking of certain traditional dishes (lovo) Access to electricity Urban area access 96%, rural access 82% (2007) Life line tariff in place for low volume users under 75 kWh per month Rural electrification programme in place Modern energy for productive uses Most productive entities are adequately supplied Few rural households use electricity for income generation. A few pilot projects implemented by DoE (e.g. fish freezing) Bio-fuel industry is emerging, but at early stages	Modern energy for thermal applications Lack of reliable data on use of traditional biomass fuels, supply chain weakness for modern fuels in remote areas, affordability of modern, clean energy in rural areas Access to electricity Increasing specific connection cost and low profitability as grid moves to more remote, low consumption areas. No provisions for concession agreements for private suppliers to cover unsupplied areas (e.g. Taveuni) Lack of funding for accelerated rural electrification Modern energy for productive uses Productive use limited in community based electricity supply (no daytime supply) In rural and remote areas factors such as poor market access, lack of available capital, low skill levels, etc. often prevent the development of income generating activities that take advantage of newly available energy sources Ethanol project feasibility established, financing not yet secured
Double the global rate of improvements in energy efficiency	Energy intensity of national economy Energy intensity remained stable in recent years at 2.89 MJ per FJD of GDP or 0.23 kWh per FJD of GDP Some energy conservation efforts in place Focus on awareness building	Energy intensity of national economy Maintain low energy intensity through continued conservation and emphasis on energy efficiency in new mining developments Lack of funding for accelerated conservation programme
SE4ALL goals	**Current status in Fiji**	**Main barriers/challenges**

Double the share of renewable energy in the global energy mix	On-grid and off-grid renewable energy Electricity generation already 60% (2011) from renewable resources Off grid electrification focussing on renewable energy solutions Use of RES for thermal applications Sugar and wood industry use waste biomass for productive thermal energy uses	On-grid and off-grid renewable energy IPP framework required to mobilise considerable potential for renewable energy based power generation Feed-in tariffs inadequate for distributed generation Use of RES for thermal applications Introduction of improved stoves needed to allow clean and efficient use of traditional biomass fuels

2.5 SE4ALL Targets

SE4ALL has defined global high-level policy targets for access, renewable energy and energy efficiency. Other targets relevant for Fiji include level of private sector participation, increased energy security and reduced import cost for fuels. These high level targets define the Government's visions for energy sector development and are helpful in guiding policies and plans that encourage investment. For policy targets to be effective and credible they need to be realistic, but they also have to show that there is ambition to achieve something that would not occur in the absence of the policy. The targets should reflect the optimal mix of energy resources against a projected future demand for electricity, fuels and energy services. Figure 13 displays a simplified target setting process as used here to determine Fiji's draft high-level policy targets for the 2014 NEP and their alignment with the global SE4ALL targets.

Figure 13 Setting Energy Policy Targets



A key decision is whether energy sector investments should focus on providing electricity and modern fuels in rural and remote areas where they are lacking even if such actions have proven to be less cost-effective or if resources should also promote larger on-grid projects that could cost less in the short and medium term. This decision depends on the availability of public resources and consumers' willingness to pay for electricity. In rural and remote areas renewable energy is preferable if:

- ❑ Natural resources are available;
- ❑ Dispersed populations lack electricity access;
- ❑ Potential electricity consumption is not large enough to justify grid extension;
- ❑ Renewable energy plants are cost-effective in the medium term relative to grid connections and fossil fuel plants.

2.5.1 SE4ALL main targets

Ideally, targets for Fiji would be developed based on modelling future energy balances based on accurate historical data for both supply and demand side of the national energy balance. These data sets are currently not available for Fiji and therefore, in the process of modelling supply and demand, assumptions have to be made. A key parameter for setting realistic targets is the availability of finance for investment. As neither investment figures nor accurate supply and demand data are available for Fiji, a simplified methodology has been used to test suggested targets for feasibility and financial impact. Based on population projections by SPC[40] and urban/rural distribution determined in the latest census, achievable targets are modelled for the electricity sector including urban and rural electrification, incremental generation requirements and energy efficiency improvements. It is assumed that government policy will favour a diversified renewable energy portfolio including hydro, geothermal, biomass and grid connected solar and wind. The conclusion of the modelling results in the SE4ALL targets for Fiji as laid out in Table 15 below.

Table 15 SE4ALL Targets

Indicator	Baseline	Targets		
		2015	2020	2030
Access to modern energy services				
Percentage of population with electricity access	89%[1] (2007)	90%	100%	100%
Percentage of population with primary reliance on wood fuels for cooking	20%[2] (2004)	18%	12%	<1%
Improving energy efficiency[8]				
Energy intensity (consumption of imported fuel per unit of GDP in MJ/FJD)	2.89[3] (2011)	2.89 (0%)	2.86 (-1%)	2.73 (-5.5%)
Energy intensity (power consumption per unit of GDP in kWh/FJD)	0.23[3] (2011)	0.219 (-4.7%)	0.215 (-6.5%)	0.209 (-9.1%)
Share of renewable energy				
Renewable energy share in electricity generation	60%[4] (2011)	67%	81%	99%
Renewable energy share in total energy consumption	13%[5] (2011)	15%	18%	25%[6]

1. Preliminary data from 2007 Census, Fiji Islands Bureau of Statistics

2. 2002-03 Household Income and Expenditure Survey, Fiji Islands Bureau of Statistics. Reliance on wood alone as fuel for cooking

3. Fiji Islands Bureau of Statistics based on average 36 MJ per litre of fuel

4. Annual Report 2011, FEA

5. Based on total energy consumption of 16,500 TJ (Fiji Islands Bureau of Statistics) and 55% power generation from renewables (FEA)

6. Based on 99% renewable power and 25,000 KL of biofuel

40 http://www.spc.int/prism/country/fj/stats/Census2007/Release%201%20-%20Population%20Size.pdf

These targets have been developed based on a demand and supply model which is driven by high level parameters such as projected population growth, GDP growth and assumptions with regard to funding that could be realistically made available for projects and investments that contribute to achieving the targets. Concerning the latter it is assumed that an annual average investment in electrification and renewable energy of approximately FJD 50 million can be achieved between 2014 and 2030. In energy efficiency an average annual investment of FJD 2 million is assumed. If the implementation of the draft 2014 NEP encourages even larger increases in investment then the dates for achieving targets could be advanced. The targets will be further developed and refined over time as more energy supply and demand data becomes available.

Energy Access

With regard to access to electricity, the overall target suggested above does not distinguish between rural and urban population. For rural electrification it is assumed that grid expansion will be the preferred option where feasible, whereby the bulk of off-grid electrification will be based on solar (with some pico-hydro and biogas where resources exist). Achieving 100% electrification by 2020 will require approximately 5,700 connections per year between 2015 and 2020. The viability of using FEA grid extensions to reach the remaining unserved communities in Fiji is largely unknown at present and there is little information available on the cost of off-grid connections, which makes it difficult to estimate the cost of electrification. However assuming an average cost of around FJD 2,000 per connection by grid extension and FJD 2,000 per solar home system gives an investment requirement of around 11.5 million FJD per annum until 2020. This investment figure is significantly higher than historical government allocations and therefore assumes an increase in funding, from the central budget, development partners, and beneficiary contributions. After 2020, investment in access would taper off to compensate for population growth and would average approximately 2.5 million FJD p.a. until 2030.

Renewable Energy

In setting the above main targets for electricity access and renewable energy generation, it is assumed that incremental investment in the electricity sector will be in the order of 45 million FJD per annum from now until 2030. Total investment will be significantly higher as old assets of the FEA systems will need to be replaced. It is further assumed that new generation from geothermal, biomass, solar and wind will be undertaken by the private sector either as IPP[41] or as embedded generation (net metering and feed-in tariffs). As details of individual projects are not available the model is based on average annual investments in the various categories. The following table displays average annual investments required to achieve SE4ALL targets in the electricity sector until 2020.

Table 16 Average annual investments required to achieve SE4ALL targets in the electricity sector from 2014 - 2020

Investment Cost	F$/annum	Investor
Efficiency	2,000,000	Private
Hydro	14,100,000	FEA
Grid Connected Solar	1,500,000	Private
Solar Stand Alone	11,500,000	Government
Geothermal	14,411,765	Private
Biomass/Waste to Energy	6,180,000	Private
Medium Wind	1,250,000	Private
Grid Extensions	3,220,000	Government
Total Annual	54,161,765	

In total, average annual investments required to achieve the policy targets above are in the order of FJD 54 million between 2014 and 2020 and slightly lower for the period 2020-2030. Over the entire SE4ALL period incremental investment would be in excess of 800 million FJD. These investments would allow achieving full access of the population to electricity by 2020 and also ensuring that diesel generation will be gradually replaced by a diversified mix of renewable energy resources, both in the FEA grids and in all other rural supply schemes.

Ideally, the costing of investments would be done on the basis of a project pipeline that contains a series of projects, their capacity factors and their merit order. As such data are currently not available, generic investment costs are used here for the technologies and interventions considered. The generic figures are based on Fiji national and Pacific regional averages and are listed in table 17 below.

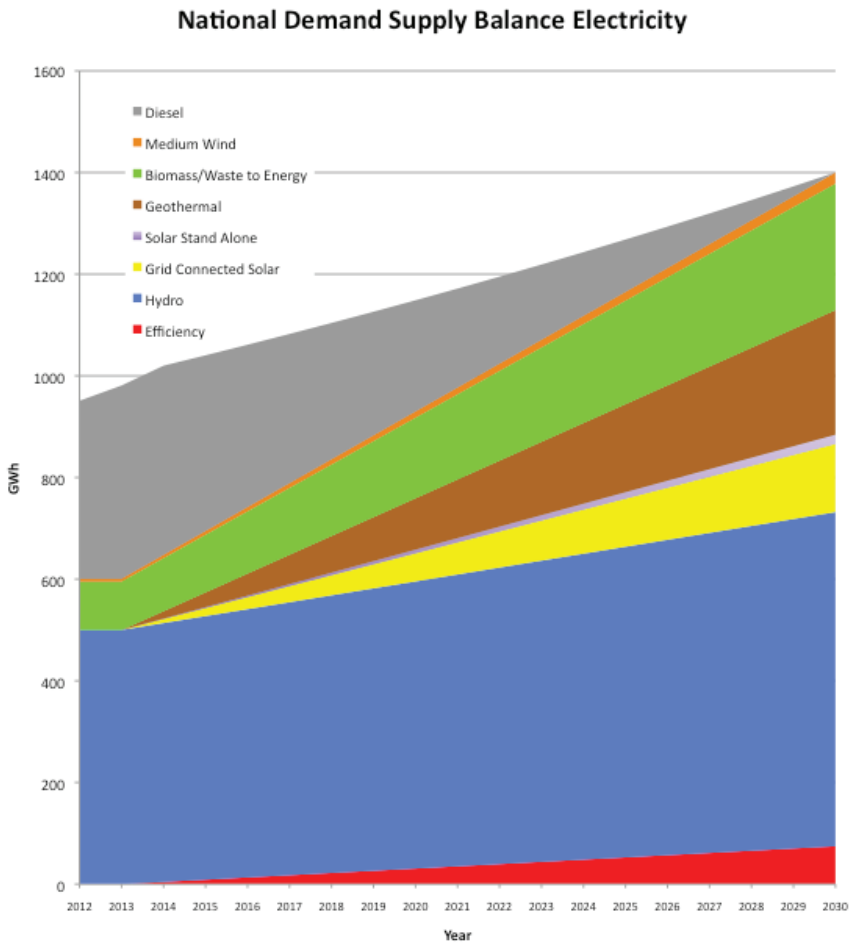
41 The World Bank Definition for IPP is used here: A long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility (Reference Guide PPP, World Bank, 2012 p11).

Table 17 Assumed Specific Investment Cost

Technology	Capacity Factor	Cost FJD
Efficiency	100%	4,000/kW
Hydro	45%	6,000/kW
Distributed Solar	18%	3,000/kW
Solar Home Systems	15%	8,000/kW
Geothermal	80%	7,000/kW
Biomass/Waste	50%	3,000/kW
Wind	22%	2,500/kW
Grid extension connection	100%	2,000/connection

Figure 14 depicts the investment sequence for power generation and efficiency improvements in power use. The model is based on a 2012 baseline of 970 GWh of total demand and an assumed growth rate for electricity demand of 2% p.a. Demand growth is assumed to be above the population growth (assumed to be 1.3% in line with SPC projections for demographic development). This demand growth assumption has been made in order to reflect a trend towards more energy intensive mining development. Energy efficiency gains are assumed to be negative loads, i.e. energy efficiency contributes to a projected demand for electricity in the same way that generation investments would. The full supply and demand model is depicted in Annex 4.

Figure 14 Electricity Demand Supply Balance



Globally SE4ALL requires a doubling of the total share of renewable energy by 2030. In Fiji the above investment programme can achieve this mostly by replacing diesel in power generation. In addition a bio-fuel programme that would replace 5% of the total liquid fuel requirements by ethanol and other bio-fuels has been assumed.

Energy Intensity and Efficiency

The energy intensity of Fiji's economy is calculated on the basis of the Fiji Bureau of Statistics GDP figures and the total modern energy supplied in the country. It is difficult to project this target into the future, as increasing energy intensity is not necessarily a bad thing, for example, major mining projects would probably increase energy intensity but would at the same time stimulate growth and employment. Therefore it is suggested to introduce separate intensity targets for imported fuels and electricity generated. This distinction recognises the fact that the two forms of energy are not perfect substitutes and also have very different impacts on balance of payments.

Such a measure would also acknowledge the different thermodynamic qualities of the two forms of modern energy[42]. Modelling intensity for the two major forms of energy is based on a population and GDP growth of 1.3% and 2% p.a. respectively. It is assumed that locally produced bio-fuels would gradually replace imported fuels up to a level of 25,000 KL in 2030. At the same time energy efficiency improvements are also modelled at a growth rate of 3% reflecting better fuel efficiency in transport and industrial use of fuel. The results of the modelling show energy intensity reductions from 2011 baseline values for electricity of 0.23 kWh/unit GDP in FJD and for imported fuel of 2.89 MJ/unit GDP in FJD to 0.209 kWh/FJD and to 2.73 MJ/FJD respectively. It would be advisable to disaggregate energy efficiency targets broken down into demand sectors. However at present there are no reliable baseline data available to perform such a task and the first step to monitor energy efficiency improvements in Fiji's economy would be to collect baseline fuel and electricity consumption data by sector. Once data collection has been completed, the next step would be to breakdown energy efficiency targets into demand sectors.

2.5.2 SE4ALL sub-sector targets

Grid-based power supply

The targets for grid based power supply are derived from the same model mentioned above based on the assumption that new generation in solar, wind, biomass and geothermal will be undertaken by the private sector. In line with the investment sequence displayed in Figure 14, 100% of incremental electricity generation will be from renewable energies, gradually replacing fossil fuels in generation. The 2030 power supply balance would still have a residual share of fossil fuel based generation, mostly used as back-up for hybrid systems and peak loads. The substitution of fossil based generation by renewable energies will require an average annual investment of FJD 37.5 million of which FJD 23.3 million are assumed to be mobilized by private sector IPP investors. While this requires a significant improvement of the enabling framework for private sector investors, it is feasible given the interest of private sector investors to date and Fiji's favourable resource endowment.

Table 18 Targets - Grid Based Power

Indicator	Baseline	Targets		
	2011	2015	2020	2030
Percentage of grid-based electricity generation from renewables[1]	60%	67%	81%	99%
Percentage of electricity generated by privately owned independent power producers[1]	0%	8%	23%	45%

1. FEA Annual Report 2011

Rural electrification

The modelling of electricity access shows that approximately 4,140 new rural connections per year are required to achieve 100% electrification by 2020. Assuming an average cost per connection of 2,000 FJD (based on the approximate cost of a 200Wp solar home system) results in an annual investment cost in rural electrification of 11.5 million FJD.

Table 19 Targets - Rural Power Access

Indicator	Baseline	Targets		
	2007	2015	2020	2030
Percentage of rural households with access to electricity[1]	82%	85%	100%	100%

1. Preliminary data from 2007 Census (Fiji Islands Bureau of Statistics)

Access to modern fuels

Data on cooking fuel use in Fiji is limited and needs to be improved including through more questions during census and HIES surveys. According to the 2002-03 HIES, 29% of rural and 9 % of urban household used woodfuel as their sole source

42 It requires for instance 3 MJ of fuel to generate 1 MJ of electricity

of cooking energy. In order to provide these households with modern alternatives, the penetration of fuels such as kerosene, LPG and electricity needs to be accelerated. Modelling of the penetration rates suggests that in order to provide 100% of the population with access to modern fuels in 2030, an annual increase in access to modern fuels of 3.5% for rural and 1.9% for urban households is required. For this to materialise, low income households need to be provided with additional income. In addition, private sector supply chains need to expand into underserved or unserved areas. While beyond the scope of energy sector policy, it is assumed that general economic development and improvement in job opportunities and income generation will allow this scenario to materialise.

Table 20 Targets - Modern Fuel Access

Indicator	Baseline[1]	Targets		
	2002-03	2015	2020	2030
Percentage of rural households with access to modern fuels	71%	73%	81%	100%
Percentage of urban households with access to modern fuels[1]	91%	92%	94%	100%

1. 2002-03 HIES

Transport

At present there is no definition of a fuel-efficient vehicle in Fiji. It is however assumed that as part of the implementation of the new draft energy policy, standards for fuel-efficient vehicles will be defined and their market penetration will be supported by regulation and incentives. These measures would need to be carried out through a cooperative effort between DoE and the Department of Transport. The following targets for fuel-efficient vehicles assume that each year more efficient vehicles will replace 1% of Fiji's existing vehicle fleet.

Table 21 Targets Fuel Efficient Vehicles

Indicator	Baseline	Targets		
		2015	2020	2030
Percentage of fuel efficient vehicles as a % of total vehicles on the road	n.a.	1%	5%	15%

In addition to the above, there are opportunities to reduce fuel consumption in national and regional maritime operations. These opportunities have not yet been quantified but there is potential to conserve additional fuel in this sector and targets in the transport sector will be reviewed as detailed information on maritime transport becomes available.

Petroleum and substitute fuels

It is assumed that only bio-fuel projects that are financially viable and environmentally sound will be financed. Presently, this means the main bio-fuel investment will be an ethanol production from molasses although as other projects are developed these can be added to a bio-fuel project pipeline. It is assumed that eventually all 100,000 tonnes of molasses produced by FSC will be converted to 25,000 KL of ethanol. It is assumed that the revitalisation of the sugar industry will continue and a feed-stock level of 100,000 tonnes per annum will continue to be available. The investment cost for the first phase of this venture (production capacity 16,000 KL) has been estimated by FSC to be FJD 80 million. Initially only 10,000 KL per annum can be absorbed in an E10 blend with the balance been exported or used for non-energy purposes. Gradually the amount of fuel ethanol used would increase with the introduction of flexi-fuel vehicles in Fiji until renewable fuel would reach a level of 5% by 2030. Flexi-fuel vehicles can use ethanol blends up to E80.

It is further assumed that the use of vegetable oils (in particular CNO) will be confined to niche markets in outer islands as the LNC/World Bank feasibility study and other assessments have concluded that a biodiesel production would not be a viable proposition for Fiji at this point in time.

Table 22 Targets - Biofuels

Indicator	Baseline	Targets		
	2011	2015	2020	2030
Percentage of biofuel consumption in total liquid fuel supply	0%	0.76%	1.11%	2.37%

3 Challenges and Opportunities for Achieving SE4ALL Goal

3.1 Institutional and Policy Framework

3.1.1 Energy and Development

The energy portfolio in Fiji is currently held by the Ministry of Works, Transport and Public Utilities where the DoE is located. It should be noted that there is no specific act or decree that would define the roles, responsibilities and regulatory functions of the DoE. In November 2006, however, the Fiji Government endorsed its first National Energy Policy and associated strategic action plan, which has since guided the work of the DoE and the development of the energy sector. The stated objectives of the 2006 policy were:

- ❑ Strengthen the capacity for energy planning through appropriate policy, regulatory and implementation frameworks and effective and efficient management
- ❑ Enhance energy security through greater participation and collaboration within the industry
- ❑ Increase access to affordable and reliable electricity services
- ❑ Research, promotion and utilisation of renewable energy applications.

Under each stated objective, a policy framework described the strategic actions the Fiji Government intended to make in order to develop and expand the country's energy sector. The policy was accompanied by a detailed strategic action plan that listed numerous activities all geared towards achieving the above objectives.

An important document governing Fiji's development is the Roadmap for Democracy and Sustainable Socio - Economic Development (RDSSED) 2010 – 2014. The RDSSED sets out a framework to achieve sustainable democracy, good and just governance, socio-economic development and national unity. The key foundation of the Roadmap is the Peoples Charter for Change, Peace and Progress (PCCPP) which was compiled through a nationwide consultation process, involving a wide range of stakeholders. The objective of the Roadmap is to implement policies to achieve the Vision of "A Better Fiji for All", which is consistent with the Peoples Charter. To achieve this vision, the overarching objective is to rebuild Fiji into a non-racial, culturally vibrant and united, well-governed, truly democratic nation that seeks progress and prosperity through merit-based equality of opportunity and peace. In the Roadmap, the Fiji Government sets the energy sector goal as "To facilitate the development of a resource-efficient, cost effective and environmentally – sustainable energy sector".

The institutional and policy framework guiding the energy sector in Fiji is quite complex, with overlapping responsibilities and some gaps in the area of regulation and oversight of the sector players. Recently a major review of the 2006 NEP was undertaken with the support of GIZ and UNDP and guided by a advisory committee comprising DoE, RBF, Ministry of Planning, Department of Transport, the Ministry of Foreign Affairs Climate Change Unit, GIZ and UNDP. The institutional challenges are addressed by the resulting new draft 2014 NEP which aims to implement Fiji Government's vision for a resource efficient, cost effective, and environmentally sustainable energy sector.

The three objectives of the draft 2014 NEP are to achieve:

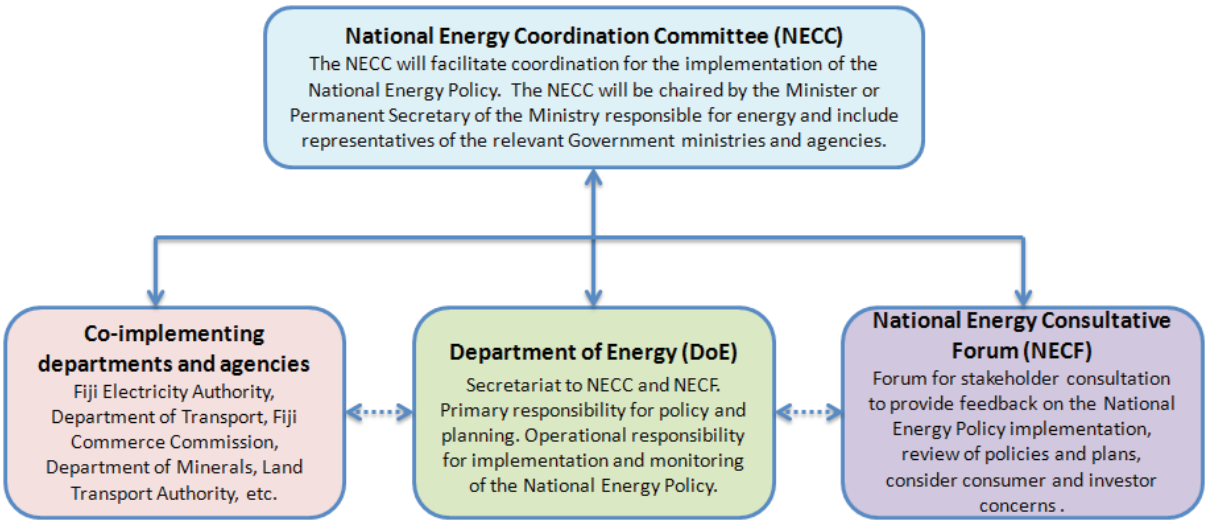
1. Affordable energy for all: Ensure that all Fijians have access to affordable and reliable modern energy services[43].
2. Sustainable energy supplies: Establish environmentally sound and sustainable systems for energy production, procurement, transportation, distribution and end-use.

43 Modern energy services is defined as per the IEA's World Energy Outlook as "clean cooking facilities, a first connection to electricity (defined as a minimum level of electricity consumption) and then an increasing level of electricity consumption over time".

3. Reduced import costs: Encourage the efficient use of energy and the use of indigenous energy sources to reduce the financial burden of energy imports on Fiji.

The key priority policies of the new draft NEP are listed in Section 1.2.5 of this report. For all the proposed new policies please refer to the draft 2014 NEP. In order to fulfil the objectives of the new draft NEP changes to the institutional framework are also proposed within the new NEP as described in Figure 15 below.

Figure 15 Proposed Institutional Arrangements



Coordination

Overall coordination for the implementation of the draft 2014 NEP would be led by a National Energy Coordination Committee (NECC). The NECC should be chaired by the Minister or Permanent Secretary of the Ministry responsible for energy and its membership should include representatives of the relevant Government ministries and agencies, including those responsible for environmental and social issues.

The NECC would be responsible for facilitating coordination across ministries and the departments under them in implementing the 2014 NEP. This includes facilitating aligning policies and activities of individual ministries with the new NEP, reviewing planning and policy proposals prepared by the DoE, providing advice and recommendations as appropriate and resolving any inter-ministry or inter-agency conflicts that may emerge. The NECC would meet at least two times annually. DoE would be the secretariat to the NECC.

Planning and Policy Development

Under the new draft NEP, primary responsibility for planning and policy development in the energy sector would lie with DoE. It is proposed that legislation will be established to provide DoE with a clear mandate to carry out this and other responsibilities, including a regulatory role. National master plans and cross-cutting policies developed by DoE will be reviewed by the NECC. DoE as required will conduct Regulatory Impact Assessments (RIAs) on specific plans and programmes under the new draft NEP. The overall structure of the DoE will be examined including that the necessary human resources are available to implement the policy. This may require increased staffing and capacity-building support to DoE.

FEA remains responsible for planning of the national grid, including generation and network planning and planning of grid extensions. DoE would be responsible for national master plans, including for renewable energy and electrification, and the plans prepared by FEA will be expected to be in accordance with these. Responsibility for policy matters such as the role of the private sector in the electricity industry and development of frameworks for private sector participation in the electricity sector would be transferred from FEA to DoE to avoid potential conflicts of interest.

DoE would not combine a remit for planning and policy development under the new NEP with continued responsibility for detailed implementation, including the installation and maintenance of electrification installations and energy efficiency equipment. DoE would continue to gradually contract out these functions as part of the development of new electrification models.

A focus of DoE's lead role in the energy sector will be a systematic collection and processing of data and information relevant for energy planning. This will include areas that are currently not adequately documented such as the use of traditional biomass household fuels. DoE will co-operate with the Fiji Bureau of Statistics in efforts to improve energy data collection in future household income and expenditure surveys and in the national census. A national energy information system and database will be established and housed at DoE. This will be publicly accessible. The national energy information system will include an electronic record of all relevant past studies in the energy sector, such as resource assessments, feasibility studies, and project evaluations. The database will include demand and supply-side data on all aspects of energy in Fiji and detailed fuel and electricity price data obtained from the FCC.

The organisational structure and resourcing of DoE will be reviewed in light of its role as defined in the new draft NEP. This will include a training needs assessment and the development of a human resource plan, which ensures that DoE has the required set of skills and knowledge to fulfil its new responsibilities.

Stakeholder Consultation

As well as informal discussions and public consultations on specific proposals, the draft NEP proposes that DoE would also consult more generally at least once yearly with representatives of non-government stakeholders in the energy sector. Measures should be adopted to ensure full and inclusive consultation processes including with private users, communities, civil society and non-governmental organisations (NGOs). These consultations will be used to present and receive feedback on on-going activities under the new NEP, progress with implementation of plans and policies and preliminary proposals on new or revised plans and policies. Consideration will be given to consumer protection and consumer and investor concerns. The consultations would be conducted through a National Energy Consultative Forum (NECF) modelled on the similar body established for the transport sector. The material presented and minutes of the consultations would be made publicly available.

Regulation

The draft 2014 NEP states that regulation in the energy sector will consider national interest; while balancing both consumer and investor interests.

The FCC will continue to be responsible for the regulation of fuel and electricity tariffs. The draft 2014 NEP proposes the introduction of a new regulatory contract mechanism for electricity tariffs. The FCC will be able to call on the technical expertise including those contained within DoE where sector-specific knowledge is required.

Non-tariff regulatory functions in the electricity sector that are currently held by FEA, including licensing and approvals, would be transferred to DoE under the new NEP in line with the proposed separation of operational and regulatory functions of FEA. DoE would also take responsibility for developing an IPP framework, which will include procurement processes and power purchase agreement principles for large-scale capacity and feed-in tariffs and net-metering arrangements for grid-connected small-scale renewables. This would mean that in regulating retail electricity tariffs, the FCC would allow FEA to recover its power purchase costs that are in line with the IPP framework put in place by DoE.

Changes to regulatory responsibilities under the draft 2014 NEP would be covered by amendments to existing and new legislation where necessary. To avoid DoE's policy-making/planning and regulatory responsibilities being confused, a separate unit under DoE would be established to undertake these regulatory functions.

Coordination Reporting, Monitoring and Evaluation

DoE would continue lead reporting and monitoring of all energy sector activity, including the implementation of the new NEP. It has been proposed that evaluation of progress in implementation of the new NEP would be carried out externally of DoE including by relevant Government agencies and/or independent non-government organisations as appropriate.

DoE would monitor the implementation of the new NEP, including specific progress against the actions contained in the Strategic Action Plan, and inform the NECC on a yearly basis. Based on the findings, Government may decide to amend targets and actions as considered necessary. An annual report would be presented to the NECF and comments received from stakeholders through this mechanism would be provided to NECC for its consideration.

3.1.2 Thermal Energy for Households

There is currently no specific institutional arrangement for cooking fuels. The FCC regulates the prices for LPG distributed by two competing companies and kerosene distributed through the network of petrol pumps. The DoE promotes biogas technology as an alternative to firewood and to the use of kerosene. Under the new draft NEP the DoE will conduct surveys and cooperate with the Fiji Bureau of Statistics in order to establish a reliable database from which measures to improve sustainable thermal household energy can be planned. Resources to conduct such surveys and establish a database (preferably a GIS based system) will be needed.

3.1.3 Power Sector

Fiji Electricity Authority

One of the key institutions in the power sector is FEA, which is a state owned power utility responsible for providing grid electricity. FEA also has regulatory functions in the power sector, and is the contracting agency for IPPs. FEA has the technical capacity to perform its functions and according to recent benchmarking of PIC utilities in some areas is performing above average within the region (PPA, 2012).

FEA has developed a power sector development plan that aims to undertake investments to upgrade its generation and transmission systems to augment the existing network to a very secure 2020 network and incorporating the first level of redundancy (N-1).

FEA's current renewable energy target of 90%by 2015 can likely only be achieved if the enabling framework for IPP projects is improved to a point where prospective investors into renewable energy projects can achieve financial closure within an acceptable time frame. This will require the development of an IPP framework including a clearly defined regulatory, procurement and tariff setting process. DoE has started to work on a diagnostic review of past IPP experiences in Fiji but additional resources will be needed to develop a comprehensive IPP framework including standard power purchase agreements.

The Fiji Commerce Commission

The Fiji Commerce Commission (FCC) was established in the late nineties and is empowered under the Commerce Act (1998) to determine price adjustments for regulated goods and services, including electricity. However, price reviews for electricity are infrequent and customers have come to accept constant prices as the norm. A regulatory review initiated by DoE and the Ministry of Public Enterprise in 2005 recommended the flowing adjustments to the FCC electricity tariff regulation:

- ❑ Increase the frequency of tariff adjustments to better track FEA's supply costs and to condition customers to the reality that these costs change.
- ❑ Introduce clear and verifiable procedures for managing each tariff review. Tariff adjustments could be calculated periodically by a specialist consultant with interim adjustments determined transparently by the FCC using an objective template approach based on an appropriate pricing model that allows FEA to recover its costs (cost-based or performance-based).
- ❑ Provide the FCC with the resources, independence and autonomy it needs to conduct tariff reviews in accordance with the requirements of relevant legislation.
- ❑ Agree a procedure for annually quantifying and reimbursing FEA's social obligation costs. The procedure should include a transparent calculation methodology.

In addition to the FCC, financial scrutiny of FEA's affairs is authorised under the Electricity Act and Public Enterprise Act. This includes the requirement to audit its accounts annually. The Public Enterprise Act goes further, empowering the Minister to examine the institutional efficiency of FEA. The powers provided under existing legislation are adequate for overseeing FEA's commercial performance, but they are largely discretionary. It must also be taken into consideration that neither the FCC nor the Ministry of Public Enterprise and Tourism have in-house power sector expertise, which in practice means that except for the tariff, FEA is largely self-regulating. As mentioned above, changes are proposed under the new draft NEP, which aim to remove regulatory functions from FEA.

FEA conducts load forecasting, generation expansion simulations and power system planning, and, at present, no other Fiji Government agency has the in-house expertise or software to do this work or evaluate the proposals which FEA makes. Currently, FEA develops its own investment plans, sets the rules for IPPs, and also licenses other enterprises active in the electricity sector. This consistently causes concerns amongst stakeholders including the general public as electricity consumers. The Fiji Government has acknowledged that regulatory changes in the electricity sector would be beneficial for its future development and to encourage greater involvement of the private sector and has initiated a major review of the Electricity Act and the restructuring of FEA through the Ministry of Public Enterprise. The review is currently underway.

Department of Energy

The existing policy framework puts the responsibility for rural electrification largely with DoE's Rural Electrification Unit (REU). The 2006 NEP reinforces the Government's commitment to rural electrification. It also affirms the use of Renewable Energy Service Companies (RESCOs) in the provision of electricity access (as set out in the Charter for Renewable Energy Based Rural Electrification with Participation of Private Enterprises), alongside FEA grid extensions and community-operated systems (as outlined in the Rural Electrification Policy of 1993).

The 2006 NEP also provides the following criteria for prioritising areas of Fiji to electrify:

- ❑ Contributions from the villages. Villages where contributions to the required up-front investment exceed the current 5% compulsory contribution.
- ❑ Focal villages and settlements where joint infrastructure development is possible and infrastructure service packages promise to trigger economic development.
- ❑ Areas identified as most likely to optimise income-raising and socio-economic benefits from electricity supply.
- ❑ Locations where environmental protection and rural development measures are complemented by electricity supply.
- ❑ Locations where organizational initiative is demonstrated as adequate to assure reliable and expanded supply.
- ❑ Villages where electrification complements social, economic, and environmental priorities of localities.

The new draft 2014 NEP emphasises rural electrification and has foreseen two key elements that will enable 100% electricity access by 2020:

- ❑ Develop a national electrification master plan, showing how each un-electrified area of Fiji will be served with least cost solutions.
- ❑ Establish a dedicated electrification fund and an associated framework that will be used to provide capital subsidies for electrification projects.

Achieving 100% electrification will require an average annual investment of FJD 9.72 million from 2014 until 2030. While the Government is committed to allocating significant resources to rural electrification it is also envisioned that funding can be partly sourced from development partners under initiatives such as SE4ALL. In addition to expanding services, there are also opportunities to reduce fuel consumption of more than 500 existing diesel mini-grids. With solar PV technology now competitively priced, a conversion of existing diesel schemes to hybrids could allow the replacement more than 50% of the current fuel consumption.

3.1.4 Modern Energy for Productive Sectors

There are currently no specific institutional arrangements that would address modern energy access for productive sectors. FEA has considered upcoming productive investments (tourism, mining) and their implications on electricity demand in their power sector development plan.

3.1.5 National Monitoring Framework for SE4ALL

Currently, there is no specific mandate or legislation for a central agency to monitor performance of the energy sector as a whole. The DoE is currently carrying out this role and collects information from the various key actors in the sector. The new draft energy policy, when implemented, should assist in providing a better monitoring framework.

The performance indicators, which would measure progress towards the SE4ALL goals, should be based on data and information that can be easily collected and integrated in the regular surveys including census and HIES. Provided that relevant supply and demand side data are collected regularly, SE4ALL reporting can be based on these data. Ideally, both the census and the HIES surveys would use the same questions/data in future events. The following list contains examples of performance indicators would allow monitoring of progress:

- ❑ Energy intensity of economy (MJ/$GDP in FJD)
- ❑ Share of energy purchases in household expenditure (%)
- ❑ Access to grid power (%) broken down by province
- ❑ Percentage of new generation capacity provided by private sector IPP investors
- ❑ SAIDI and SAIFI as recorded by utility
- ❑ Specific fuel consumption for thermal generation (kWh/l)
- ❑ Access to rural electrification grid (%) part time supply
- ❑ Access to rural electrification grid (%) full time supply
- ❑ Share of RE generated power in rural mini-grids (%)
- ❑ Access to PV lighting systems in rural areas (%)
- ❑ Technical losses FEA (%)
- ❑ Reduction in transport fuel use (%)
- ❑ Share of electric vehicles in fleet (%)
- ❑ Reduction in energy intensity of major industries (%)
- ❑ Share of renewable energy in FEA generation mix (%)
- ❑ Share of private investment in RE generation (%)
- ❑ Banking sector lending to RE and EE investments
- ❑ Total annual energy investment by private sector (FJD)

The above list is not necessarily comprehensive and may be adapted in response to specific requirements. It is, however, aligned with energy security indicators collected and compiled by SPC's Energy Programme and therefore allows a comparison across PICs.

3.2 Programmes and Financing

In contrast to the other PICs, external financial assistance plays a relatively small role in Fiji's economy. Between 2008 and 2010, Fiji received an amount equivalent to 2% of GDP, from Organisation for Economic Co-operation and Development (OECD) countries. In 2008 Fiji received a total of $40 million in net Official Development Assistance (ODA), of which $28.6 million was in the form of bilateral grants and $11.8 million was multilateral assistance. The main traditional bilateral donors are Australia, Japan, and New Zealand, with France and the United States (US) also providing aid in some years. Multilateral aid flows are from the Asian Development Bank (ADB), the European Union (EU), the United Nations (UN), and the World Bank (WB). New donors, such as the People's Republic of China, India, and Malaysia, have been providing significant external credits since 2008.

The ratio of aid to GDP ranged from 2.4% of GDP to almost 5% of GDP in the 1990s, but it has fallen to about 2% of GDP in 2008–2010. In 2006, the EU suspended new aid programmes while the WB and ADB halted new lending. New sources of foreign borrowing have been tapped to offset the decline in financing from Fiji's traditional donors, with official loans for infrastructure development provided by a number of new development partners such as China. However, the number of externally funded projects and programmes in Fiji is small.

The government budget allocation to the energy sector has increased over time and reached 18.9 million FJD in 2012. This funding is allocated to the operation of the DoE and includes government subsidies for the lifeline electricity tariff. It also includes donor contributions from various sources.

Table 23 Government budget for energy (000 FJD)

	2007	2008	2009	2010	2011	2012
Total Gov Budget	7061.9	8241.9	16,748.5	8687.7	10,010.4	27,005.5
Fuel and Energy	6203.8	7030.0	14,195	6800	6950.0	18,916.7

Source: DoE

3.2.1 Thermal Energy

There is currently no specific programme that would finance thermal energy supply. Thermal energy is either supplied through collecting biomass (wood and wastes) or through the private sector supply chains for petroleum products, including LPG and kerosene. The FCC regulates fuel prices.

3.2.2 Power Sector

FEA Power Sector Development Plan

Fiji's power sector investments such as the Monasavu hydro scheme have traditionally been financed through a mix of International Financial Institution (IFI) loans (such as WB, ADB) and local sources such as commercial banks and the pension fund (Fiji National Pension Fund or FNPF). Since 2006, IFI financing has not been accessible and the Government has sourced financing from elsewhere. The most important lender to the Government of Fiji since 2006 has been the People's Republic of China, which, for example, co-financed the FJD 310 million Nadarivatu hydro project that was commissioned in September 2012. It is worth noting that ANZ bank also provided loan financing towards the Nadarivatu project. FEA and the Government plan to source funding for the 1.5 billion FJD that makes up the FEA medium term development plan from a variety of public and private organisations, including bi-lateral and multi-lateral development partners. It is likely that the private sector will have a significant contribution to make to reach the investment levels needed for the power sector.

Fiji Renewable Energy Power Project (FREPP)

DoE is currently implementing together with the UNDP a renewable energy project with funding from the Global Environment Facility (GEF). The project focuses on the removal of barriers (policy, regulatory, market, finance and technical) to the wide-scale use of renewable energy resources for grid-connected power generation in Fiji. FREPP consists of four main components and is expected to yield the following major outputs:

- Energy Policy and Regulatory Frameworks
  - Enactment and Enforcement of Fiji Energy Act
  - Enforcement of Implementing Rules and Regulations for the Fiji Energy Act
- Renewable Energy Resource Assessments and Renewable Energy-based Project Assessments
  - Establishment of a Centralized Energy Database System
  - Completion and Publishing of Renewable Energy Resource Assessments in Fiji
  - Completion of Feasibility Assessments of Renewable Energy Investments
  - Renewable Energy-based Power Generation Demonstrations
  - Designing and Implementation of Renewable Energy-based Power Generation Demonstration
- Renewable Energy Institutional Strengthening
  - Completion of Training Programme on Integrated Energy Planning and Administrative Policy for Government Personnel
  - Completion and Approval of National Electrification Master Plan

Further to the above, FREPP is expected to facilitate investments in renewable energy-based power generation in Fiji, which will not only support the socio-economic development of the country, but also make use of the country's renewable energy resources and reduce greenhouse gas emissions.

Sustainable Energy Financing Project (SEFP)

Since it is a Government initiative to reduce fuel importation and environment pollution and reduce spending in fuel imports by converting electricity generation from fossil fuel to renewable energy, the DoE with the WB and funding from GEF is promoting the use of solar, hydro or coconut oil fuel (alternative fuel for diesel generators) for lights or electricity generation and energy efficiency equipment to reduce electricity bills, through the 'Sustainable Energy Financing Project (SEFP)' loan scheme. The DoE is the executing agency for the WB in implementing SEFP and the project has been underway since 2007, with a finishing date of 2017.

The SEFP aims to make renewable energy and energy efficiency equipment more affordable and offers concessionary loans for individuals, communities and private, businesses in rural or urban areas. Through the SEFP, financial assistance in the form of a loan can help spread out the upfront cost of investment into small-scale renewable energy technologies into more manageable amounts. The SEFP supports three renewable energy technologies; solar PV; pico-hydro; and using coconut oil as a diesel fuel alternative for generating electricity. Other technologies such as wind and biomass are not currently supported by the project, but can be considered. The SEFP partners with banks and financial institutions in Fiji so that customers have more choice and flexibility in accessing financial assistance. Currently ANZ Fiji and Fiji Development Bank (FDB) are the Participating Financial Institutions (PFI).

Anyone (individual/community/private/business) who wants to use or supply energy efficiency equipment, solar, hydro or coconut oil fuel for electrification purposes is eligible under the project. Equipment can be procured from any supplier either locally or overseas as long as the equipment/proposals are approved by the WB. ANZ Bank offers a 1% discount on their interest rate for personal or business loans under this project and FDB is charging 6% interest to all loans under the SEFP. Applicants need to provide only 50% security, the project provides the other 50% as guarantee.

DoE Rural Electrification Programme

Table 24 provides a cost estimate for an expansion of the programme that would cover almost all households that currently do not have access to any form of electricity. However, funding for the programme would require 25 million FJD and has not yet been secured.

Table 24 Solar electrification programme

	Division	Province	Number of Household	Cost (US$)
1.	Eastern	Lomaiviti, Kadavu, Lau	10,000	$15.0 Million
2	Northern	Cakaudrove, Bua & Macuata	3,000	$4.5 Million
3	Western	Ba, Nadroga/Navosa & Ra	2,000	$3.0 Million
4	Contingency Cost (10%)			$2.5 Million
Total			15,000	$25.0 Million

Source: DoE

Increasingly, DoE plans to replace diesel in remote and rural areas with locally produced coconut oil (CNO). Four CNO mills have already been installed under DoE's bio-fuel programme that eventually will involve up to 20 installations (see below for details).

DoE bio-fuel programme

Table 25 provides an overview of the DoE bio-fuel programme, which will be funded from the government budget allocation for DoE. The bio-fuel programme is designed to produce CNO locally and sell it at a regulated price to the communities in the vicinity of the mills. The communities would then blend CNO and diesel at a CNO ratio of 20% and use it for electricity generation. DoE has plans to introduce dual fuel kits for the generators supplied with CNO. If successful this retrofit has the potential to increase CNO use to 90% of total fuel use.

Table 25 Biofuel programme

Province	Village	Year	Cost FJD
Lau	Lakeba	2012	600,234
	Vanuabalavu	2011	622,636
	Cicia	2010	468, 192
	Matuku	2012	358, 475
	Moala	2013	468, 054
Lomaiviti	Gau	2011	604,386
	Koro	2010	500,000
	Batiki	2012	Not feasible
	Nairai	2013	Not feasible
Rotuma	Motusa	2010	468, 192
	Juju	2012	
Bua	Lekutu	2011	Study under way
	Wainunu	2012	
Macuata	Udu	2012	Not feasible
Kadavu	Naikororo	2011	Study under way
	Nabukalevu	2012	Study under way
Cakaudrove	Vuna, Taveuni	2011	Study under way
	Naselesele, Taveuni	2013	Study under way
	Rabi Island	2013	601, 119
	Saqani	2013	Study under way
	Cakaudrove-i-Vanua	2013	Study under way

Source: DoE, 2013

It is widely acknowledged that value can be added to products at the rural communities' level through local processing of agricultural products such as copra. However, some further analysis and evaluation is needed to compare the bio-fuel programme's financial and economic viability to alternatives such as diesel or solar. As further data becomes available from the existing bio-fuel mills in Fiji, DoE would be well placed to undertake this analysis if appropriate human and financial resources are made available.

World market developments suggest that CNO prices (adjusted for 10% less energy per litre) have been consistently above prices for diesel. It remains to be demonstrated that CNO can indeed compete with diesel oil when all additional costs (of producing and using CNO) are considered. However, in the case of CNO produced and used locally on isolated and remote islands, the economics of CNO and diesel could be different and a full cost benefit analysis is needed.

A recent biofuel project funded by ADB in the Solomon Islands found the economics of CNO use to be marginal[44]. The report on the operation in Solomon Islands concluded: "An analysis of commodity price developments suggest that the world energy-equivalent price per litre of CNO has at all times from 1986 to the present exceeded the world price of diesel fuel (before the costs of shipment to and within the Solomon Islands are included). From 1986 to about 2001, the world price of CNO was not highly correlated with that of diesel fuel, in the period thereafter to the present; the two prices appear to be closely linked. After 2001, the price of CNO rises and falls closely in line with the price of diesel fuel."

Recently, the prices for CNO and diesel have been gradually rising since mid-2009 and are now at a level last seen in 2008. Changes in nominal CNO prices have matched changes in nominal diesel prices very closely in this later period also. The linkage between CNO prices and diesel prices in recent years undoubtedly reflects CNO's increasing importance as a bio-fuel. CNO energy equivalent prices have been consistently higher over this period as CNO and other vegetable oils also have primary, non-fuel uses (as foods and chemical feedstocks), and competition by those uses has driven the price higher than its use as a fuel could do alone.

44 ADB – Coconut Oil as a Substitute Fuel in Auki, Malaita - Feasibility Study on CNO Use for Power Generation GHD 2012.

In addition, it should be noted that any introduction and promotion of biofuel in the Western world has enjoyed (and still enjoys) some form of government subsidy. These subsidies obviously increase demand for bio-fuel feedstocks including vegetable oils. The world market price for vegetable oils including CNO is supported by the commodity price for fossil fuels. While prices can easily move above the energy equivalent of fossil fuels they have rarely fallen below it.

The financial advantage that indigenous CNO has over imported diesel is that it avoids international and local shipping costs from remote supply markets, since it is produced and used locally. In general, the smaller and more remote the outstation, the higher the cost of delivered diesel fuel due to the costs of shipping and the greater the benefit of using locally produced CNO. DoE has selected its CNO pilot projects using these criteria.

CNO produced from local resources can also enhance energy security for outer island locations that frequently experience fuel shortages and supply interruptions. Burning CNO is nearly carbon neutral as long as the coconut production does not have to rely on significant inputs of mineral fertilizer and does not involve the need to clear indigenous forests for the establishment of coconut palm plantations.

3.2.3 Modern Energy for Productive Use

The DoE sponsors an energy efficiency competition for productive uses and awards prizes each year. The private sector competition is aimed at both commercial and industrial businesses. In 2012 the competition was divided into three categories namely: i) Commercial; ii) Industrial & Manufacturing; and iii) Hotels. Prizes are awarded for each category during the Fiji Business Excellence Awards. Entities are encouraged to participate for a chance to become an award-winning energy-saver company and also a chance to win prizes. Apart from this, the DoE also run similar kind of competitions for the public sector, schools and domestic households. For the public sector, the prizes are awarded through the Public Service Excellence Award Night.

Apart from DoE's initiative, there are at present no specific programmes or financing to improve access, efficiency and use of renewable resources in productive sectors. The SEFP described earlier, however, would be open for those who seek to finance productive clean energy activities.

3.3 Private Investment and Enabling Business Environment

In recent years, total investment has been below the target of 25% of GDP, which the government estimates is required to achieve an annual GDP growth rate of 4%– 5%. Private investment was only 3.5% of GDP in 2010; and reportedly 2% to 3% of GDP in 2011, the lowest since Fiji gained its independence in 1970 (ADB 2012). However, in 2012 investment as percentage of GDP has increased again both from private and government sources and was predicted to reach the 25% target in 2013 (RBF, 2013). Various indicators reflect the stronger investment activity in 2012 including 28.1% increase in new investment lending by banks, 6.1% increase in the number of building permits issued and 8.8% increase in imports of investments goods for 2012 (RBF, 2013).

The international perception of the investment and business climate in Fiji is reflected in the WB's Ease of Doing Business Survey. In the category 'starting a new business' the 2012 survey ranked Fiji as no. 138 of 183 surveyed countries, well below the Pacific regional average of 93. Fiji's ranking has weakened for almost all sub-categories between 2011 and 2012 showing a trend towards a less favourable business climate. Only the category trading across borders has seen Fiji being ranked one place higher in 2012. The categories investor protection, access to finance, dealing with construction permits, registering businesses and enforcing contracts have all seen downgrades between 2011 and 2012. This trend is also reflected in the findings of the ADB's Private Sector Assessment of 2011[45] (Re-invigorating private sector investment) the report states: "The general business climate in Fiji is not conducive to attract sufficient private capital".

The difficulties for private sector investors who want to invest in an IPP project was illustrated both during the National Energy Forum in April 2013 and the National Consultation Workshop in August 2013 where representatives of IPP investors reported their difficulties to bring projects to financial closure. It would appear that the power purchase tariffs that FEA is prepared to offer are insufficient to finance potential energy sector projects.

45 FIJI Private Sector Assessment , Re-invigorating private sector investment, Asian Development Bank, 2011.

3.3.1 Thermal Energy for Households

While thermal energy in rural areas is normally provided by fuelwood that is collected in the vicinity of the households, modern cooking fuels such as LPG and kerosene are provided through private sector actors in both rural and urban areas.

Supply chains for kerosene start with a diversion of kerosene from the aviation market (where it is used in large quantities as jet fuel) and reach to the remotest places in Fiji, often involving multiple businesses (wholesale by oil companies, then retailing into 200 litre drums by shipping agents and suppliers) until the fuel is finally retailed in small quantities through local stores.

LPG on the other hand is distributed through two private local companies: Fiji Gas and Blue Gas. Fiji Gas agents or agents of its competitor Blue Gas can now be found in all major towns on Fiji's two main islands, a branch office is set-up in Sigatoka and a road tanker operates to provide deliveries of bulk gas to hotels and other industrial facilities. Today, Fiji Gas' seven terminals, including two in Tonga, have a combined capacity of over 1,375 tonnes, and employ 110 permanent staff.

Fiji Gas competitor Blue Gas is a local family company, which is part of the Hari Punja Group of Companies. It was established in 1989 as part of the group's business diversification strategy. Blue Gas imports (from New Zealand), stores and supplies LPG gas for residential, commercial and industrial uses for both the domestic and export markets. In 1996, Blue Gas became the first gas company in Fiji to receive ISO 9002 quality assurance certification.

All the three major modern household energy forms, i.e. electricity, LPG and kerosene are price controlled by the FCC. However, the regulation of fuel prices does not take into account that LPG is a cleaner, more desirable fuel for household cooking than, for example, kerosene. Per unit of energy, LPG is the most expensive fuel when price regulation by the FCC is considered. It seems recommendable that pricing and taxation of LPG be reviewed in order to make this clean and efficient household fuel more affordable.

3.3.2 Power Sector

In 1996, the DoE with support from an EU funded regional project (Pacific Regional Energy Programme - PREP) called for an expression of interest from prospective IPP developers as the government of the day saw the need to broaden financing of generation projects by tapping into the internationally fast developing IPP market. More than 70 expressions of interest were received and consultants evaluating these expressions rated about 50% of the proposals interesting and technically feasible. The proposals included biomass, hydro, wind and solar energy. Subsequently, a number of prospective IPP investors have presented themselves but while FEA has signed five power purchase agreements with potential IPPs, none of these projects have achieved financial closure to date. These projects include biomass (3), used oil (1) and one mini-hydro project.

According to prospective investors, the reasons for this poor performance of IPPs include:

- ❑ Power purchase tariffs are significantly below avoided cost of FEA's thermal generation, and thus cannot render IPP projects financially viable;
- ❑ Unclear situation with regard to FCC ruling on minimum tariffs; [46]
- ❑ Complex and costly approval procedures;
- ❑ Self-regulating of FEA with regards to grid access;
- ❑ Difficulties to access financing; and ,
- ❑ Difficult or no access to relevant information.

The tariff issue has been singled out as a major obstacle by potential IPP investors. In its December 2012 ruling on new tariffs the FCC reduced the minimum tariff that FEA should pay for firm power to FJD 0.2565 per kWh. This feed-in tariff is significantly below avoided cost of thermal generation, which the FCC assessed to be FJD 0.61 per kWh. The power purchase tariff is also uniform for all FEA grids although some grids such as Ovalau are 100% diesel fired and would therefore allow much more margin for a feed-in tariff. An option for the future would be to consider different power purchase tariffs (feed-in tariffs) for different locations around Fiji.

46 In its December 2012 ruling the Fiji Commerce Commission set the minimum tariff for IPP at 25.65 cents. In a submission made by FEA's CEO in September 2013, the tariff offered by FEA was 23 cents, i.e. 11.5% less than the Fiji Commerce Commission set tariff.

In 2005, the DoE together with the Chief Executive Officer of the Ministry of Public Enterprises and Public Sector Reform requested assistance from the Secretariat of the Pacific Applied Geoscience Commission (SOPAC) and UNDP to review regulatory arrangements in Fiji's power sector in order to determine why private sector participation in power generation has been restricted to a long-term maintenance contract for Kinoya power station. An independent consultant was engaged under the Danish funded Pacific Islands Energy Policy and Strategic Action Planning (PIEPSAP) project to review the regulatory framework. The report came to the conclusion that regulatory strengthening would be required to effectively attract IPP investors. It stated:

> "…From an examination of current regulation of the FEA system it is clear that an appropriate legal and institutional framework substantially exists already. Existing legislation, particularly the Commerce Act and Public Enterprise Act, gives Government of Fiji agencies broad regulatory mandates to scrutinise FEA's planning, operations and transactions. These regulatory powers tend to be discretionary and the regulatory agencies lack the staff and resources to act. The situation is not uncommon. Legal and institutional changes can be made relatively quickly, but implementation of the new arrangements requires resources and the responsible agencies are often under-resourced and unable to discharge their new regulatory duties."

Based on these findings a number of recommendations on how to improve the regulatory framework were made. They can be summarized as follows:

> "The Commerce Commission has been created as an independent commission to regulate specified activities across a number of sectors. Enabling legislation is in place, the Commission has been established and is building a track record. The Commission therefore provides a natural focus for progressive strengthening of the scope and autonomy of the regulatory framework. In respect of the electricity sub-sector, the Commission currently regulates electricity pricing and is taking on other duties with the absorption of the regulatory functions of the Department of Fair Trading and the Prices and Incomes Board. "

The report also developed a detailed implementation plan on how to strengthen the regulatory framework in the power sector, which is summarized in Table 26. The report acknowledged that reforming the regulatory framework required considerable time but found that reforms should be manageable. Initial steps were specified to address regulatory reform in respect of tariff reviews and tariff adjustments, IPP/PPP procurement and power system planning. None of the recommendations made in this study have been implemented as yet and many participants in the National Energy Forum in April 2013 raised the same concerns about an inadequate regulatory framework that triggered the regulatory review in 2005.

Table 26 Regulatory reform programme

Reform Initiative	Implementation Plan	Agent
Tariff Reviews / Adjustments	Develop formal tariff review and price adjustment procedures	Fiji Commerce Commission / Consultant
	Develop template for determining interim tariff adjustments	Fiji Commerce Commission / Consultant
	Commission Tariff Study (every 3 to 5 years)	Consultant
	Manage public education programme to explain tariff adjustments	Fiji Commerce Commission / consultant
PPP Procurement:	Develop PPP regulations governing all stages of procurement	Consultant
	Prepare model RFP and model PPA documentation for use, as appropriate, in competitively soliciting PPP bids.	Consultant
	Prepare a PPP procurement manual setting out GoF requirements with respect to procurement processes, responsible agencies, required studies, approvals and consents, contract documents, review processes, etc.	Consultant
System expansion Planning:	Prepare formal procedures by which national priorities are accounted for in power system planning, including specification of inputs, assumptions and criteria (e.g. system reliability, self-sufficiency targets, environmental constraints).	Fiji Commerce Commission / FEA / DOE

Source: Maunsell, Regulatory Review FEA, 2005

3.3.3 Modern Energy for Productive Sectors

As mentioned earlier FEA sells most of its electricity to commercial and industrial consumers, which use power for the manufacturing of goods or the supply of services. At the same time productive enterprises such as Tropik Woods and FSC are part of the supply chain for electricity as they sell excess power to FEA. These enterprises are not IPPs,[47] as they are state owned enterprises that generate their own process steam and electricity for their production processes. Electricity is a by-product of these productive activities which is, when generated in excess of their own demands, sold to FEA at rate of FJD 0.15 per kWh. At this tariff level, no true IPP (a single purposes investor who would invest in generation) could achieve a bankable project in Fiji. FEA also applies this feed-in tariff to distributed grid connected solar generation. Net metering has seen remarkable successes internationally and in the Pacific region, but currently there is no national net-metering policy or arrangements in place.

3.4 Gaps and Barriers

3.4.1 Thermal Energy for Households

There is a considerable information gap in the household cooking fuel sector. Very few quantitative data sets exist on rural fuelwood use, cost of fuelwood and environmental impacts of wood use. There are barriers and limitations for the penetration of fossil cooking fuels that replace wood as the Fiji Government is already concerned with the growing size of its import bill for fossil fuels. It is also unlikely that most rural households could afford the use of LPG even if the supply chains for the fuel were extended to cover the entire country. It would thus appear that replacing all wood with LPG or kerosene is not a sustainable approach. An option that could be investigated in the medium term would be to introduce improved wood stoves, which would replace open fires. Again there is currently no project or programme that would promote woodstoves and a project to promote these would fit very well under the SE4ALL initiative. Another option could be to further investigate and implement biogas for cooking projects at farms, rural public sector institutions and rural households.

3.4.2 Power Sector

Governance

One of the main challenges in the power sector is institutional in nature: there is no effective enabling framework in place to attract the required private capital to renewable energy based power generation. FEA has operated since 1966 as a SOE without effective regulatory oversight. Hence, FEA has determined the conditions for potential private participants. For example: tariffs offered by FEA have not been sufficient to attract private investors or IPPs to date and power generation project selection criteria are not clear. FEA currently offers an IPP tariff that is 11.5% under the minimum IPP tariff of 25.65 cents/kWh set by Fiji's price regulator the Commerce Commission[48]. Whilst planning for restructuring of FEA is under way, another gap exists in Fiji's business climate. Although the commercial banking sector has an unprecedented liquidity, access to capital for energy sector investment is difficult. For private sector investment to take off, these and other gaps needed to be closed. As mentioned the WB supported SEFP implemented by DoE addresses smaller scale financing, but does not have the resources to support financing of larger IPP projects.

An enabling framework for private sector participation would also have to address the barriers that currently exist with regards to small-scale decentralised grid-connected renewable energy based generation. At present there are no feed-in tariffs, net metering provisions or incentive programmes that would promote such generation by households and SMEs. As also mentioned DoE has launched the FREPP, which aims to address some of the constraints in these areas. However more resources will be required to streamline the entire selection and procurement process for IPP and small-scale distributed generation.

DoE currently has limited resources to fulfil regulatory functions and engage in promoting private sector participation in the electricity industry. There is a need for capacity building to assist the DoE in effectively fulfilling its new functions under the new draft NEP. Key areas where DoE staffs need to be trained are financial/economic analysis, IPP procurement, financing, legal issues related to private sector engagement and project development. Furthermore the establishment of a 'one stop shop' authority for private sector investment in the energy sector is currently being considered and could help to streamline application and compliance procedures.

47 The World Bank Definition for IPP is used here: A long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility (Reference Guide PPP, World Bank, 2012 p11).
48 The IPP tariff was set by the Fiji Commerce Commission determination of 2012.

Supply chain

In the rural electrification segment there is no comprehensive plan that would describe a least cost path to full affordable and reliable access to electricity. Such a plan would include a full inventory of existing rural electrification schemes. Existing diesel schemes that are suitable for a conversion to diesel-solar hybrid schemes would be indicated. At present there are various initiatives including grid expansion, diesel mini-grids, diesel mini-grids partly fuelled with CNO and SHSs. The process of quantifying the renewable energy resources is incomplete and needs to be continued so all technologies and resources are addressed. This should be an on-going process. The 2006 NEP appeared to consider this a one-time effort but in the face of climate change, it will be important to continue collection and storage of renewable energy data for all technologies. A considerable data gap exists in the area of traditional cooking fuels. It is recommended to start collecting data for biomass used for cooking and other traditional purposes as soon as possible.

There is also an urgent need to make all resource data widely available to prospective investors. Lack of access to resource data has been an impediment to private sector project development in the past and a provision should be made in the new policy to publish resource data (access to DoE database on resources) in order to attract reputable project developers.

End-users

Despite a considerable potential, efforts to improve end-use energy efficiency have to be continued and expanded in order to reach the targets laid out in this report. Energy efficiency is not as visible as energy generation, and lacks rigorous monitoring and evaluation. The importance of energy efficiency in reaching the sustainable energy goals of Fiji needs to be recognised by all energy sector actors and this will require continued awareness raising and capacity building efforts by the DoE in collaboration with other Government departments and agencies and with FEA. The DoE will need access to additional resources and expertise to facilitate expansion of its activities in the field of energy efficiency. Subsidized or cross-subsidized energy prices (such as Fiji's uniform power tariff) constitute a barrier to consumer-driven improvements.

Mainstreaming of energy efficiency should be broadened to all government departments and other end-user segments. For promoting energy efficiency measures targeting specific end-user segments, certain design principles must be observed. For the successful introduction of a demand-side energy efficiency intervention or some other energy efficiency intervention that targets specific measures in specific end-user segments, the following are considered important aspects of project design:

- ❑ Prioritizing interventions with high impact (such as refurbishment of street lighting with low energy LED technology)'
- ❑ Aligning the interests of all stakeholders to achieve programme objectives'
- ❑ Instituting information systems so that a verifiable data trail is created and energy savings can be reasonably verified, and,
- ❑ Minimizing the probability that stakeholders cannot recover the costs of participating in energy efficiency programmes through a thorough analysis of energy efficiency economics.

For Fiji, there could be significant opportunity to learn from the successes of energy conservation programmes in the Asia Pacific region. ADB for instance has accumulated a considerable body of knowledge and expertise through a large number of energy efficiency interventions across the Asia-Pacific region[49]. DoE has started to work on the incorporation of energy efficient designs and standards into Fiji's building code. This activity will require additional resources in the future in order to make sure that building codes and standards in other industries include provisions which ensure low energy footprints.

3.4.3 Modern Energy for Productive Sectors

There are currently no major specific gaps or barriers to the supply of modern energy for productive sectors. This picture may, however, change when new, large scale mining investment eventuates in the future. The Namosi copper mine alone is estimated to have a power demand of 100 MW and the current power system would not be able to supply this without major investments. Assuming that several mining projects will materialise, it will be of critical importance to ensure that their substantial energy requirements will be met in a sustainable manner, preferably through development of indigenous renewable energy sources such as geothermal and hydro. Ensuring sustainable supply of incremental demand from new industry requires an early quantification of demand, a task where DoE should be engaged as soon as information on new developments becomes available.

49 ADB – Review of Energy Efficiency Interventions, Knowledge Evaluation Report, Manila 2012.

3.4.4 Summary

Table below summarises some of the key gaps and barriers, and additional requirements needed to achieve the SE4ALL goals.

Table 27 Summary of key gaps, barriers and additional requirements

Aspects	Main gaps and barriers	Additional requirements
Institutional and policy framework	Legislation governing the energy sector needs to be updated Data and information on energy supply, demand and resources not comprehensive and not accessible to public and prospective investors	New legislation or amendment of existing legislation to streamline energy sector governance and to provide a mandate to DoE as the lead policy and planning agency in Fiji Resource DoE to collect information and establish web-based searchable database for all relevant energy sector information
Programmes and financing	There is no comprehensive rural electrification master plan Data and information on supply chain for household cooking fuels inadequate Data and information on renewable energy potential only partly available No detailed resource assessments for geothermal energy Rural electrification will require annual investment of 9.4 million FJD per annum from 2014-2030 which can only be partly funded by Government resources Data and information on energy use and conservation in land and maritime transport lacking Lack of funding for pilot projects in low energy maritime transport Energy conservation and labelling not yet covering all relevant devices	Resource DoE to develop rural electrification master plan Resource DoE to perform surveys in co-operation with the Fiji Bureau of Statistics Continue assessments and resource DoE to make information available to the public Source funding for exploratory drilling of priority geothermal sites Source funding to fill financing gap in rural electrification and continue to accelerate the existing rural electrification programme Conduct surveys and assessments on energy use, conservation and renewable energy use in transport Source funding for priority pilot projects Resource DoE to expand energy conservation activities and labelling to include motors, outboard engines and other equipment
Private investments	There is no private sector investment in the power sector due to substantial barriers in tariff determination and regulatory handling of IPP investors Complex approval and licensing process deters private sector investors Wide participation of electricity consumers in distributed generation not possible	Amendments to legislation and establishment of an effective enabling framework for both IPP investments and electricity supply concessions Resource FCC and DoE to take on further regulatory responsibilities Establish on-stop shop for IPP and other private sector investors Amend legislation to allow net metering and establish viable feed-in tariffs that promote distributed renewable energy generation

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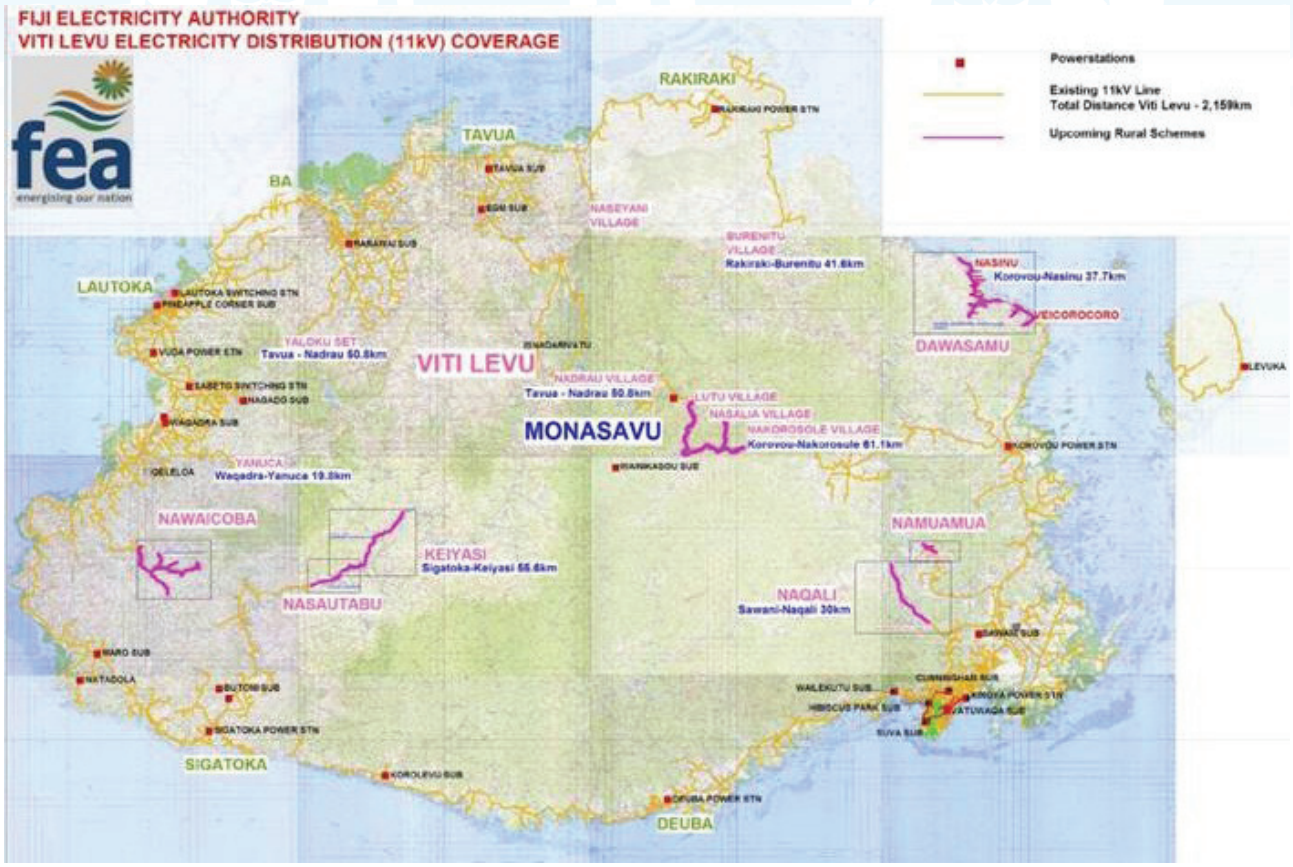
A2 Physical Extension of FEA Grid in Viti Levu

Figure 16 Physical extension of FEA Grid in Viti Levu



A3 Hydro Potential in the Main Islands

Table 28 Hydro potential in the main islands

NO.	SITE (RIVER)	LOCATION	CAPACITY (kW)
Vanua Levu			
1.	Nadamanu	Lekutu, Bua	1,000
2.	Saquru	Labasa, Macuata	1,000
3.	Nuku	Navakasali, Bua	1,100
Viti Levu			
4.	Wailoa Downstream	Naboubuco, Naitasiri	10,300
5.	Wainavau	Sigatoka, Navosa	1,400
6.	Nasa	Sigatoka, Navosa	1,500
7.	Sigatoka 1	Sigatoka, Navosa	3,100
8.	Sigatoka 2	Sigatoka, Navosa	3,900
9.	Solikana	Sigatoka, Navosa	1,300
10.	Nabiaurua	Tavua	1,600
11.	Ba	Ba	2,600
12.	Nakara	Ba	1,100
13.	Loqa	Rakiraki, Ra	1,300
14.	Tawa	Rakiraki, Ra	3,100
15.	Savu	Saivou, Ra	1,600
16.	Nasoqo	Wainimala, Naitasiri	4,100
17.	Naboubuco	Wainimala, Naitasiri	3,700
18.	Waqaitabua	Matailomaibau	1,500
19.	Waikonavona	Matailomaibau	2,100
20.	Waiduvu	Matailomaibau	1,200
21.	Wainivodi	Wainimala, Naitasiri	2,000
22.	Wainisavulevu 1	Wainimala	3,000
23.	Wainisavulevu 2	Wainimala	4,100
24.	Wainimala	Wainimala	2,300
25.	Wainimakutu	Namosi	3,000
26.	Nakavika	Namosi	8,800
27.	Sovi	Namosi	4,700
28.	Wainivadu	Namosi	5,400
29.	Wainamoli	Wailoa, Naitasiri	4,600

Source: Pilot Study for Comprehensive Renewable Energy Power Development, Tokyo Electric Power Company for Japan Bank for International Cooperation (JBIC).

A4 Geothermal Potential in the Main Islands

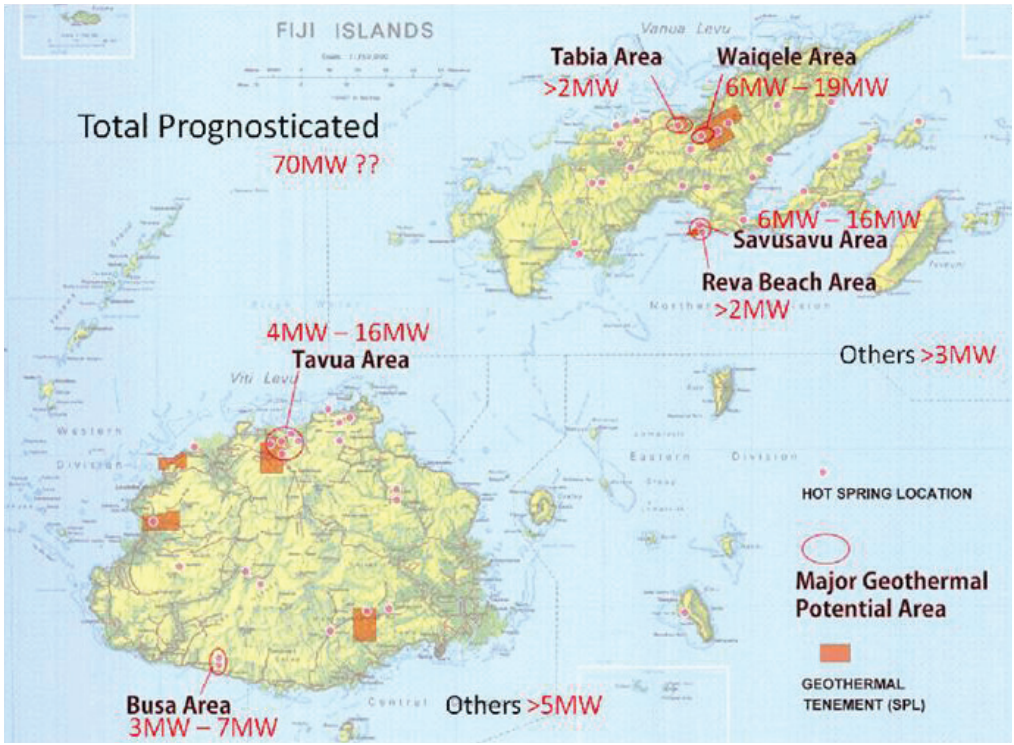
Table 29 Geothermal potential in the main islands

Area	Estimate Temperature (°C)	Suitability	Temperature and Volume of Reservoir	Capacity
Viti Levu				
Sabeto	120°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. - 120°C Area – 1km x 2km Thickness – 200m	0.5MW
Ba	120°C	Mangrove Too far to grid-connected system	Reservoir Temp. – 120°C Area – 1km x 2km Thickness – 200m	0.5MW
Tavua (Waikatakata)	Boiling before: 150°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 160°C Area – 2.5km x 1km Thickness – 400m	6MW
Rabulu	110°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 110°C Area – 1km x 1.5km Thickness – 200m	0.2MW
Nakavika	140°C	In steep mountains Impossible for grid-connected system	Reservoir Temp. – 140°C Area – 1km x 2km Thickness – 200m	1.5MW
Naseuvou	130°C	Flatland No bridge near this point Impossible for grid-connected system	Reservoir Temp. – 130°C Area – 1km x 2km Thickness – 200m	1MW
Wainawaqa	Discharge temp: 28°C	Flatland Impossible for grid-connected system	Reservoir Temp. – 100°C Area – 1km x 1.5km Thickness – 200m	0MW
Busa	180°C	Necessary to confirm access road	Reservoir Temp. – 180°C Area – 1km x 1.5km Thickness – 200m	4MW
Waibasaga	150°C	No bridge near this point Impossible for grid-connected system No access road	Reservoir Temp. – 150°C Area – 1km x 1.5km Thickness – 200m	1.5MW
Viti Levu Total	15MW			
Vanua Levu				
Savusavu	170°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. - 170°C Area – 2.5km x 1km Thickness – 400m	8MW
Rava Beach	185°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 185°C Area – 1km x 1km Thickness – 200m	2MW

Area	Estimate Temperature (°C)	Suitability	Temperature and Volume of Reservoir	Capacity
Tabia	150°C Boiling spring	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 150°C Area – 1km x 1km Thickness – 400m	2MW
Waiqele	150°C Boiling spring	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 150°C Area – 2.5km x 1.5km Thickness – 400m	8MW
Vunimoli	130°C	No problem for PS construction No problem for grid-connected system	Reservoir Temp. – 130°C Area – 1km x 2km Thickness – 200m	1MW
Vanua Levu Total>23MW				

Source: Department of Energy: Project Dossier on Renewable Energies 2010/JBIC

Figure 17 Renewable energy potential in Fiji



Source: Department of Energy: Project Dossier on Renewable Energies 2010/JBIC

A5 Supply and Demand Model SE4ALL Targets

Table 30 Supply and Demand Model SE4ALL Targets

Population Model																			
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Population	866,000	877,258	888,662	900,215	911,918	923,773	935,782	947,947	960,270	972,754	985,400	998,210	1,011,186	1,024,332	1,037,648	1,051,138	1,064,802
	Rural	458,980	464,947	470,991	477,114	483,316	489,600	495,964	502,412	508,943	515,559	522,262	529,051	535,929	542,896	549,954	557,103	564,345
	Urban	407,020	412,311	417,671	423,101	428,601	434,173	439,817	445,535	451,327	457,194	463,138	469,159	475,258	481,436	487,695	494,035	500,457
	No of Connections	74,355	77,176	80,776	84,376	87,976	91,576	95,176	98,776	102,376	105,976	109,576	113,176	116,776	120,376	123,976	127,576	131,176
	Access Rural	371,774	382,934	394,094	405,254	416,414	427,574	438,734	449,894	461,054	472,214	483,374	494,534	505,694	516,854	528,014	539,174	550,334
	Acces Urban	390,739	397,579	404,419	411,259	418,099	424,939	431,779	438,619	445,459	452,299	459,139	465,979	472,819	479,659	486,499	493,339	500,179
	Gap rural	17,441	16,403	15,379	14,372	13,381	12,405	11,446	10,504	9,578	8,669	7,778	6,903	6,047	5,208	4,388	3,586	2,802
	Gap Urban	3,256	2,946	2,650	2,368	2,100	1,847	1,608	1,383	1,174	979	800	636	488	355	239	139	56
	Connections made	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
	Rural	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232
	Urban	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368
	Acces Rural	81%	82%	84%	85%	86%	87%	88%	90%	91%	92%	93%	93%	94%	95%	96%	97%	98%
	Access Urban	96%	96%	97%	97%	98%	98%	98%	98%	99%	99%	99%	99%	99%	100%	100%	100%	100%
	Based on:http://www.spc.int/prism/country/fj/stats/Census2007/Release%201%20-%20Population%20Size.pdf																	
Supply Demand Model																		
Demand	End of Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New Demand BAU	MW	3.80	3.88	3.95	4.03	4.11	4.20	4.28	4.37	4.45	4.54	4.63	4.72	4.82	4.92	5.01	5.11	5.22
Accumulative Demand	MW	3.80	7.68	11.63	15.66	19.78	23.97	28.25	32.62	37.07	41.61	46.24	50.97	55.79	60.70	65.71	70.83	76.05
New Demand	Energy MWh	20,000	20,400	20,808	21,224	21,649	22,082	22,523	22,974	23,433	23,902	24,380	24,867	25,365	25,872	26,390	26,917	27,456
Accumulative New Demand	Energy MWh	20,000	40,400	61,208	82,432	104,081	126,162	148,686	171,659	195,093	218,994	243,374	268,242	293,607	319,479	345,868	372,786	400,241
Energy Efficiency	MW	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Acc Efficiency gains	MW	0.5	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9
Demand reduced	MWh	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380
Accumulative Demand reduced	MWh	4,380	8,760	13,140	17,520	21,900	26,280	30,660	35,040	39,420	43,800	48,180	52,560	56,940	61,320	65,700	70,080	74,460
ACC Demand + Efficiency	MW	3.30	6.68	10.13	13.66	17.28	20.97	24.75	28.62	32.57	36.61	40.74	44.97	49.29	53.70	58.21	62.83	67.55
ACC Demand + Efficiency	MWh	15,620	31,640	48,068	64,912	82,181	99,882	118,026	136,619	155,673	175,194	195,194	215,682	236,667	258,159	280,168	302,706	325,781
Grid connections	Number	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368	1,368
Solar Connections	Number	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232	2,232
New Capacity		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Hydro	MW	2.4	4.7	7.1	9.4	11.8	14.1	16.5	18.8	21.2	23.5	25.9	28.2	30.6	32.9	35.3	37.6	40.0
	MWh	9,264	18,527	27,791	37,055	46,319	55,582	64,846	74,110	83,373	92,637	101,901	111,164	120,428	129,692	138,956	148,219	157,483
Grid Connected Solar	MW	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50
	MWh	788	1,577	2,365	3,154	3,942	4,730	5,519	6,307	7,096	7,884	8,672	9,461	10,249	11,038	11,826	12,614	13,403
Solar Stand Alone	MW	0.31	0.63	0.94	1.26	1.57	1.89	2.20	2.52	2.83	3.15	3.46	3.78	4.09	4.41	4.72	5.04	5.35
	MWh	414	827	1,241	1,654	2,068	2,481	2,895	3,308	3,722	4,135	4,549	4,962	5,376	5,789	6,203	6,616	7,030
Geothermal	MW	2.1	4.1	6.2	8.2	10.3	12.4	14.4	16.5	18.5	20.6	22.6	24.7	26.8	28.8	30.9	32.9	35.0
	MWh	14,428	28,856	43,285	57,713	72,141	86,569	100,998	115,426	129,854	144,282	158,711	173,139	187,567	201,995	216,424	230,852	245,280
Biomass/Waste to Energy	MW	2.1	4	6	8	10	12	14	16	19	21	23	25	27	29	31	33	35
	MWh	9,023	18,046	27,068	36,091	45,114	54,137	63,160	72,182	81,205	90,228	99,251	108,274	117,296	126,319	135,342	144,365	153,388
Medium Wind	MW	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5
	MWh	964	1,927	2,891	3,854	4,818	5,782	6,745	7,709	8,672	9,636	10,600	11,563	12,527	13,490	14,454	15,418	16,381
Total incremental Capacity	MW	7.78	15.57	23.35	31.13	38.92	46.70	54.48	62.27	70.05	77.84	85.62	93.40	101.19	108.97	116.75	124.54	132.32
Total incremental Supply	MWh	34,880	69,761	104,641	139,521	174,401	209,282	244,162	279,042	313,922	348,803	383,683	418,563	453,443	488,324	523,204	558,084	592,964