REVIEW OF EXISTING SUBSIDY AND INCENTIVE SCHEMES - FIJI

Final Report

30 September 2014

Report to the UNDP

Formulation of an Independent Power Producer and Investment Framework for Developers of Renewable Energy Power Generation Projects in Fiji

(RFP/FJI0-007-14)

About IT Power

The IT Power Group, formed in 1981, is a specialist renewable energy, energy efficiency and carbon markets consulting company. The group has offices and projects throughout the world.

IT Power (Australia) was established in 2003 and has undertaken a wide range of projects, including designing grid-connected renewable power systems, providing advice for government policy, feasibility studies for large, off-grid power systems, developing micro-finance models for community-owned power systems in developing countries and modelling large-scale power systems for industrial use.

The staff at IT Power (Australia) have backgrounds in renewable energy and energy efficiency, research, development and implementation, managing and reviewing government incentive programs, high level policy analysis and research, including carbon markets, engineering design and project management.

About this report

This report is part of work commissioned by the UNDP to help Fiji meet its Renewable Energy Power Project (FREPP) goals. This work is intended to contribute to the revitalisation of the renewable energy market in Fiji, especially where IPPs are concerned. Of particular interest is the policy framework regulating both public and the private investments in renewable energy, and the incentives which could be applied to stimulate growth in the sector.

The work is divided into three components, a) the development of standard Power Purchase Agreements, b) the formulation of Investment Promotion Packages, and c) the assessment and development of Renewable Energy Incentive Schemes.

This report contributes to part c) and reviews the existing subsidy and incentive schemes in Fiji. It will be incorporated into the Final Report.

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1. INTRODUCTION

1.1. Project Background

The UNDP funded Fiji Renewable Energy Power Project (FREPP) addresses 4 categories of barriers to the widespread application of RE-based power generation in the country:

a) Energy Policy *&* Regulatory Frameworks;

b) RE Resource Assessments & RE-based Project Assessments;

c) RE-based Power Generation Demonstrations; and

d) RE Institutional Strengthening.

This project focuses on the third component — Renewable Energy-based Power Generation Demonstration. This component is intended to contribute to the revitalisation of the renewable energy market in Fiji, especially where IPPs are concerned. To date, there are several companies or project developers, apart from the Fiji Sugar Corporation (FSC) and Tropik Woods (both state-owned companies) that have signed Power Purchase Agreements (PPA) with Fiji's Utility Company, the Fiji Electricity Authority (FEA), but have not yet been able to secure complete financing for their respective RE-based power generation projects.

Currently, there is no effective IPP framework in place that would attract the private capital needed for additional renewable energy based power generation. The FEA has operated since 1966 as a State-owned Enterprise without independent regulatory oversight. Hence, the 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, although FEA has indicated that it is in discussions with several companies interested in new hydro and biomass generators, and the Commerce Commission has recently ruled that electricity exported to the national grid must be paid 33.08c/kWh. Also, power generation project proposal, assessment and approval criteria are not clear, although FEA says they have an internal process in place.

Fiji's energy supply is characterised by a heavy reliance on imported fuels. The energy demand in Fiji is driven by households and transport and also by the need of major industries, in particular agriculture, forestry, tourism and mining. Fiji is also endowed with significant renewable energy resources such as hydropower, wind, geothermal and solar. Currently over 60% of electricity is generated from hydropower. Because of the abundance of renewable energy resources in Fiji, there is huge potential to increase the renewable energy share of both energy in general and electricity generation in particular.

The FEA is a vertically-integrated, state-owned power utility which is responsible for providing grid-based electricity in the islands of Viti Levu, Vanua Levu and Ovalau. In 2013 FEA's total generation was 872GWh, 60% of which was generated through hydro, 37% through diesel and heavy fuel oil, 1% through wind power and 2% via Independent Power Producers (Tropic Wood and Fiji Sugar Corporation)[1]. It aims to reach 90% renewable energy generation by 2015. More than 93% of generation is supplied on the main island of Viti Levu. The total installed capacity of FEA is 263MW.

The FEA has indicated that Fiji's power sector will need investment in the order of $FJD1.5B[2] over the next decade, and this cannot be funded by the public sector alone.

In order to create an enabling environment for private sector investment in the power sector, the Department of Energy (DOE) aims to formulate an IPP and Investment Framework, which will be used for the implementation of large-scale renewable energy power projects by project developers, the successful establishment of IPPs, stimulation of the consumer renewable energy market, and facilitation of FEA in reaching the government's renewable energy targets.

This report examines existing subsidies and incentives available in Fiji for renewable energy investment, assessing them under the criteria of Effectiveness, Efficiency, Equity and Administration. Separate reports as part of this project will examine international subsidy and investment strategies, power purchase agreements and suggested investment strategies.

Section 1.2 firstly provides details of the inception meetings and the existing power generators in Fiji.

Section 2 then assesses Fiji's current and proposed mechanisms to directly drive uptake of renewable energy.

Section 3 then briefly discusses indirect support mechanisms for renewable energy in Fiji.

1.2. Inception Meetings

Dr Muriel Watt and Dr Robert Passey, IT Power, attended inception meetings in Suva over the week of 14-18 July 2014. The schedule of meetings held is provided in Table 1, and the summaries of the discussions are provided in Appendix 1. Table 2 lists the various types of power generators in Fiji as of July 2014.

[1] FEA, 2014, FEA Annual Report 2013, May 2014.
[2] Throughout the report costs are assumed to be in Fiji Dollars unless stated otherwise.

Table 1: Schedule of Inception Meetings, Suva, 14-18 July 2014.

Date	People involved
Mon 14 July 2014	Susana Pulini (FDOE), Emma Mario (UNDP), Rob Passey and Muriel Watt (IT Power)
Mon 14 July 2014	Ajay Raniga (Sunergise), Rob Passey (IT Power) (by phone)
Tues 15 July 2014	Bobby Maharaj (CEO, Commerce Commission), Susana Pulini and Miriama Kolinisau (FDOE), Rob Passey and Muriel Watt (IT Power)
Tues 15 July 2014	Peceli Nakavulevu (Director, FDOE), various FDOE staff, Susana Pulini and Miriama Kolinisau (FDOE), Rob Passey and Muriel Watt (IT Power)
Wed 16 July 2014	Bruce Clay (Clay Energy), Rob Passey and Muriel Watt (IT Power)
Wed 16 July 2014	Katerina Syngellakis (GIZ), Rob Passey and Muriel Watt (IT Power)
Thurs 17 July 2014	Timoci Lesi Natuva (Minister for Public Utilities (Water and Energy), Works and Transport), Susana Pulini (FDOE), Rob Passey and Muriel Watt (IT Power)
Thurs 17 July 2014	Community Diesel Grid Manager (FDOE), Rob Passey and Muriel Watt (IT Power)
Thurs 17 July 2014	Amlesh Kumar Din (Powerlite), Rob Passey and Muriel Watt (IT Power)
Thurs 17 July 2014	Prof. Atul Raturi (University of the South Pacific), Rob Passey and Muriel Watt (IT Power)
Fri 18 July 2014	Amit Singh (General Manager, CBS Power Solutions), Rob Passey and Muriel Watt (IT Power)
Fri 18 July 2014	Bobby C. Naimawi (CFO) and Karunesh Rao (Executive Projects and Public Relations) (both FEA), Peceli Nakavulevu, Susana Pulini and Miriama Kolinisau (all FDOE), Robert Passey and Muriel Watt (IT Power)

Table 2: Existing power generation in Fiji (July 2014)

Name/Location	Capacity	Owner/Operator	Funded by
Centralised grid			
Viti Levu	223.1 MW + 5 MW for 6 months: 112 MW hydro 92.1 MW diesel 10 MW wind 9 MW biomass 5 MW for 6 months	FEA Tropik Wood FSC	FEA direct PPA PPA
Vanua Levu	17.56 MW + 4 MW for 6 months: 16.76 MW diesel 0.8 MW hydro 4 MW biomass (6 months)	FEA FSC	FEA direct PPA
Ovalau (minigrid)	2.8MW diesel	FEA	FEA
Total	**243.46MW plus 9 MW biomass for 6 months**		
Minigrids 600			
Diesel	14 MW diesel total	FDOE	Community
Diesel		FEA	Community
Diesel x 5	~20 kW PV ~35 kVA diesel	Dept Public Works	Community
Diesel/PV	500 kW PV 150kW diesel	Community	UAE / Community
Mini-hydro	30kW, 100kW		
Total	**~14 + MW**		
Stand alone			
SHS (110W) / Mostly	110 kW	FDOE/Powerlight	All donor funded

Vanua Levu		Generators, CBS Power Solutions	
SHS (270W) / Firstly in the Maritime Islands then in Vanua Levu and Viti Levu	810 kW (Target 2.4 MW)	FDOE/Powerlight Generators, CBS Power Solutions	Mostly FDOE funded
Community systems		Community cooperatives	Community, SEFP
Owner PV	~1 MW PV	Owner/Installer (Commercial)	Owner and SEFP
Distributed			
Grid-connected / Viti Levu and Vanua Levu	~0.5 MW PV (another 1.5 under construction)	Owner and Financier/Installer (Commercial)	Net FiT (FEA), SEFP
	120kW (target 3 MW)	Householder / FDOE	FDOE

2. ASSESSMENT OF MECHANISMS TO DRIVE UPTAKE OF RE IN FIJI

In this section the subsidies and incentives identified in Table 3 are assessed according to the following criteria:

1. **Effectiveness:** How effective is the scheme at deploying plant that generate the expected amount of renewable electricity over a given timeframe?
2. **Efficiency:** Is the scheme able to deliver renewable energy at low cost, and are there any other cost impacts?
3. **Equity:** Are the costs and benefits of the scheme distributed fairly?
4. **Administration:** Is the scheme difficult to administer, including any relevant auditing and compliance requirements?

Table 3 lists the renewable energy support mechanisms that are either currently operating in Fiji or are under development.

Table 3: Renewable Energy support mechanisms in Fiji

Mechanism	Description	Comments
CURRENT		
Power Purchase Agreements	Offered by FEA to IPPs that pass their due diligence assessment.	Until recently the tariff rate offered has been too low for IPPs to obtain finance. This may improve with the new 33.08 Fc/kWh rate. FEA preference for 'fully fledged' 24/7 generation is unnecessarily restrictive and likely to increase costs and risks because of lack of diversification.
Sustainable Energy Financing Project (SEFP)	The World Bank offers concessionary loans through ANZ and the Fiji Development Bank. Loan can be for 100% of system. The World Bank guarantees 50% of the loan. Max value $FJD1 million.	Appears to be working well although only where customers have some sort of credit rating and so can act as guarantor for 50% of the system. Hence difficulties experienced by residents/businesses in remote islands wishing to invest in power systems, as they have no credit rating.
Solar Home Systems (SHS)	Originally 100W PV/battery systems where customer paid $FJD50 plus $FJD14/month for maintenance.	Main problem is with customer payment for systems and transport of components and installers to

	Now 270W PV/battery/inverter systems, customer pays $FJD198 up front and $FJD18/month for maintenance (first month is free and 5 months is included in the $FJD198).	remote islands. Customers also prefer larger systems that operate 24/7 but cost is prohibitive, with per kWh costs already significantly higher than for grid-connected customers. Payments for maintenance are likely too low.
Commercial net feed-in tariff	Distributed PV systems on FEA's grid at Viti Levu offset onsite demand and receive up to 15c/kWh for exported electricity.	Appears to be working well although systems are restricted in size in order to minimise export. The recent Commerce Commission ruling may result in exported electricity receiving 33.08c/kWh. This mechanism has no administration costs for government, and low admin costs for FEA.
UNDER DEVELOPMENT		
Residential net billing trial	Households are given either 1.2kW or 2.4kW PV systems that are gross metered but net billed, being paid 15c/kWh for excess generation over a billing period.	Is only in the initial stages with 60 households selected to take part. Looks to be an interesting project with data for each household collected via the internet. The effectiveness of this trial will depend on its design, data collection and targeted outcomes.
Community PV trial	Communities with a good track record in maintaining their diesel systems (20 & 40 kVA) will be offered PV as a fuel saver and/or to extend hours of power availability.	Community will pay 5% of capital cost. Systems will be installed on community buildings or ground mounted.
Solar Hybrid Systems	PV to be used as a fuel saver (no batteries included) in diesel/hybrid power stations on 3 government stations (Vunisea, Lakeba and Rotuma in the Lau Group)	Funded by the UAE and installed by the Masdar Institute, Will reduce fuel imports and be used to provide more reliable, 24 hr power for government offices, schools and health facilities.

2.1. Power Purchase Agreements

Most of the current central generating capacity is owned by FEA. It has been acknowledged that the Government will not be in a position to finance significant amounts of new capacity and that private investment should be sought. FEA has developed an in-house PPA process and contracts. Our report 'Review of Existing Power Purchase Agreements' provides a detailed

assessment of the current PPAs, as well as recommendations for improvement. The assessment below provides an overview of current / recent practice.

2.1.1. Effectiveness

Although two non-disclosure agreements have been signed, there have been no recent PPAs finalised by FEA for generators connected to the central grid, indicating that the current process is not effective. Several agreements have been signed for smaller, distributed generators for the small amounts of exported power and FEA is negotiating on several new or expanded biomass and hydro plants. Although FEA is of the view that it has sufficient power available with its current capacity and the new plants it is negotiating on, the government has been concerned that the current process, and the PPA price offered, has not been sufficient to encourage proposals, or for proponents to negotiate finance arrangements. The FEA prefers 'fully fledged' 24/7 year round generation because it believes that intermittent renewable energy generation does not reduce its capex. However, the current level of spinning reserve (42MW) can cover the variability of a significant amount of intermittent generation, and where such generation is owned by private investors, it is they who cover the cost of the capex, not the FEA.

2.1.2. Efficiency

Although FEA is negotiating PPAs on several new hydro and biomass plants, since the process has not been transparent, it is difficult to assess efficiency. It may deliver lower prices than the proposed mandatory PPA rate.

FEA's preference for 'fully fledged' 24/7 year round power has the potential to create inefficiencies over the longer term since the supply mix is not being diversified, and hence is especially vulnerable to drought and other weather events, while options for lower cost, intermittent renewables, including wind and solar PV, are not being considered. Nevertheless, the latter may be increasingly taken up by customers at a distributed level, albeit potentially creating problems for the grid if not appropriately managed.

2.1.3. Equity

The current process has not been transparent or equitable. FEA has negotiated with project proponents who have approached them directly and has sought to achieve the lowest feed-in tariffs possible for the site. FEA is of the view that offering higher PPAs than achievable via negotiation is not in the best interests of customers. While this is a commendable aim, the current process does not necessarily elicit all the options that may be on offer should a transparent procurement process be followed. FEA has also instigated or encouraged RE electricity generation from government-owned sugar mills, which currently generate only 6 months of the year, to explore options for 12 month supply. This is in line with its objective to contract for 24/7 year round power, rather than allowing a range of intermittent generators to contribute to demand. Hence the process is not equitable for intermittent generators, which may be able to supply at

lower costs, when available, than plants with 24/7 year round capacity. It is also worth noting that the outlook for Fiji's sugar industry is not certain, because of problems relating to weather damage and low prices driven by global oversupply.[3]

2.1.4. Administration

The administrative costs associated with current PPA processes are difficult to gauge, since negotiations are private. It seems current negotiations for new hydro and biomass plants have been underway for several months, if not years. Small distributed generators are provided with standard grid connect arrangements and appear to have no problems in reaching agreement. For larger plants however, individual negotiation under non-standard conditions may increase the time and difficulty in reaching agreement. Non-standard arrangements may also make it more difficult for project proponents to raise finance.

2.2. Sustainable Energy Financing Project

The SEFP has been set up to facilitate private financing of energy projects, both on the main grids and in rural areas. It is a World Bank initiative, administered in Fiji by the FDOE and is a valuable adjunct to the Government's rural electrification, RE targets and PPA aims. SEFP loans are limited to $FJD1M, with repayments initially required over 5 year (individuals) to 7 years (enterprises). All World Bank loan guarantees end in 2017, which means that customers need to have their 2017 equity assessed and provide their own guarantees for loans that extend beyond 2017.

2.2.1. Effectiveness

This program has provided 40 loans and $FJD20M in finance for 19,000 lanterns and about 1,500 SHS, 12 Coconut Oil projects and 58 Energy Efficiency projects. Feedback from government agencies, the FEA and private power companies indicates that it has been effective in deploying RE, increasing access to finance, reducing risks and costs and improving the timeliness of finance approvals.

Eligible expenditure is typically restricted to initial costs, not long run operation and maintenance, which may lead to problems over time, when systems need servicing. However, only World Bank approved equipment suppliers can be used, so there is some check on quality.

2.2.2. Efficiency

The process appears to be efficient. It involves getting a quote for the energy system, preparing a business plan (in the case of business customers) and an equipment specification, then applying for a loan (currently available through the ANZ and Fiji Development Banks). When

[3] *Pacific Economic Monitor: Growth Outlook*, Asian Development Bank, March 2013.

approved, the World Bank, via the FDOE, provides a loan guarantee for 50% of the approved amount. The amount approved is determined by the capacity to make repayments, the latter typically calculated based on fossil fuel or other energy savings.

2.2.3. Equity

Loans are available to anyone who can provide the necessary surety. The latter has been a problem for people in some of the more remote islands, since it is difficult for them to prove income or the capacity to repay.

2.2.4. Administration

The most common issues arising have been inadequate documentation accompanying the applications and difficulty in assessment of assets for security.

2.3. Solar Home Systems

This scheme began in 2000 and to date has resulted in the installation of over 4,000 PV/battery stand-alone systems. It targets customers that are too far from either a full sized grid or a minigrid.

Originally customers received a 100W PV/battery system and paid $FJD50 up front and $FJD14/month for maintenance. Customers are now receiving a 270W PV/battery system that provides DC power as well as AC through a 300 W inverter. The FDOE retains ownership of all systems. For these larger systems the customer pays $FJD198 up front and $FJD18/month for maintenance (the first month is free and 5 months is included in the $FJD198).

Typically fees are collected by a nominated person and paid to the FDOE revenue collector when they visit. Maintenance checks are carried out every 3 months, with bulbs, components and performance assessed. Batteries are replaced on the next visit if their performance has deteriorated. Battery life is typically 18 months to 4 years and old batteries are returned to Suva for recycling.

Tenders for the maintenance contracts are called every 3 years and performance is reviewed every year. At present, Powerlite and CBS Power Solutions have the contracts.

2.3.1. Effectiveness

After initial problems with local batteries, it seems that systems are well designed and are maintained and operating. They are typically providing lights, phone charging, radio / TV for around 4 hours a day. Transport of components and staff for installation and maintenance remains a key challenge since many islands do not have frequent or regular transfers from the main islands.

Although SHS are the only likely solution to be affordable in the short term, most customers are thought to want more power and/or 24/7 power. Some have added PV panels themselves, typically for commercial purposes, such as small shops.

In future, as prices fall, larger systems could be supplied, or PV mini-grids could potentially be added to villages.

2.3.2. Efficiency

Early systems ran on a pre-pay meter system, which seems to have worked well. Such meters have not been available recently (although a new source has been identified). Solar managers have been appointed to collect the monthly fee on each island, however some islands or communities have problems with collection. Alternative payment systems are needed, such as those used for mobile phones (which appear to be used widely, even on remote islands).[4]

Payments for maintenance are likely to be too low over the long term, mostly due to high costs of transport to the islands and the relatively low battery life (average 3 years, rather than the 7 usually anticipated, because of very deep cycling).

2.3.3. Equity

This scheme provides electricity to people who are far from any grid and would not otherwise have electricity. SHSs allow provision of lighting and power for DC appliances where lighting or power were not available before, and / or replace kerosene lamps and single use batteries for torches. Hence, it has significant local benefits for health, education and general amenity, and is a cheaper option than kerosene.

Nevertheless, we estimate the cost of the 270W systems to the customer to be over $FJD1/kWh[5], which is much higher than the cost paid by grid-connected customers. The capital cost of the system is paid by the Fijian government, sometimes with international Aid funding, and so is already subsidised. Overall, the scheme has reasonable equity impacts.

2.3.4. Administration

All schemes such as this have relatively high administration costs because of the small system sizes, the remote locations, the limited access and the lack of local skills. It appears that the FDOE has minimised these costs by tendering out implementation to the private sector, to help ensure competitive pricing.

[4] CBS Solutions has proposed new payment options, while several options are being trialled world-wide. These will be documented in the final report.
[5] This assumes the average 270W system produces 24.3kWh/month and 30% is lost either through battery losses or is just unused.

2.4. Commercial Net Feed-in Tariff

Large grid-connected PV systems have recently been privately installed on FEA's grid at Viti Levu. They are sized to offset onsite demand and minimise export. Generation used onsite displaces the prevailing retail tariff and potentially reduces demand charges, while exported electricity currently receives up to 15c/kWh (this may increase to 33.08c if deemed to fall under the new IPP rates). Several PV systems up to 250kW have been installed, with at least one 700kW PV system planned for an international hotel.

2.4.1. Effectiveness

The installed cost of PV systems has declined significantly over the last five years, making the levelised cost of electricity (LCOE) less than the commercial retail tariff in Fiji (either the standard tariff or the demand tariff which consists of a demand charge and an energy charge). This makes such a FiT a very effective mechanism to drive deployment of distributed generation such as PV. However, systems are currently receiving either nothing or 15c/kWh for electricity that is exported to the grid, which limits their size. Larger systems may be able to provide electricity to nearby demand on the network and so provide network support and reduce line losses. The recent ruling by the Commerce Commission, that "any individual, private or public enterprise that generates or produces electricity and sells the electricity to the national grid or directly to consumers"[6] must be paid 33.08c/kWh, should mean that exported electricity is paid this rate. How much distributed generation local grids can readily accept will remain a separate, site-specific issue.

2.4.2. Efficiency

This mechanism requires no government support and relies entirely on favourable market economics to drive uptake. Systems will only be installed if they generate a net financial benefit for the customer, making this mechanism economically efficient from their perspective. Where the customer is on a demand charge tariff, the PV electricity used onsite offsets the energy tariff component, which is set at a lower rate than the Commerce Commission's estimate of the avoided generation cost (33.08c/kWh)[6] – and so should result in a slight benefit for the FEA. The PV system may also reduce the demand charge paid by the customer, which will reduce income for the FEA, but only in proportion for the reduced need for network support.[7] Where the customer is on a standard commercial tariff, the energy use component of the tariff is higher than the 33.08c/kWh avoided generation cost, meaning that FEA could incur a small loss where PV reduces onsite demand. However, the FEA uses two different types of diesel fuel to generate electricity, which have different generation costs (excluding TDR)[8], being 32c/kWh (lower grade

[6] FCC, 2014, 'Final Authorisation: Independent Power Producing Rates ("IPP"), "Second Phase: Full IPP Rates"', Fiji Commerce Commission, 26 May 2014, page 3.
[7] Thus, there will be no negative impact on the FEA, if their demand charge tariffs are cost-reflective.
[8] The costs incurred in transmission, distribution and retail of electricity.

fuel) and 46c/kWh (Heavy Fuel Oil),[9] and the Commerce Commission value appears to be based on the lower grade fuel cost. Thus, the actual cost to the FEA of PV reducing onsite demand would depend on the ratio of the two fuel types being used, being, for example, 39c/kWh for a 50:50 mix, which is close to the standard commercial tariff and significantly greater than the energy component of the demand charge tariff.

Thus, reduction of electricity use by grid-connected PV systems is expected to have very little financial impact on FEA, and may even provide a benefit (depending on the amount of HFO used). It will also serve to reduce Fiji's diesel fuel imports, reduce greenhouse gas emissions, reduce electricity costs for the system owners and potentially reduce electricity costs for other customers as well (if any cost reductions for FEA are passed on to customers).

2.4.3. Equity

This mechanism is currently only available to commercial customers, however the trial discussed in Section 2.5 is intended to make it available to residential customers also. Even though not all customers may be able to install PV or other independent power generators, all customers stand to benefit if overall electricity costs are reduced.

2.4.4. Administration

This mechanism has no administration costs for government and should have relatively low administration costs for the customer and FEA, especially with standardised connection procedures apparently in place. According to PV installers the administration involved in meeting the technical connection and billing requirements are not onerous, and so administration costs appear to be acceptable.[10]

2.5. Residential Net Billing Trial

This trial is being conducted by the FDOE. It involves the installation of either 1.2kW or 2.4kW PV systems at no cost to the household. Although it is referred to in the Legislative Gap Analysis report as the net metering trial, the systems will in fact be gross metered and net billed. This means that all PV generation will be separately metered and will be subtracted from total electricity use over a billing period. Only generation in excess of total use will be paid the FiT, while all PV generation used onsite offsets use at the prevailing retail tariff. At this stage 60 households and an installer have been selected, as have the types of PV panels and inverters. The installation of the PV systems and smart meters has been completed, and installation of the data logging systems and network systems are currently in progress.

[9] Stakeholder meeting with the FEA, Fri 18 July 2014.
[10] We are waiting on the standard grid connection agreements from the FEA.

2.5.1. Effectiveness

As the trial is yet to commence, its effectiveness is unknown at this stage. The effectiveness of such trials relates to more than just the number of systems successfully deployed. The desirable outcomes also include:

1. Information for the households taking part, so they know what to expect, how the technology works, general maintenance aspects, and who to call in case of concerns,
2. The development of a streamlined grid-connection application process and agreement with the FEA,
3. The development of a streamlined installation process, that is shared with other installers, follows agreed standards and can significantly decrease installation costs,
4. The collection of data that lead to a better understanding of the financial and technical impacts of distributed small-scale PV systems, by the FEA, the FDOE, installers and householders, and
5. A public information dissemination phase as the trail begins and at regular intervals, to inform all potential customers (both those interested in PV and those sharing the grid) of performance, costs, lifetimes, and other issues likely to be of interest.

2.5.2. Efficiency

Again, the efficiency of this trial cannot yet be assessed, but should be based on the administration costs (which in this case will include the system costs), the outcomes described above and its usefulness in leading to the development of efficient programs for future general roll-out.

2.5.3. Equity

This trial improves the equity impacts beyond that offered by the Commercial Net FiT described in Section 2.4 by making net billing available to selected residential customers. An unavoidable feature of such schemes is that they only directly benefit the chosen households, and these again are restricted to those with suitable roof space (eg. not apartments or houses with weak roofs). In addition, those with good solar access (eg. good orientation, no shading, suitable tilt) are better off than those without.

Community solar financing options can help overcome these issues. Households that are unable to purchase a PV system may also be disadvantaged, although this can be overcome through options such as hire purchase and solar leasing.

2.5.4. Administration

Being a trial, it will have high administration costs. It should ideally result in a streamlined grid-connection and billing process for future more widespread roll-out, with low administration costs based on simple standardised connection agreements.

2.6. Community PV Systems

About 600 community diesel power systems operate around the smaller islands, and have been installed between 1978 and 2013. The diesel systems are provided under the Rural Electrification Policy, managed by the FDoE, and is subsidised by the Government.

The community pays $FJD150/year for twice yearly maintenance and one third of other repair and component replacement costs. For the remainder of the systems, the villagers pay 5% of the upfront costs of the diesel generators, plus the fuel costs, while the FDOE pays the maintenance costs and 95% of the capital cost. They are operated by the FDOE for 3 years then passed on to the community. In general, these diesel systems are working well, but access to fuel is a problem, because of lack of money as well as the limitations of fuel delivery. Hence most villages have power for a set number of hours a day (typically 4 - 5hrs), and some villages run out of fuel from time to time. Some systems are reportedly not working at all due to poor management and inadequate maintenance[11]. Recent reviews of the program, and rural electrification more generally have suggested the establishment of a transparent process for assessing the full cost of service delivery and payment, and establishing a fund to cover the shortfall. This would also mean that energy service providers could tender for service delivery and that the program would not be linked to annual budget allocations[12]. Trials of locally produced coconut oil as a diesel substitute are also underway in some islands, and may be another means of reducing fuel imports. The prospects for this are under separate review as part of the Fiji Renewable Energy Power Project processes.

Village cooperatives have different ways of paying for energy use, but generally payment is via a weekly or monthly charge to each household or building, which is collected by a village committee. Collection of payments can be an issue, depending on local management and the reliability of electricity supply.

The DOE is to trial the addition of PV to a small number of existing diesel systems. They may be ground-mounted or on a community building. Their approach is to choose communities with well-run power plants for these trials. One such system is the 20kW PV mini-grid installed in 2013 at Rukua, Beqa Island. This system was financed by a combination of public, private, donor (Japan)

[11] IRENA, 2013, Pacific Lighthouses: Renewable energy opportunities and challenges in the Pacific Islands region – Fiji.
[12] See for instance SMEC, 2013, Review of the Fiji Energy Policy: Draft Strategic Action Plan, August 2013.

and community contributions and replaces a diesel generator, which provided 2-3 hours of power a day, and kerosene and other fossil fuel lamps. Training for local managers has been provided and payment is via pre-paid meters[13].

2.6.1. Effectiveness

The effectiveness of this approach cannot be assessed as it has not yet been fully implemented. However, there would appear to be two main aims: i) to reduce diesel use, and ii) to increase the time that electricity is available to villagers. Thus, a number of alternative implementation models are possible. For example, in order of increasing complexity:

1. The PV system operates only when the diesel generator is running. This is effective at reducing diesel use and could extend hours of power availability, but does not allow diesel-free operation and may cause low-load diesel operation problems, including cylinder glazing and increased maintenance.
2. The PV system operates only when the diesel generator is not running. This is effective at increasing the time electricity is available but would be more costly since batteries would be needed to maintain power output and the inverter will need to be able to establish voltage and frequency.
3. The system operates as PV-alone and with PV/diesel. This is effective at both reducing diesel use and increasing the time that electricity is available. It does have the added cost of batteries and will need more sophisticated inverter and control systems.

2.6.2. Efficiency

Option 1 above would be the most cost efficient at delivering renewable energy because batteries and more expensive inverters and control systems would not be needed. However, having electricity available for a longer time may have additional benefits, including financial, that make the extra costs in options 2 and 3 worthwhile.

Efficiency will be reduced if the PV systems result in the diesel generators running at low loads for extended periods of time, because this may increase maintenance requirements and costs, and may reduce the fuel efficiency of the generators.

The efficiency of this mechanism will also depend on how organised the village committees are in collecting payments and in operating and maintaining their plant. The Beqa Island PV system is expected to pay for itself via diesel savings within 5 – 7 years.

[13] IRENA, 2014, A path to prosperity: Renewable energy for islands.

2.6.3. Equity

This mechanism should have positive equity impacts because it should reduce costs for both villagers and the FDOE. The only negative equity impact could be that people who don't live in villages will not have access to this mechanism, however, they should have access to the Solar Home Systems mechanism.

2.6.4. Administration

Being a trial this will have high administration costs. Assuming the trial is successful, and the FDOE wish to deploy PV systems to a large number of community diesel systems, some form of sustainable payment mechanism will need to be developed. The simplest approach from an administrative point of view would be the same as that currently used for the diesel generators, where the FDOE pays 95% of the capital cost and the village pays 5%. Since the PV system is reducing the village's diesel cost, they have an incentive to perform basic maintenance such as cleaning of panels and care of batteries. More complicated and expensive maintenance, such as replacement of batteries or faulty panels, could be paid for by the FDOE.

2.7. Solar Hybrid Systems

Five government owned and operated diesel power systems operate around the smaller islands, providing power for government services, schools and health facilities. Most systems provide power for 4 - 5 hours a day.

Funding of FjD5 million from the UAE government is being used to provide PV / diesel hybrid systems in 3 of these stations. The PV systems will be 15 – 20 kW each and will be installed by the UAE based Masdar Institute. The systems will allow 24 hour power supplies, reduce the need for fuel transport to these remote sites, reduce maintenance costs and make the power supply more reliable.

2.7.1. Effectiveness

The effectiveness of this approach cannot be assessed as it has not yet been fully implemented. However, there are two main aims: i) to reduce diesel use, and associated maintenance requirements, and ii) to increase the time that electricity is available for government services, schools and health facilities, and to villagers. It will be possible to assess the immediate effectiveness of the projects quite soon after they are operational. Monitoring of performance, fuel use and maintenance costs over the long term will be required in order to assess lifetime effectiveness.

2.7.2. Efficiency

The PV systems should facilitate more efficient provision of government services. If they operate as planned, they should provide a good case study for future PV hybrid system deployment. Having electricity available for a longer time each day may have additional local benefits to health, education, safety and productive enterprise.

Depending on the system design and diesel generators used, efficiency could be reduced if the PV systems result in the diesel generators running at low loads for extended periods of time, because this may increase maintenance requirements and costs, and may reduce the fuel efficiency of the generators.

2.7.3. Equity

This mechanism should have positive equity impacts because it should provide benefits and reduce costs for both villagers and the Government.

2.7.4. Administration

There may be high administration costs, depending on the relationship and responsibilities of Masdar Institute and the FDoE for project implementation, as well as for ongoing assessment and operation. However, if successful, longer term administrative costs should be reduced for the Government stations.

3. INDIRECT SUPPORT MECHANISMS

3.1. Renewable energy targets

The Government's targets of 100% renewable electricity and 23% renewable energy by 2030 are clear drivers for RE deployment by FEA and the FDOE. Note that these are 'aspirational targets', which are different to the renewable energy targets in countries such as Australia, which are legally binding and impose financial penalties for non-compliance. For the electricity sector, the main aim is to reduce diesel generation and the use of kerosene lights, while for energy overall, the focus is on transport fuels, with a drive to increasing coconut oil blends and some discussion of electric vehicles. The latter has yet to be formally reflected in electricity projections and planning. It is difficult to assess how quickly a country like Fiji could switch to electric transport, given the infrastructure requirements and the vehicle ownership and fleet composition.

3.2. Resource monitoring

The FDOE is keen to see diversification of energy sources, because of risks associated with high reliance on electricity based on hydro and imported diesel.

A biomass resource study is commencing shortly, which will assess sustainable waste-to-energy sources. While some sugarcane bagasse-based electricity is produced seasonally each year, and the FEA is negotiating year-round supply from these plants, the view is that these sources are subject to the same drought constraints as hydro. The sugar industry is also struggling in the aftermath of cyclones and low sugar prices, so may not be a reliable electricity supply source in the future. Substitution of coconut oil for diesel is the other main focus of bioenergy development. This could have benefits at the local level for both electricity generation and transport fuel.

Solar resources are monitored at nine locations in Fiji, including the airports, and work on the installation of wind monitoring stations at 50m has commenced for 14 sites on Viti Levu and Vanua Levu, following recent wind speed modelling which was validated against data from 4 sites with 10m monitoring stations[14].

There is likely to be considerable potential for geothermal-based power generation at Labasa and Savusavu on Vanua Levu, as well as other sites in Vanua Levu and Viti Levu. However, the final assessment of these resources requires deep drilling which is expensive, and they are located in remote areas.

[14] Garrad Hassan, 2013, *Wind Speed Modelling of Viti Levu and Vanua Levu, Fiji*, Report for the Fiji Department of Energy.

3.3. Energy efficiency

Improvements in the efficiency of energy use will reduce the overall energy demand and hence assist in meeting renewable energy targets. EE is included under the SEFP and is also supported via the MEPS program. Since 2012, Australian standards have been mandated for refrigerators and freezers, which is expected to result in a 20% reduction in electricity use compared with BAU projected in 2007. Issues include import monitoring, both from retail stores and individuals. The Government has plans to widen the MEPS program to other appliances.

The 2013 review of the National Energy Policy recommended the inclusion of energy efficiency under the National Building Code[15]. A subsequent report by the New Buildings Institute[16] recommended:

1. Codify current best practices, including:

    a. Daylighting
    b. Exterior shading of wall and window areas
    c. Tinted windows (based on shading and orientation)
    d. Reduced lighting loads (measured in watts/meter2)
    e. Standards for natural ventilation

2. Augment current best practices to codify:

    a. Cool roofs and/or roofing insulation (to be determined based on modeling in Phase II of the project)
    b. Standards for mixed-mode (naturally ventilated and cooled buildings)

3. Amend the FNBC to include building additions and alterations.

4. Develop prototype village house and government mixed-mode building plans based on current practices modified for greater efficiency.

5. Adopt lease agreement standards for efficiency of all federal buildings.

6. Establish equipment efficiencies for lighting ballasts and air cooling, specifically to eliminate the use of incandescent bulbs nationwide, eliminate use of magnetic ballast fluorescent fixtures in urban areas with stable power supplies, and set a minimum efficiency standard for all air cooling equipment sold.

7. Establish standards for new subdivision development and land use policies to address building orientation, heat island mitigation, solar access, and solar ready construction.

[15] SMEC, 2013, Review of the Fiji National Energy Policy: Legislative gap analysis.
[16] NBI, 2014, Incorporation of energy efficiency in the National Building Code, Phase 1: Status report and recommendations.

8. Establish a Tier II standard above the FNBC for a comprehensive “green” building, which is encouraged through an adopted incentive program.

9. Establish a 20 year roadmap for increased building energy efficiency

The government is now planning to implement energy efficient building standards targeting daylighting, efficient light fixtures and controls, ventilation and shading, especially for offices, schools, public and church buildings and shops.

APPENDIX 1: SUMMARIES OF INCEPTION MEETINGS

The following are the rough notes from each of the inception meetings held in the week Mon 14 July to Fri 18 July 2014.

Inception Meeting with UNDP and Department of Energy

Date: 14th July 2014

Present: Emma Mario (UNDP), Susana Pulini (DoE), Rob Passey and Muriel Watt (IT Power)

- Clarified
    - when final reports are due and set dates for drafts
    - only doing electricity not heat
    - doing all islands
    - no preference for centralised or DG
    - our project is part of part c of the FREPP
- we need to develop policies for
    - centralised generation
    - minigrids
    - household systems (grid-connected and off-grid)
- There is no need for policies for CNO under this assignment, although there is a need for bioenergy policies and this is being addressed by the FDOE elsewhere.
- Much of the recommendations we've seen won't be enacted until the Energy Policy is passed, which most likely won't be until after the election
- This is very much a political process, so not guaranteed
    - Need to take this into consideration when recommending policies
    - Some recommendations can go ahead regardless
- Combined Final Inception Report - FREPP RE Demo Project by Grue + Hornstrup refers to a Power Generation Mix Options Analysis and a subsequent Power Price Mix Options Analysis, neither of these have been done yet although a very simple PGMOA was done for the EP report
- Had 2 National Energy Consultative Forums (public consultation) last year, outcomes on website under EP dropdown
- Minigrids

  - Most minigrids are run by DoE
  - 5 islands where Dept Public Works runs minigrids – clarify with FEA
  - customer tariffs on FEA minigrids are same as in Suva, except for Ovalau which is diesel-only
  - Beqa island – DoE owned system mini grid recently installed

- SHSs

  - owned by DoE, come out of the rural electrification budget, separate to FEA
  - Started installing 110W systems from 2000 and owner paid $50 plus $14/month but now have 270W where customers pay ~$196 up front and $18/month (but the first 6 months are free)
  - The 110W systems were prepaid using special meters but the company went broke and they no are longer used
  - they provide lights (CFLs, but LED trials underway), customers can do what else they want
  - making cash contributions are not a problem for customers
  - most of the SHS are on Vanua Levu
  - RESCOs – they will send us the review report on how well the RESCO program is going, targeting 10,000 systems, currently at 4,000 – is working, now have 2 maintenance companies (started with 1)
  - Installers/maintainers are Powerlight Generators and CBS, they will send contact details so we can talk to them (batteries changed every 3 years and systems working well)
  - Sometimes have community systems (stand alone) paid for by community cooperatives (have a Cooperatives Dept in Fiji gov) with no gov subsidies, although they may be able to use SEFP

- Sustainable Energy Financing Project (SEFP) offers concessionary loans through ANZ and Fiji Development Bank (FDB). Did not have much impact when it was just ANZ, but now with FDB seems to be working well, mainly commercial systems:

  - FDB loan is 6% available for 6 years, ANZ 1% discount to their normal rate, available 5 years
  - Govt guarantees 50%

- Demand growth

  - There was some basic analysis done which assumed 4% demand growth, no analysis on growth in peak demand
  - They thought that new mines would increase demand and that most would be grid-connected

  - We pointed out that, excluding mines, demand may not grow and could actually decrease because of EE and DG

- Need to talk to Commerce Commission regarding what happens to a customer with >75kWh/month – do they pay the full rate on all their use or only that in excess of 75kWh?
- Net metering trial
  - Trial has started, they asked for expressions of interest for customers spread through all inlands
  - 1.5kW systems
  - They will organise someone to talk to
  - Funding and idea for net metering came from the PIGGAREP based in Samoa
  - Are being monitored, not sure to what level
- Once the EP has been passed, the separate regulatory arm of the DoE can be established
- Fiji Meteorological Office, Susana will ask for data
  - They may be making some data public (suggested this could be at a basic level, charge for complex data)
- Concessions referred to in Strategic Action Plan
  - Bonobono hydro project funded by Chinese govt and built by a Chinese company
  - Concession still in negotiation
  - Will be for all the people currently serviced by the existing diesel grid (don't know who owns or operates)

Meeting with Ajay Raniga, Sunergise

Date: 14th July, phone conversation

Present: Rob Passey (IT Power)

- Clay Energy is their only installer
- Most systems are commercial PV - size them so there's no (or very little) export, use an import/export meter
- All but one of their installations are grid-connected
- FEA are good to work with

- We need to talk to Bruce Clay regarding technical questions, such as whether they use the SEAPI installation guidelines

Meeting with Bobby Maharaj, CEO of the Commerce Commission

Date: 15th July, 2014

Present: Rob Passey and Muriel Watt (IT Power), Susana Pulini and Miriama Kolinisau

- CC sees its role as tariff regulator, not wider policy or regulatory functions, even under new Energy Policy
- It has some role in reviewing submissions on policy and regulation
- The residential tariff (non-lifeline and without the 15.9c/kWh govt subsidy) is 33.10c/kWh and this is based on the average generation cost that is 17 to 23 at 60/40 hydro/diesel independent consultant's report. The cost of TDR (said to be 12.67c/kWh) is then added onto that to get the final tariff.
- This is why the Commerce Commission recommended 33.08c/kWh for PPAs since diesel is about 46c then take away 12.67c to get the actual generation cost.
- Diesel is used more in drought and CC says that FEA use this to justify buying more diesel gensets, and claiming higher generation costs, when the droughts may only occur once a decade
- TDR was reduced this year because of reduced corporate tax rate
- The CC said that their recommended tariff is meant to apply to ALL elect in Fiji, including elect from the DoE owned mini-grids, and potentially also the off-grid systems – but this would result in increased govt subsidy, so could have different tariffs for off-grid?
- Mine sites which run private generators and also supply local loads could theoretically also be under the regulated tariff, but difficult to regulate
    - One mine offers a subsidised tariff for its workers, but charges the full cost to others
- New IPP arrangements being negotiated (under new 33.08c/kWh tariff?)
    - FEA distinguishes between "fully fledged" (scheduled, but seems to be more like 24/7) and "not fully fledged" (on the basis that PV etc is not 'baseload generation')
    - Gimco (10MW biomass plant using sugarcane waste plus dedicated plantation).
    - Astroenergy (10MW PV – with plans up to 40MW)
    - Both in Western Division, near Lautoka city

  - Sunergize has negotiated arrangements for grid connection of several large PV systems, with an export rate of 15 c/kWh (not fully fledged rate)
  - Grid connect standards / requirements set by FEA
  - SEAPI standards used for SHS and certification schemes being developed
  - Comment – recent 'certification course' run at USP was not an installer certification, but just a technician solar info course

- No fixed charges on retail tariffs, only the initial connection cost which is set by the Commerce Commission
  - Rates set under old Electricity Act and now over 20 years old
  - Suggestion that FEA refunds connection costs if energy use is higher than initially estimated

- Energy efficiency:
  - DOE run MEPS program
  - FEA energy audits

- Ministry of Public Enterprises
  - Review major government expenditure such as new spend by FEA (2 new diesel gen sets, new hydro)

Meeting with Peceli Nakavulevu (Director of Energy)

Date: Tuesday, 15th July 2014

Present: Rob Passey, Muriel Watt, 8 others from DoE, Susana Pulini and Miriama Kolinisau

- Peceli thought that Commerce Commission ruling only applies to grid tariffs (although agreed that original legislation/intent was that uniform regulated tariffs should apply to all)
- The 5 government run stations, which supply hospitals, schools, govt offices and local residents, use regulated tariffs
- Of the 5000 SHS, 2000 are AC, 3000 are DC. The older ones were aid funded, the more recent ones government funded
  - DOE say the systems have operated well and customers are satisfied
- Exploring options to the prepay meters initially installed, as these are no longer available and the new versions are very expensive

    - Discussed mobile app options and should include a few in the report

- Peceli said he didn't think that the RE target requirements would be placed on mines or IPPs, only suggested
- Some of the hydro are run of river
- FEA have a Power Development Plan used for demand projections
- 4% is from Reserve Bank
- net metering trial
    - actually gross metered but net billed
    - applies to 60 houses
    - they selected customers that met 100% of requirements eg. shading, roof orientation, 20 degrees roof
    - provide either 1.2kW or 2.4kW systems, Trina panels, SMA inverters – so can get data
    - Clay Energy are installers
    - They are collecting the data through internet, but seems they are only collecting the 24 hr accumulated generation and use?
    - Paid 15c/kWh for excess generation over a billing period
    - Looking at net metering of up to 10kW / 1500 systems? Or some other set quota
    - ITP commented on the problems inherent in programs with capacity or time limits
- SEFP systems:
    - 50% of loan guaranteed by government, can take out loan for all of system, up to a value of $1million
    - 40 loans so far, $20 million, 1500 units installed (range from 100W to 245kW)
- DoE are hoping to produce a National Electrification Master Plan next year
- Ingenero doing UAE funded PV systems, 2x 200kW, 1x 100kW, added to existing diesels
- Utility Reform study currently being done by Mintner Ellison, including IPO, retail competition, structural separation - talk with Minister of Public Enterprise
- DOE concerned about due diligence on IPP proponents – how to evaluate companies, how to do this independently and transparently
    - Also risk of having only a small number of companies, eg the sugar industry
    - Need more certainty in both supply and demand for IPP process to work well

- Talk about Solar Schools program options in report recommendations, 80% private, 20% public schools
    - DOE keen on this but not sure how best to structure such a program, what tariffs to offer, how to treat govt vs non-govt schools
- Peceli prefers DG over PPA, social good, increased awareness, don't need land
- Want resource diversification
    - Wind monitoring underway
    - Solar data from airport sites, but unsure of details available (Met office)
    - Biomass assessment starting
    - IRENA has undertaken some assessment?

Meeting with Bruce Clay, Clay Energy

Date: Wednesday, 16th July 2014

Present: Robert Passey, Muriel Watt

- Typical PV output: 1250 kWh/yr in Suva and 1550 kWh/yr out west
- Long term PV work mostly off-grid, 50% telecommunications
- Recent interest in large-scale commercial systems, most / some via Sunergise, which manages the project investment finance and offers lease arrangements
    - Chicken farm 250kW, plus extra 250kW planned
    - Intercontinental 500kw
    - Garment factory, Suva 250 kW
    - Another 700kW system planned
    - Turtle Island – PV/diesel/battery hybrid with 228 kW PV (1 MWh/day load) (not financed)
    - Another island – 3 MWh/day load, 200kW PV
- Potential for community solar in new high-end apartment blocks
- Process for development of new energy policy was good, especially the stakeholder workshops
- Potential for PV grid support at end of grid locations, eg Rakiraki
- Residential loads not really suitable for PV – most power would be exported
    - Net metering would be recommended

  - Storage may be needed to balance load and PV
  - Could be used to reduce need for grid upgrade

- DOE Trials – will have detailed (10 min) monitoring via both SMA inverters and separate kWh meters
- SHW widely used by middle class, especially in western region, and locally made (tanks imported)
- School PV systems could attract aid funding
- Previous EU funded schools project provided PV lights for rural schools
  - Ecokinetics awarded project
  - Ongoing maintenance not funded, so provided by DOE
- SHS – contracts awarded by DOE every 2 years
  - $18/mnth too low to cover maintenance and battery replacement costs
  - Powerlight, CBS
- FEA
  - No new IPPs needed, have signed contracts for new hydro and biomass
  - Standard grid connect guidelines available
  - Have been happy with interactions with FEA. They needed some training but generally quite helpful and open to PV on the distribution network
- Training and accreditation
  - SEAPI accreditation
  - Australian standards
  - IRENA – training course on grid connect
  - Utility training needed
  - Pacific Power Association – supports utilities – contact Andrew Daka, very supportive of RE
  - Herb Wade does PPA training

Meeting with Katerina Syngellakis, GIZ

Date: Tuesday 15th July, 2014

Present: Robert Passey and Muriel Watt (IT Power)

- A lot of work and consultation went into development of new Energy Policy
- Now with Government for more than 6 months
- May or may not be approved after election
- Privatisation of FEA under consideration
- SHS and community diesel grids – some customer dissatisfaction
    - Most want 24/7 power and ability to run appliances
- FEA – familiarity with hydro and diesel, reluctant to install other technologies, especially intermittent RE
- Need for transparent processes for grid planning and tenders

Meeting with Timoci Lesi Natuva - Minister of Energy

Date: Thursday 17th July 2014

Present: Robert Passey and Muriel Watt (IT Power), Susana Pulini (DoE)

- New Energy Policy expected to be approved after election
    - Currently held up by the AG, not entirely clear why
- Demand also expected to increase after election
    - New grid and generation projects, especially in areas currently with restricted supply
    - Gold Mine, currently operating own diesel, wants FEA supply / new biomass plant
- FEA focus on hydro, but:
    - rainfall patterns changing
    - more risk with droughts as currently over 60% reliance on hydro
    - hydro more expensive that biomass (although he may have been referring only to the capital expense)
- Private investment in PV or other technologies will save the government or FEA needing to invest

  - Should be encouraged
  - Should have access to the new 33.08c feed-in tariff
  - However, may need to reconsider when 24/7 supply couldn't be guaranteed
  - Need to clarify 24/7 requirements currently placed on supply by FEA

- 600 DOE managed diesel mini-grids
  - Typically 50-60 kVa
  - 40 systems being retrofitted with dual fuel engines to allow coconut oil use
  - Coconut oil expected to be lower cost (30-50c/litre?) and reducing
  - Start (to warm engine) and stop (to clear fuel lines) with diesel
  - Accreditation underway of USP biodiesel test centre – will allow testing of various products and sources to ensure compatibility

- Larger diesels – trial of PV funded by UAE
- Also Jaico funded PV in village with 25 homes
- Fiji expects to have 100% electrification within 3 years
- Grid extensions are funded partly by FEA, partly by DOE ($4000 per connection) and partly by customer (5%)
- All options will be considered:
  - Best
  - Cheapest
  - Sustainable

- Outcomes will be relevant for use in other Pacific countries

Meeting with DOE Community Diesel Grid Manager

Date: 17th July 2014

Present: Robert Passey, Muriel Watt (IT Power)

- About 600 diesel systems across the 333 Fiji Islands, installed from 1978 to 2013
- Installed and operated by DOE for 3 years, then passed to community management
- Under 1978 Policy – which now covers about 50% of systems – community pays $150/year for twice yearly maintenance and 1/3 of other repair / component replacement costs

- Communities set their own tariffs, typically $2-4 per week
- Systems operate either a few set hours per day, or when fuel is available
- Most systems operate 2-4 hrs a day
- Some operate for school hours, eg. 6am-3pm, then 6-10pm
- PV would be a good way to increase operating hours and/or reduce fuel use
- 3x UAE funded systems are for Government Stations, not Community systems
- Proposal to add PV to 2 well run community systems as a trial
    - Community will contribute 5%
    - June 2015
    - Ground mounted or on community building roof
- PV also installed by Dept of Health in clinics and nurse quarters – esp outer islands
- Ausaid provided $1M for hybrid systems in schools – date?
- 40 islands will trial dual fuel engines using coconut oil
    - These won't get government $ for PV
    - Price of copra is regulated, and expected to be cheaper than diesel
- villagers pay only 5% of capital costs of diesel gensets and the fuel costs, DoE pays maintenance costs (except that community pays $150/year for twice yearly maintenance and 1/3 of other repair / component replacement costs?) and rest of capital cost
- generally systems are working very well but access to fuel is a problem (because of lack of money and lack of physical access)
- village coops have different ways of paying for minigrids, but generally through some weekly or monthly charge collected by the village committee
    - some village committees are much more organised than others

Meeting with Amlesh Kumar Din, Powerlite

Date: 17th July 2014

Present: Susana Pulini (DoE), Robert Passey, Muriel Watt (IT Power)

- Has been operating since 2005
- From 2012 to the current time that have installed 2,500 SHSs
- DoE has a standard design that is adhered to by installers, they can suggest changes, although he seems to think it is basically fine
- The 100W systems were 2x50W panels with a 100Ah battery, and included a DC to DC converter for phones and radios
- The 270W systems are 2x 135W PV, 200Ah battery, 300W inverter for TV and maybe radio, lights
- Use Kyocera panels, Morningstar inverters, deep cycle lead acid sealed battery Ritar power (US company, made in China)
- 3 main issues
    - often poor people without regular income
    - need to get World Bank to help, but they require 50% upfront and customers don't have any savings
    - physical access is a real issue but one that they overcome, it just increases costs. When they submit proposals to do maintenance they just do different prices depending on difficulty of access
- Some people want to own their own system so they can increase the size
- They make maintenance trips 4 times a year to check components, bulbs, battery and general operation
    - If running hours reduced, order new battery for next visit
- Systems are reasonably robust - PV panels and pole are often all that remains after a cyclone, houses gone
- Of the $18 for the 270W systems, $9 goes to maintenance company and $9 to a trust account run by the government to pay for replacements
- To decide whether a battery needs to be replaced they do some technical tests but also rely on feedback from customers

- Lead acid batteries used to be locally made, but the quality started to decline, now use imports
    - Old batteries returned to DOE for recycling
- Also sell DC appliances but as part of their own business, and this is usually to non-SHS customers who can afford larger systems
- Other Ministries (eg. Ministry of Agriculture), have stations on islands that are also getting PV to reduce diesel use, they contact DoE for design and other info because they lack the internal expertise
    - Typically 3.5 – 5 kW PV in 6-10 kVA diesels
    - Used to extend electricity hours
- No more prepaid meters, were too expensive because only a small number of units were being produced
    - However, these were less flexible, with set cut-out at 10pm
- Consumers are complaining a lot that $18/month is too high. This mentality needs to change, people need to learn that things are not free – and this is changing
- Government employees now pay their way when visiting villages
- People who buy their own systems, look after them better and so they last longer
- Indians tend to live in isolation, Fijians tend to live in clusters/villages and they would be more suitable to convert to a single system for the village (but there doesn't seem to be much demand / capacity to pay)
    - Lau group, 15-20kW PV, with 35kV back-up generator
    - Beqa – 20kW Japanese funded system
- They take some spare parts such as lights and small components but not batteries or panels. If they identify a problem they notify DoE and they can take a replacement next trip. As part of their contract they are not allowed to make special trips, so people have to wait until the next 3 monthly round. There is some flexibility in that if they know a battery is likely to need replacing then they can request one from the DoE to take with them. Also, if DoE officers are visiting then they may take batteries etc
- The main problem is collection of the $18/month to pay for the systems. Some villagers have Solar Managers who are responsible for collecting the money and banking at the local post office.

- Westpac is thinking of having something like an EFTPOS machine in the local shops of a remote islands. Most people don't have bank accounts, so things like direct debit are not feasible.
- 333 islands, so difficult to cover

Meeting with Prof. Atul Raturi, University of the South Pacific

Date: Thursday 17th July 2014

Present: Robert Passey, Muriel Watt (IT Power)

- FEA one of the most efficient utilities in the Pacific
- Supply problems in the non-FEA areas, eg. SHS and community diesel grids
- New generation in all areas usually aid funded
- Coconut oil as diesel fuel option not available in all islands
- USP training
    - Basic courses on all RE technologies at undergrad level
    - Extra courses available for Masters
    - PhDs also available – 3 at present, studying ocean energy and energy planning
- Vocational courses funded via USAid (run by Gavin Perera)
    - 3 level 1 courses run at USP (15 students each)
    - About $5000 to run each course (venue, food, materials) – no charge, but USAid funding for students' travel and accommodation
    - 10 run in other countries
        - Basics of stand-alone sizing, resource assessment, shade, temperature etc
    - 2 level 2 courses – "train the trainer"
    - 12 other countries
        - 2 Weeks, covers ac supply, energy efficiency, design etc
- Several onsite PV, SHW and monitoring systems – all used for student projects
    - 45kW grid connect system – paid 15c/kWh for export (only on weekends)
        - $2M Korean funding
        - Included costs for 8 Pacific Island students to do Masters Course
        - 12 monitoring stations for RE resource assessment across various Pacific countries

        - Provides about 10% of $2.5M annual elect bill
    - 1.5 kW stand-alone system
    - EV charging station – for previous onsite golf buggies
        - Some local interest in EV manufacture and use to displace fuel imports

- Other RE systems in Fiji
    - 10kW Ausaid system built 1990's– no longer operating- inverter problem and system abandoned
    - 42 MW run of river
    - 10 MW wind farm – not operating well
    - About 4000 SHS – most working OK
        - RESCO model working better than departmental management
    - 30 - 40,000 PV torches provided via French aid funding, tested at USP and distributed to schools to replace kerosene lamps
        - Sunking best so far
    - Water pump at school – Taiwan funded

- Main interest is capacity development – training in feasibility assessment, design, maintenance
- Use of generic, standardised designs from aid projects has led to problems as local conditions differ
- New biodiesel test centre being accredited
- Many project proposals for often untested new RE systems
- No process to assess credibility
- New PV household trials will be good to get data and develop control / grid integration protocols

Meeting with Amit Singh, CBS Power Solutions

Date: Friday 18th July 2014

Present: Robert Passey, Muriel Watt

- Have suggested that, instead of prepay meter use a lockable battery box
    - 2400 old SHS being upgraded to include this

- Without prepay meters, many people don't pay, so now will get disconnected after 6 months or so
    - People now confused about who to pay and when
- Have also proposed a mobile phone payment solution, negotiated with Vodaphone, whereby monthly electricity payment would be added to phone recharge and passed on to DOE
    - DoE hasn't responded to this suggestion and Vodaphone offer has lapsed
- Also proposed their own prepaid solution, with lower cost meters
    - DoE hasn't responded to this suggestion to date
- Thinks focus may be too much on price and not enough on quality
    - Example of selection of cheaper charge controllers with 1 year warranty over their option with 5 year warranty
- CBS also work in many other pacific island countries
- On community diesel the government only does maintenance for first 3 years, problems arise after that
- Fiji is behind other countries in dealing with remote systems
- Marshall Island approach is better
- Examined hire purchase option for private sale of SHS, but if a customer doesn't pay then is very expensive for them to go all the way there to get the money
- In Tonga they train people to do simple maintenance like cleaning the panels, making sure they aren't shaded (and no trees growing on the panels!) and collecting the monthly fee. Have someone assigned in each village.
- Now is a good time for them to stop installing more systems and evaluate what they've done
- 275W systems used sealed batteries, 100W systems used open
- CBS installing 11 of the trial grid connect residential systems
- Also 11 of the biofuel generators
- SEFP a very useful program, now extended to June 2015
    - One customer has used it to finance a PV system which allows them to run a business on a remote island

Meeting with FEA

Date: Friday 18th July 2014

Present: Robert Passey and Muriel Watt (IT Power), Susana Pulini, Miriama, Peceli Nakavulevu (all DoE), Bobby C. Naimawi (CFO) and Karunesh Rao, Executive Projects and Public Relations (both FEA).

- They will provide us with various types of load profiles as well as 2013 peak demand and generation capacity. We need to email them specifying what we want.
- Plans for development of the grid
    - Proponents come forward with project proposals
    - Because the grid is interconnected then it doesn't matter too much where the generators go, and because all are meant to be 24/7 then is doesn't matter what type.
    - Agree that diversification with different types of generators would be a good thing and are interested in geothermal and waste to energy
    - Have identified parts of the network where grid support is needed
    - However this isn't used to identify where to put DG – because they don't consider DG capable of providing grid support.

- Load forecasts based on:
    - 4% historical and they add new loads onto that, eg. New hotels.
    - Load drop in 2010 and 2011 was due to a 60% increase in retail tariff.
    - Expect that load will keep increasing, but also agreed that MEPS etc will have an impact
    - They undertake energy audits of large businesses and suggest savings

- Spinning reserve:
    - about 40MW (so n-0.5) and cost F$320 million (based on latest 42MW run of river hydro).
    - Fiji can't afford to have n-1, if largest hydro is considered to be a single 80MW unit. In fact it comprises 4 X 20MW units, so they use half the capacity to calculate spinning reserve

- Have had 1 drought in 30 years when hydro had to be reduced (CEO said 2 droughts in his presentation), they brought in diesel sets from NZ.
- FEA runs their hydro as baseload and diesel to meet peaks
    - So thermal generation cost is their marginal cost

    - Marginal cost excluding TDR 32c/kWh for lower grade fuel, 46c/kWh for better fuel (HFO, Heavy Fuel Oil), so average marginal cost somewhere between the two – so paying only 33.08c they are in front
  - The 33.08c/kWh includes capex
  - The 15c/kWh for export was separately negotiated at lower rate, due to intermittency. Expect to pay 33.08 now, but have sought clarification / exemption

- Distributed PV:
  - Seemed they were happy and are mostly concerned with export of excess power, since they perceive a liability to FEA to accept and pay (regardless of need)
  - Standard grid connection agreements for both DG and IPPs – to be supplied to ITP
  - They would be interested in any new ideas for different types of PPA

- Effect of DG on load forecasts:
  - Agreed there would be effects but they don't yet take it into their 4% pa projection, as only a few systems have gone in so far.
  - Load forecast does include new mine systems
  - EVs also not taken into account in load forecast
  - The projected F$1.5 billion needed mostly for TDR

- Biomass is also subject to drought
  - Plans are for biomass plant bagasse to be used with biomass from somewhere else
  - Extend to 12 month operation (no scheduled down-time?)

Other notes

- They have signed 2 PPAs and don't think they will need more
- Tenders were called for the two new hydro systems
- 24/7 X 365 days is a priority
- Due diligence done on any company that proposes IPPs
- In all their PPAs they have an agreed quantity, they'll pay for any generation up to that point but not above
- He said that the 33.08c will apply to all PPAs, including ones already signed – but perhaps shouldn't, so need to get clarity from Commerce Commission

- They would prefer to pay IPPs at cost of generation + margin, rather than their own avoided fuel cost, as they feel they can negotiate lower rates than the 33.08c (note however, that this was introduced because no IPPs had been signed since the 23c was introduced in 2008)
- PPAs are for 15-20 years
- PV system at Rooster, is 250kW
- Population not really growing
- Grid connection – part paid by FEA part by IPP, is part of negotiation process (referring to large-scale).
- Monosavo hydro has paid off its capex
- Geothermal studies done for 2 sites up to but not including deep drilling – see report
- Every DG PV system is checked by the FEA, costs the customer about F$5 so wouldn't cover costs. He said that all installers and inspectors are trained / accredited. They seemed to like the idea of having fully accredited installers and eventually checking only say 10% of systems for compliance.
- 'net metering' trial is in northern division, central and west of main island. FEA is interested in the trial results
- Also interested in biomass assessment, and to a lesser extent wind.
- SHW mostly used in new hotels etc
- Worried about cyclone ratings of PV, despite using Australian installation standards – seem to be concerned with Chinese modules

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