Pacific SIDS Energy, Ecosystems and Sustainable Livelihoods Initiative: Managing the Ecosystem Implications of Energy Policies in the Pacific Island States

Review Report 2011

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ACRONYMS & ABBREVIATIONS

ADMIRE	Action for the Development of Marshall Islands Renewable Energies
CDM	Clean Development Mechanism
CROP	Council of Regional Organisations of the Pacific
EE	Energy Efficiency
EESLI	Energy, Ecosystems and Sustainable Livelihoods Initiative
EELI	Energy, Ecosystems and Livelihoods Initiative
EIA	Environmental impact assessment
ENERGIA	International Network on Gender and Sustainable Energy
FAESP	Framework for Action on Energy Security in the Pacific
GEF	Global Environment Facility
GHG	Greenhouse Gas
IRENA	International Renewable Energy Agency
IUCN	International Union for Conservation of Nature
HSES	Ha'apai Solar Electricity Society Inc.
kW	Kilowatt
LED	Light Emitting Diode
LTA	Land Transport Authority, Samoa
MEC	Marshalls Energy Company
M&E	Monitoring and Evaluation
MTR	Mid-Term Review
NDBP	National Development Bank of Palau
O&M	Operations and Maintenance
ORO	Oceania Regional Office
PIC	Pacific Island Country
PIGGAREP	Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project
PNG	Papua New Guinea
PV	Photovoltaic
RE	Renewable Energy
RMI	Republic of the Marshall Islands
ROC	Republic of China
SEIAPI	Sustainable Energy Industry Association of Pacific Islands
SHS	Solar Home System
SIDS	Small Island Developing State
SOPAC	Secretariat of the Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
STEC	Samoa Trust Estates Corporation
TEC	Tuvalu Electricity Corporation
TOP	Tongan Pa'anga
UNDP	United Nations Development Programme
USD	United States Dollar
USP	University of the South Pacific

EXECUTIVE SUMMARY

The Energy, Ecosystem, Sustainable Livelihood Initiative (EESLI) has been operative in the 6 PICs for the last 3 years. This review is a follow-up of a mid-term review of the EESLI projects that was carried out in November- December 2009. The EESLI is part of a larger programme being funded by the Government of Italy (Ministry of Environment, Land and Sea and Ministry of Foreign Affairs), in collaboration with the Government of Austria and the City of Milan. The overarching objective of this programme is the reduction of GHGs through implementation of renewable energy (RE) and energy efficiency (EE) projects in the six participating countries. In addition, there are a number of small-scale activities being undertaken under the Special Initiatives component.

The main findings of this review are:

- All country projects with the exception of Vanuatu have almost reached their end point.
- Vanuatu solar rehabilitation is 90% complete and wind monitoring equipment is being installed at present. The hydropower project is finally taking shape and is expected to be completed in 2012. Landowners' concerns (regarding wind monitoring locations) are still an issue. The refurbished solar PV systems in health centres have made a remarkable impact on provision of basic health services to rural population and also enhanced educational facilities in hitherto un-electrified schools.
- The Palau project has been able to create a multiplier effect with banks/financial institutions from the other PICs planning to start subsidy schemes in their countries. The energy efficiency loan scheme is now being extended to cover loans for renewable energy equipment. This project has also encouraged other agencies (GEF, SPC and ADB) to support similar efforts.
- The Tuvalu GCPV project was completed in 2009 but faces difficulty, as one of the battery banks is not functional at present (November 2011). The solar street lighting component has helped make the school environs much safer especially for the girl boarders and staff.
- RMI project (retrofitting of LED lights) is 90% complete. The project proponents envisage annual savings of USD 300,000 due to reduced diesel consumption. This project itself is straightforward and should not have serious issues. Performance monitoring is critical for making a proper evaluation. The solar lighting component is being supported by additional funding from Taiwan and Canada. Shortage of technically qualified staff within the energy unit is a concern for long term sustainability of these initiatives.
- The Samoan project has also reached its end point. The coconut biodiesel pilot plant is set up with two vehicles currently running on biodiesel. This project component has been able to create interest regarding the use of biofuel. The IUCN funded Jatropha curcas assessment of key environmental impacts has been accepted by the government. The LTA has been involved in an awareness campaign regarding energy efficiency. However, it is difficult to find any tangible outcomes of this project component.
- The major portion of solar PV system rehabilitation in Tonga was completed in 2009. The activity is now focused on the last unserved island in the Ha'paai group, Lofanga. This project has been able to uplift the living conditions of the islanders by providing clean and efficient lighting.
- EESLI has helped project proponents to investigate the impact of energy systems on biodiversity and ecosystems. The J. curcas [as above] in Samoa and EMP study for Talise hydropower in Vanuatu are crucial for projects development.
- The special initiatives have been able to impact on the communities involved in many different ways from availability of clean and efficient lighting to gender mainstreaming of energy issues.

INTRODUCTION

This report presents the findings and recommendations of a review of the programme entitled "IUCN Pacific Energy, Ecosystems and Sustainable Livelihoods Initiative (EESLI): Managing the Ecosystem and Livelihood Implications of Energy Policies in the Pacific Island States". This initiative is coordinated by the Oceania Regional Office (ORO) of IUCN which is located in Suva, Fiji and implemented in six Pacific Island Countries (PICs)[1] . The initiative is funded by the Governments of Italy and Austria.

The review follows the mid-term review undertaken in November-December 2009, and is for the period 2010-2011.

BACKGROUND

The EESLI has its origin in the IUCN Energy, Ecosystems and Livelihoods Initiative (EELI). The main aspiration of the EELI is "to support and accelerate the transition to energy systems that are ecologically sustainable, socially equitable, and economically efficient". The Pacific component of this initiative is EESLI which is "aimed at increasing awareness in the six Pacific Island Countries (PICs) of critical linkages between energy systems and the natural ecosystems through sustainable and socially equitable energy projects".

This would be achieved by:

- Supporting beneficiary countries in the development and implementation of environmentally sound, sustainable energy policies; and
- Implementing a number of renewable energy pilot projects focusing on ecosystem conservation and livelihood enhancement.
- It is expected that program will help implement pilot projects in six Pacific SIDS that demonstrate sustainable energy technologies, and management systems for those technologies, that are suitable for wider dissemination in other Pacific SIDS and beyond.
- The main features of this programme are as follows:
- It is governed by a memorandum of understanding (MOU) between the Government of Italy and twelve PICs;
- All activities are aimed at greenhouse gas emission reduction, with projects being implemented in a range of sectors;
- A total of USD 10 million is provided by the Government of Italy;
- Co-funding is made available by the Government of Austria (EUR 1 million) and
- The City of Milan (USD 500,000);
- Six countries (Fiji, Kiribati, Federated States of Micronesia - FSM, Nauru, Papua New Guinea - PNG, and Solomon Islands) are supported through "direct financing", i.e. funding provided by the Italian Ministry of Environment, Land and Sea and channelled through the Permanent Missions of the PICs in New York;
- Six countries (the Republic of the Marshall Island, Palau, Samoa, Tonga, Tuvalu and Vanuatu) are supported through IUCN;
- A Joint Committee (JC) comprising representatives from the Government of Italy and the Heads of Missions of the Permanent Missions of the PICs to the United Nations in New York is responsible for the implementation of the MOU, including the allocation of funds and the selection of projects;
- A Joint Working Group (JWG) of experts designated by the signatories of the MOU was established, under the coordination of the Euro Mediterranean Centre on Climate Change, to conduct the initial feasibility study.

Actual implementation of the IUCN Initiative began in mid-2008, following a period of design and negotiations that included the following steps:

- May 2007: the Government of Italy and the Governments of twelve Pacific Small Island States sign an MOU and issue a Joint Communiqué.
- 30 June – 1 July 2007: a Regional Meeting for the Implementation of the Cooperation programme between the Italian Government and the Governments of the Pacific Small Island States is held in Vanuatu.
- 13 December 2007: the first meeting of the Joint Committee is convened.
- February 2008: IUCN and Italy sign an MOU, and a meeting is held in Rome between the Ministry of Foreign Affairs, the Ministry of Environment, Land and Sea and IUCN.

1 The six countries are Palau, the Republic of the Marshall Islands (RMI), Samoa, Tonga, Tuvalu and Vanuatu.

- 6 March 2008: the second meeting of the Joint Committee is held and the decision is made, upon recommendations of the Italian Ministry of Environment, that the country projects in Samoa, Tonga and Vanuatu will be supported through IUCN.
- April 2008: IUCN ORO recruits a Coordinator for the Initiative.
- 6 – 8 May 2008: the pre-inception meeting for the Initiative is held in Fiji. It is attended by representatives from Samoa, Tonga, Vanuatu and IUCN.
- 13 May 2008: at its third meeting, the JC decides to add three countries (Palau, RMI and Tuvalu) to the Initiative, with funding approved for Palau and Tuvalu, and budget for the RMI project to be considered at its next meeting.
- July 2008: IUCN finalises the project document, with five country projects (Palau, Samoa, Tonga, Tuvalu and Vanuatu), multi-country and regional support activities, as well as a country project in the RMI, subject to the availability of funding.
- August 2008: the first contract is signed between IUCN and one of the participating countries (Tonga).
- November 2008: the inception meeting is attended by Palau, Samoa, Tonga, Vanuatu and IUCN.
- 16 January 2009: at its fourth meeting, the JC approves a budget of EUR 360,000 for the project in the RMI.
- According to the Project Document, the first phase was to end in May 2011, but the programme has been extended to 2013 by a decision made by the Joint Committee in New York in May 2010.

In addition to the six country projects the initiative also includes a number of other activities, usually under the label of “Special initiatives”. The special initiatives comprise:

- Demonstration Projects: This category includes the comprehensive initiatives focused on the practical implementation of various renewable energy technologies, approaches and methods that demonstrate improvement in livelihoods and the preservation of biodiversity.
- Information Projects: The initiatives should focus on raising awareness of the general public to the environmental problems and impacts of unsustainable energy systems within the Pacific region.
- Innovative Approaches to Sustainable Energy and Environment Policy: This category focuses on the development of a roadmap for a clear pathway for a national energy sector development plan. This will include national dialogue forums where all key stakeholders, from implementers to users, policy makers, politicians and donors discuss and develop a national energy strategy for the country.
- Evaluation and Impact Assessment: This category will include the proposals to evaluate existing projects/programs and collect the lessons learnt and the best practices. It will also include projects that focus on assessments of the environmental impacts of energy systems.

The Pacific SIDS EESLI has about 20 special initiatives associated with it. Some of them are[2]:

- Participation in and provision of support to a policy process in Tonga, known as the Tonga Energy Roadmap and more recently the Vanuatu Energy Roadmap
- Promotion of cycling, in collaboration with the Velocity Cycling Club of Fiji and the Tonga Community Development Trust.
- Supply of Solar home systems/lights in Solomon Islands
- Provision of Solar streetlights in Tavua, Fiji
- Support for UNEP regional CDM capacity building workshops
- A partnership between the Pacific Islands Applied Geoscience Commission (SOPAC), the International Network on Gender and Sustainable Energy (ENERGIA) and IUCN for the implementation of the “Gender Mainstreaming into SIDS IUCN’s Pacific Energy Ecosystems and Sustainable Livelihoods Initiative”, a project of ENERGIA’s financial and technical assistance to enhance gender mainstreaming into energy projects in the PICs;
- The conduct of a regional training workshop on environmental impact assessment (EIA), as a first step towards the development of guidelines and the provision of support to EIAs within selected energy projects;
- Support of regional workshops/conferences in collaboration with other regional partners.

2 A complete list is given in section 6

MIDTERM REVIEW (MTR) 2010

A mid-term review (MTR) of the EESLI was undertaken in November-December 2009. The review made the following recommendations regarding the EESLI work plan:

- Pursue implementation of the country projects, with some adjustments being made to the three country projects that will remain operational beyond 2010:
- Palau: design and implementation of a monitoring system to measure impact;
- Samoa: clarification of contractual matters (duration of project and funding levels), and design and implementation of a monitoring and evaluation (M&E) protocol;
- Vanuatu: integration of ecosystems and livelihoods issues into design, assessment and implementation of the hydropower component, reconstitution of the National Task Force/Steering Committee and use of expertise available within IUCN Members and Commissions;
- Be based on a clearly articulated vision of the place of biodiversity, ecosystems and livelihoods in new, sustainable and equitable energy systems in the Pacific Island Countries (PIC);
- Sustain and strengthen collaboration with other regional actors and aim at building coherence and synergies among the missions and activities of regional and international institutions involved in the field of energy in the Pacific region;
- Give priority to policy and advocacy work, at both regional and national levels, on the basis of a simple communications framework that identifies: (a) the main regional and national stakeholders in the energy/environment sectors in the region, (b) the current perceptions and roles of each stakeholder or stakeholder category, and (c) the policy messages and advocacy goals that IUCN wishes to disseminate and pursue;
- Ensure that a major, perhaps the major, part of its work over the next 18 months is focused on this policy work, with activities including: the participation of IUCN, at the appropriate level, in policy events and processes; the publication of policy papers, briefs and guidelines; the provision of training in policy development; the facilitation of dialogue and collaboration among various stakeholders in government, civil society and the private sector; and the provision of credible advice and information to actors in the region;
- Sustain and expand current work on the gender dimensions of energy issues and solutions;
- Make effective use of global institutions and networks as sources of information and best practices, and as potential channels of advocacy and policy influencing
- Avoid dispersion in the funding and implementation of demonstration projects in the Special initiatives, focusing perhaps on EIA methodology and on community-based energy solutions;
- Ensure that sufficient time and resources are allocated to extracting, documenting and disseminating lessons learned and best practices.
- The MTR considered the projects to be highly relevant to the Pacific region benefitting the communities and other stakeholders involved. However, their impacts on sustainable livelihoods and ecosystem/biodiversity were thought to be marginal. It further commended ORO for sharing the lessons learnt and results obtained through these projects among other regional energy actors.

It is recommended that the present review report should be read in conjunction with the MTR.

METHODOLOGY

The present review looks at the status of the projects and their impacts (in some cases perceived) on the beneficiary communities and the countries themselves. Two countries Vanuatu and Tuvalu were visited during this review .The other country reports are based on the interviews/reports from the respective stakeholders. The review studied how EESLI contributes to IUCN's global objective of developing sustainable, equitable and efficient energy systems.

Each project is examined on the basis of its relevance, sustainability and its impact on the socio-economic status of the main recipients of energy services.

The sources of information include:

- A review of project documents;
- A review of the main national and regional policy documents in the fields of energy, biodiversity, environment and development;
- Interviews with project focal points and other project participants, including visits to two of the participating countries, Tuvalu and Vanuatu. These countries were not visited during the MTR.
- Interviews with other actors in country (e.g. organisations involved in energy and in environment, donors and policy-makers), at the regional level and within IUCN ORO.

A visit to all project sites would have given a much wider perspective for this review and the timing of this exercise (November- December) made contacting all stakeholders difficult due to the holiday season.

COUNTRY REPORTS

PALAU: ENERGY EFFICIENCY SUBSIDY PROGRAMME (EESP)

Project description:

The aim of this project is to promote energy efficiency by providing loans for energy efficient houses. This unique project is being managed by the National Development Bank of Palau (NDBP) with support from Palau Energy Division. The project envisages new energy efficient homes will consume 15% less energy than the normal houses. The project will also help expand the demand for energy efficient appliances and services.

The proposal was submitted in April 2008 and the contract between NDBP and IUCN was signed in December 2008. Total capital outlay over 3 years was USD 500,000. The homeowners received a subsidy to make their houses energy efficient.

Project activities:

The project activities included drafting of loan criteria and establishing the energy efficiency measures. By the end of second quarter 2011, following activities had taken place:

- Three energy model homes completed
- One energy model home under construction
- Eighteen regular homes completed under NDBP
- Eight homes completed under the Palau Housing Authority (PHA)
- Eleven regular homes under construction under NDBP
- Ten regular homes under construction under the PHA
- Awareness activities

Figure 1: Energy effecient housing

A new board has been formed. According to the project coordinator, the top brass of NDBP is very enthusiastic about this project and the committee members were driving the agenda forward. A number of awareness events (energy fair in schools) have been held to promote the energy efficient activities/appliances. The largest hardware retailer has joined the initiative as a partner.

Future plans include subsidies for retrofitting of EE measures in existing homes. Building on the EESP a new subsidy scheme under Renewable Energy Subsidy Programme (RESP) is now providing subsidies for renewable energy equipment. The funding for this component is through the national GPAS programme (GEF Pacific Sustainability Alliance).

Impacts

The EESP is the first project in the PICs where a commercial institution (NDBP) has played a leading role in sustainable energy awareness and development. It has spurred a similar interest among other institutions across Pacific.

Issues

- It is important to show how this project has contributed to decrease in GHG emission since its inception. Baseline data would be required to make a comparison and reduction calculations.
- The project had to be extended until 2013 as there is only one company involved in home construction under the EESP.
- Long term sustainability of the subsidy scheme will be a crucial issue.

REPUBLIC OF MARSHALL ISLANDS: GREEN HOUSE GAS ABATEMENT THROUGH ENERGY EFFICIENCY

Project description:

This project involves retrofitting existing mercury/sodium vapour streetlights in Ebeye and Majuro with LED lamps. A second component will see the installation of solar street lighting. The project is being implemented in collaboration with Ministry of Resources and Development and the Marshalls Energy Company (MEC).

Current status of project

By November 2011, all 175 W metal vapour lights in Ebeye and 90 % in Majuro were replaced by 30/50 W LED lamps. This work, including retrofitting of LED lights in the government buildings, will be completed in 2012. The solar lighting component has been assisted by an additional funding from Republic Of China (ROC) and the Government of Canada bringing total funds available to USD 500,000. The equipment is expected to arrive in early 2012 and installation work would start immediately after.

Impacts

- Retrofitting 500 units of metal vapour lamps would result in an annual saving of USD 96,085 (based on 39 c/kWh, and 10 hours/day usage).
- The payback time for the total project is less than 3.5 years.
- Solar lighting is being installed in areas which do not have any electricity or frequent power disruptions. This would make these locations safer for the general populace and help reduce crime.
- There is a GEF funded project ADMIRE (Action for the Development of Marshall Islands Renewable Energy) operating in RMI. This activity comprises wind monitoring, energy survey and training of SHS trainers. The two projects have a good opportunity to collaborate and develop a training/monitoring plan for the LED/solar lighting initiative.

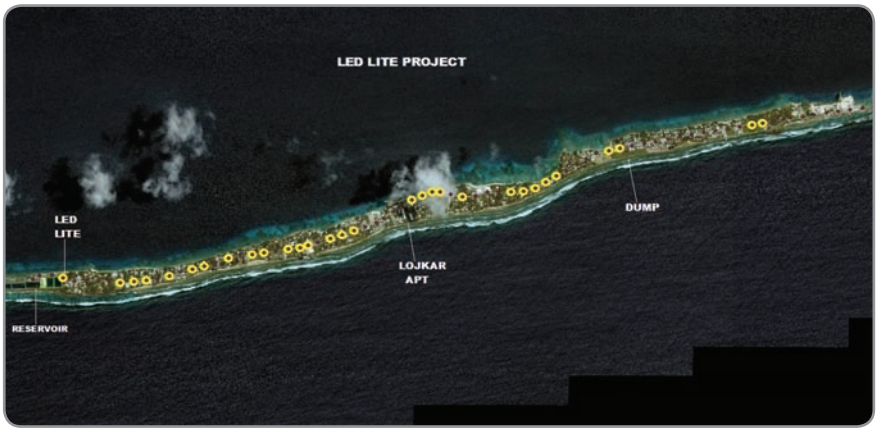

Figure 2: Retrofitted streetlights location in Majuro

Issues

- Insufficient technically-skilled staff within MEC.
- Monitoring and validation are needed to measure the actual energy savings and hence GHG reduction.

SAMOA: GREEN HOUSE GAS ABATEMENT THROUGH ENERGY THROUGH ENERGY EFFICIENCY AND BIOFUEL APPLICATIONS IN THE LAND TRANSPORT SECTOR

Project description

This project focuses on enhancing energy efficiency in the transport sector through awareness campaigns, promotion of non-motorized transport (walking, cycling etc.) and development of coconut based biofuel to replace at least a part of huge amounts of fossil fuels used by the transport sector in Samoa. The main objective is to reduce GHG emission by cutting down the usage of petroleum products in transport sector. The project is being implemented by the Renewable Energy Division of the Ministry of Natural Resources and the Environment (MNRE) with the help of a Steering Committee (chaired by CEO of MNRE) with the Land Transport Authority (LTA), the Scientific Research Organisation of Samoa (SROS), the Electric Power Corporation (EPC), the Ministry of Finance and the Ministry of Foreign Affairs and Trade as members.

Project activities

Some of the major activities of the project are:

- Workshops on energy efficiency for bus operators and auto mechanics
- Promotional materials on energy efficiency –TV, radio and Newspapers
- Awareness campaigns for non-motorized transport
- Setting up a coconut biodiesel pilot plant

The coconut biodiesel research component has been completed with the pilot plant set up and B50 blend (50% biodiesel + 50% diesel) being used to run two of the SROS vehicles. A study of the weed risk of *Jatropha curcas* was funded through the Special Initiatives component of the EESLI. The study was accepted by the National Energy Coordinating Committee[3] . SROS is working with the Samoa Trust Estates Corporation (STEC) to intercrop *J. curcas* within existing coconut plantation and is waiting for the second phase funding to expand its biodiesel activity. A request for USD 150,000 has been made through the IUCN ORO.

Figure 3: Demonstration vehicles running on Biodiesel

Impacts

- The transport sector is the biggest user of imported petroleum fuel in Samoa (40% of the total). Therefore any project that targets a reduction in the transport fuel usage would be most welcome.
- The project is consistent with national policy (National Policy on Climate Change and National GHG Abatement Strategy 2008 – 2018, as well as Samoa Development Strategy).
- Consultation with communities and social groups regarding the importance of vehicle maintenance and its impact on GHG emission has resulted in greater awareness about the climate change issues and how one could help mitigate the global warming, no matter how little.
- The promotion of non-motorized transport and car-pooling has been well received by all stakeholders.
- The coconut biodiesel pilot project is successful in demonstrating the potential of biofuels in replacing fossil fuels. IUCN funded a very important study on the potential invasiveness of J. curcas which will help expand the biodiesel project.

Issues

- The long term and tangible impacts of awareness and promotional activities on GHG reduction will not be easy to quantify.
- Supply chain management will play a major role in biodiesel development.

3 SROS Quarterly report 10, dated 27th September 2011

TONGA: SOLAR REHABILITATION

Project description

This solar rehabilitation project involves replacement of old non-functioning PV systems installed in the 80s-90s on the islands of Mango (1988-91) and Mo'unga'one (1994) in the Ha'paai group. The systems fell into disuse due to a number of issues including non-replacement of batteries. As a result, most of the islanders reverted to using expensive and inefficient kerosene lamps for their lighting needs.

Project activities

Under this IUCN EESLI project, all old systems (64) were replaced by new PV panels, batteries, charge controllers and accessories. The system components were supplied by CBS Power Solutions (Fiji) selected after a due tendering process. Local technicians trained by the Energy Planning Unit of the Ministry of Lands, Natural Resources and Environment installed the systems.

The installation was carried out over two weeks in each island and the villagers looked after the team during this period. Every system recipient paid a TOP 200 (Tongan Pa'anga) installation fee. After installation, two technicians are stationed in each island to maintain the systems and also collect a monthly fee of TOP 13 per household. Each system is divided into two parts in terms of ownership. Before the circuit breaker (CB), the solar committee is responsible and after the CB, it is the responsibility of the householder to look after the system and pay for any repairs/replacements. This part of the project was completed in 2009.

The last component of this project is the installation of SHS in Lofanga Island, the only island in the Ha'paai group without any solar electricity. Although the contracts were awarded early 2011, the installation has yet to take place. The main reason behind the delay is the supply of wrong types of solar panels.

Impacts

- On a visit to Mo'unga'one, in November 2010, all the systems were found to be in good working order and more importantly, the islanders were using the efficient lighting gainfully. The children could do their homework at night and the women continued weaving until late in the evening.
- Tonga has embarked on its ambitious Energy Road Map. The EESLI project fits in very well within the overall objective of this plan.
- This project is a very good example of cooperation between different agencies. In collaboration with the Ha'apai Solar Electricity Inc. (HSEI) and PIGGAREP, a number of technical/ financial capacity building workshops have been held.

Issues

- There are no major issues with this project. As with other SHS systems, maintenance will be the main factor in deciding the sustainability of this project. The HSEI has been managing the installed systems with reasonable success and it is hoped that the lessons learnt from other similar projects would ensure the longevity of these systems.

*Figure 4: **(Left) W**ell-lit church in Mo'unga'one, (Right) System installation*

TUVALU: TUVALU PHOTOVOLTAIC ELECTRICITY NETWORK INTEGRATION PROJECT (TPVENIP)

Project description

This project installed a 46 kW grid-parallel PV system at Motufoua secondary school in Vaitupu, the largest outer island in Tuvalu. The configuration of the system includes PV panels, battery banks, a connection to the grid and a standby generator.

The original proposal for this project was submitted by the Government of Tuvalu in April 2008, with a consultancy characteristics carried out in late 2008 to develop specifications and tender documents. The contract between IUCN and Tuvalu was signed in February 2009, for a total amount of USD 800,000. Complementary support has been provided by PIGGAREP to support training. In addition to the purchase and installation of the equipment, project funding includes the payment of salary for one person and DSA of the electricity company staff when travelling to the project site.

A second component of this project was provision of 10 solar streetlights for the school. The Motufoua School is the only government secondary school in Tuvalu and is located on the island of Vaitupu, located 130 km north of the capital Funafuti. The school has just over 500 students and has access to electricity since the late 1970s. Initially power was available from 5.30 a.m. to 10.00 p.m. daily. This was later extended to midnight in the year 2000, when all islands in Tuvalu were electrified.

Figure 5: Solar panels on grandstand roof at the Motufoua School Stadium

Presently, only the capital island has 24-hour access to electricity while the rest of the island's systems operate for 18 hrs per day. A project to upgrade almost all of the buildings in the school was funded by Japan in 1992. Several new classrooms and dormitories were constructed. Recently, there have been requests to get the school 24-hour access to electricity due to newly introduced internet

The IUCN EESLI PV project has been set up to fulfil the school's demand while reducing Tuvalu Electricity Corporation's dependence on imported diesel. The 46 kW solar PV installation was commissioned in March 2010. The installation was done by an Australian firm Ecokinetics with assistance from technical personnel from the TEC. The project was initially designed for the purpose to take up the power load for the school from midnight to morning. In mid-2011, the project was extended to install ten standalone LED solar PV streetlights for the school. The units were supplied by a firm from Fiji – Clay Energy – and installed by TEC's technical staff with assistance from local TEC staff and senior students from the school as pictured in Figure 6.

Current status

The project site was visited in October 2011. The following report is based on this trip.

Component 1: *PV system - The system characteristics*

Table 1: Vaitupu PV system characteristics

Vaitupu System
Rated output – 46kW peak
SMA inverters operable in non-air-conditioned environment – all electronics in sealed housing with external heat sink.
Marine grade (6061) aluminium frame for solar PV array – resistant to aggressive marine environment.
No integrated weather station.
Facility to connect to system via internet. Facility to remove SD cards for local download of operating data. Internet connectivity not available at the location of the inverters.
Switch gear and control system specifically matched to SMA inverter system. Data recording integral to inverters.
15 x DC / AC inverters + distribution cabinets – footprint (excluding batteries) similar to Funafuti system.

Battery banks

TEC has been having issues with charging the batteries via the grid. With the diesel generator- set at Motufoua not operational at the time of visit (awaiting spare parts for repair), the only other option is to charge from the PV system. This at times can be difficult when there are a few not–so-sunny days (rain, heavy cloud cover) in succession.

One of the battery banks (No.3) is not functional and hence the Sunny Island inverters associated with this battery bank were not operational even on a sunny day. According to the logbook, these inverters have been off most of the time since May 2011 and operating on/ off intermittently even earlier. The set up inside the battery banks and inverters shelter is as shown in Figure 7.

System Monitoring

There is currently very limited information noted down in the site logbooks. More detailed information needs to be logged to assess the performance of the installation. There is an existing Sunny Web box installed at the site which will be able to facilitate remote monitoring if there is an internet connection available. This would reduce the need for physically downloading or manual recording of the data.

Maintenance

There were no records of any regular maintenance carried out for the batteries or other equipment. There is an existing Operation & Maintenance (O&M) manual for the Motufoua PV installation and this should be referred to as the basis for maintenance procedures at recommended intervals. Some basic training was provided to the Vaitupu technicians/operators regarding general system operations.

System Load

The original system design was based on the batteries being able to supply 200 kWh per day. After the system installation, new loads have been added and this will affect the performance of the PV system.

Warranty/Inspection

In consultation with TEC, the initial phase of the project was scheduled for its one year warranty inspection in December 2010. This did not take place. The delay seems to be due to the contractor from Australia – Ecokinetics' failure to comply with the warranty arrangement. It demanded an upfront payment opposed to the Government's request to perform the warranty inspection before payment. Negotiation continues on the issue. This situation is exacerbated by the fact that the main technical person who did the installation is no longer working with Ecokinetics.

***Figure 6*:** Battery banks and inverters.

Component 2 : LED Solar Streetlights

The ten streetlights were supplied by Clay Engineering from Fiji at a total cost of FJD61, 556.00. Each streetlight consist of 1x BP Solar BP3125 12V 125W, 1 x battery type Haze Solar HZYSL12-110 gel sealed and has a capacity of 114Ah @ C100 with an autonomy of 3.4 days. The unit is fitted with LED light-SAL-01, a light source of 8 ultra-high intensity white of peak 2700 lumens, light spread 120 degrees. The LED streetlights consume significantly less energy than the ordinary streetlight bulbs.

Stakeholders' and Beneficiaries' perspective toward Solar Projects

The ten LED solar streetlights were installed in areas recommended by the school staff and students. The majority of lights are in the vicinity of girls' dormitories. At the time of visit, five senior boys were suspended from the school a week earlier after being caught inside the girls' dormitories. The girls feel much secure and there are less incidences of intrusion by outsiders.

In the school compound, no light is allowed for studies after light goes off at 9.30pm. At 4.00am each morning, student can use their personal lights such as torches for study until morning. Since the installation of the streetlight, students gather around the streetlight at 4.00 a.m. studying during good weather. There was no furniture used for studying but sitting on logs, grass and on the ground. Some students managed to complete their prep or school work during this hour. The male students have now demanded that they should have the same number of streetlight installed in their area as for the girls.

The school's night watchmen admits that the job is made easier after the installation of street lights, as students are often caught going around after lights were turned off in the dormitories. Matrons also witnessed less intrusion of privacy at night near the girls' dorms. Discussions with a few parents at the village and other islands, Nui, Nukufetau and Funafuti reveal that they were thankful for the solar PV streetlight project as they felt their daughters were much more secure. They would like to see the streetlights programme extended to cover the whole school area.

Impacts

- The project saves about 44,000 litres of diesel and reduces approximately 109 tonnes of GHG annually.
- The PV system has ensured 18-20 hours of electricity are available to the school community. In October, the diesel generator was out of operation and only the PV system supplied electricity to the school.
- The solar streetlights have made the school environment much safer especially for the girl students.
- This system will also be used for training regional solar technicians.

Issues

- The system is not being monitored at the moment which is a serious concern. There is no internet connection available for remote monitoring and the logbooks do not contain all the required data.
- Battery bank 3 needs urgent attention.
- Extra loads have been added to the system (a computer lab with two ACs) which will inevitably affect system performance and battery life.
- The one year warranty inspection was not done by the contractor.
- It is imperative that energy efficiency measures are in place before implementing RE component.

VANUATU: VANUATU RENEWABLE ENERGY PROJECT (VREP)

Project description

This project comprises the following three components:

- Rehabilitation of solar systems at schools and health centres (USD 293,000);
- Installation of community mini-hydro unit (USD 397,000).
- Wind monitoring to assess the potential of this source of energy, at the cost of USD 180,000 with the aim of installing towers in all 6 provinces;

Current status

These notes are based on visits to Vanuatu in October and December 2011 and inputs from the people interviewed.

1. Rehabilitation of existing Solar PV systems in Santo and Malekula provinces

This component involved restoration of standalone PV systems that were installed in schools and health centres under previous donor assisted projects. Unfortunately, almost all had fallen into disrepair due to lack of maintenance. The beneficiaries had gone back to using kerosene lamps/ torchlights for their lighting needs. A scoping study was done in 2006 to identify PV systems in need of restoration. A total of 39 systems were targeted and 23 of these have now been restored. All health clinics have been completed and the school systems' rehabilitation is in progress. Following is the detailed description of the individual systems that have been restored.

Santo projects: These PV systems were rehabilitated in 2010. This report describes the status of the systems in mid-October 2011.

Natawa School

This is the only English centre school on the eastern part of the largest of Vanuatu's islands, and has 170 students .The solar system supplies power for lighting in eight class rooms and four staff houses. During the rehabilitation in 2010, the original flooded gel-regulated batteries were replaced by Deka dry batteries.

Since the refurbishment of PV system, student numbers have increased from 103 in 2010 to 170 in 2011 as parents like to send their children to a school which has proper lighting facilities and hence a secure environment. The dining hall system is not functional and needs urgent attention. A new library is under construction and a PV lighting system would enable staff and students to use the facility in the evenings

Port Olry Dispensary

Port Olry dispensary was formerly a catholic mission station on the north-eastern part of Santo. The centre has one health dispensary with one nurse practitioner and one nurse aide. The dispensary has undergone a few developments over the years resulting in the construction of a new maternity ward which has two beds and a room for women in labour. The centre is connected to the Port Olry bio-fuel power station, which is currently run by UNELCO GDF Suez. However, this supply is available only from 5am to 9am in the morning and 5pm to 11pm in the evening.

The previously installed solar system has undergone full refurbishment under VREP in 2010. Old batteries were replaced by 3 flooded gel-regulated batteries and the inverter was also replaced at the same time. The Energy Unit technicians also added 3 new light bulbs in the new maternity ward following the clinic's request. The clinic paid 15,000VT to the Energy Unit for the additional electrification of the maternity ward.

The new system provides an uninterruptible power supply for basic lighting to the dispensary. The solar lights are installed in the consultation room, the maternity ward and the store room. During periods when the bio-fuel power supply is interrupted or unavailable, solar PV systems supply power for lighting. This is highly beneficial to expectant mothers admitted outside the normal bio-fuel plant operating hours. Previously when the solar PV system was not operational, the clinic utilized a privately owned small diesel generator to provide lighting during emergencies that occurred outside the normal operating hour for the bio-fuel power station. This is not needed anymore. The cost for diesel fuel for the small generator and transport to Luganville town to acquire diesel fuel is approximately 5,000VT per fortnight. Now, this money is saved for other developments for the clinic.

The current system with dry cell batteries is very effective and reliable. The nurse does not need to frequently monitor the electrolyte level and fill distilled water to the appropriate level. It should be noted that distilled water is difficult to access here.

The solar PV system inverter encountered a problem at the end of 2010. There was no technician available and the nurse was unclear of the procedures to follow in order to obtain the necessary service.

Hog Harbour School

The Hog Harbour School is located close to Port Olry. The school previously relied on a small diesel generator for their annual electricity demand of 3 MWh. The solar PV system has reduced their diesel consumption by almost 60%.

Vulesepe Dispensary

Vulesepe area is located south of Santo approximately 20 km from Luganville town. The access is via a poorly maintained gravel road. The area has one health clinic and one school. The small health clinic in the area has one nurse practitioner and one nurse aide. The health clinic has one consultation room, one antenatal room, a maternity ward which includes a labour bed and one in-patient bed and a treatment room. The health clinic has 2x 50 Watt solar PV panels connected together and 3 dry cell batteries to store the solar energy. Currently there are 3 bulbs. It provides basic lighting to the maternity ward; the consultation room and the treatment room. The solar light bulbs are installed in the consultation room, the maternity ward and store room.

Previously, when expectant mothers came at night, they had to provide for their own means of light which would normally be around 100 VT for one night. With the new operational solar PV system, they save this money which goes towards their other children's school fees.

The nurse practitioner expressed his concern over the limitations of solar PV system especially during rainy season. There is a lack of basic knowledge of solar PV system and how to manage the system. Some basic training to the clinic staff would be helpful. The system is poorly maintained. The new maternity ward small solar PV system (2x50W) stopped working in October 2011. The nurse is unaware of whom to consult with regards to the diagnosis of the problem and the solar PV system is left unattended

Tata School

Tata School is in the same area as the Vulesepe dispensary. The school provides education for students from classes 1 to 10. The school has 6 classroom buildings, one dining hall, 2 dormitories, an administration room, a school canteen and 6 staff houses. There are 8 solar PV systems, of which 7 were operational in October 2011. These systems provide basic lighting to 4 classrooms, 2 dormitories, the administration room, and 3 staff houses. The classrooms and staff houses have 2x50 W solar PV panel with one or two batteries.

The school staffs have installed their private inverters to charge mobile phones at home. The school also has a small diesel generator which uses approximately 600 litres of diesel each month. The generator operating hours are from 6pm to 9pm on a daily basis. The generator also supplies power to the Vulesepe dispensary staff houses. The nurse pays a contribution of 1,000 VT to the school at the end of each month.

Narango School

Narango School is located some 30 km from Luganville town in the Narango area. The small English primary school has classes 1 to 4 and 6. The solar system installed in late 2000 was upgraded at the end of 2010 along with all solar PV systems installed by Energy Unit for rural health dispensaries and schools.

There are 4 solar PV systems installed for the school. Two solar PV systems have 2x50W modules connected together. One PV system supplies power to light the classroom 4and the head teacher's office and the second system supplies classroom 5 and there is an inverter for small ac loads. Two smaller PV solar systems 1x500W supplies power to light two staff houses.

Solar lighting has improved the study environment for the students during night study in the school classrooms. This has helped school save money previously spent on kerosene and diesel fuel. The villagers have realized advantages of solar electricity and have started purchasing solar lamps for basic lighting needs.

Figure 7: Headmaster of Hog Harbour School in a PV lit staff room

Students also talked about the improvement in their academic performance since the advent of solar power. A class 6 student mentioned that her parents have also noticed improvements in her grades since the solar lights were installed. The system also provides relatively cheaper mobile phones charging facilities to the nearby community and the school generates a small income from the mobile charging activity. This income goes towards paying an extra teacher and also helped build a class room. In addition, the school organizes frequent fundraisings such as solar powered movie nights where an entrance fee is charged.

Namoru Primary School

Namoru primary school is a French school in the Wailapa area. Wailapa area is some 40km from Luganville town. The road access is poor and vehicles need to cross about 3 rivers without proper bridges. It takes approximately 2 hours by truck to reach the area. Students from classes 1-6 attend the school. There are 4 micro solar PV systems installed and upgraded in 2010 for classes 5 and 6 and two staff houses

Once again, this project has reduced the dependency on kerosene and diesel fuel which had to be transported from Luganville. However, in December 2010, the solar PV system that supplies power for basic lighting to classrooms 5 and 6 encountered a technical problem. Since then no qualified technician has inspected the problem and, night studies have come to a halt. This system requires immediate remedial action.

Tasmulum School

Tasmulum Secondary School is a French school south of Santo approximately 50 km from Luganville town. The school has a total of 142 students from year 7 to 13. There are 90 boarding students and 40 students from surrounding area that use the school facilities at night to study.

The school has a small diesel generator that supplies power to the school daily from 6pm to 9pm.The school uses about 200 litres of diesel fuel per fortnight. The costs of fuel every fortnight is around 35,000VT with the cost of transport to and from Luganville totals to around 43,000VT (approx. 430 USD) per fortnight. The Vanuatu Energy unit technicians had installed four solar Systems to supply power for basic lighting to the dining hall, library and 2 staff houses in 2000. The systems were upgraded in 2010 by the IUCN/VREP initiative.

Two of the aforementioned solar PV systems have failed due to technical problems since the beginning of 2011. The solar systems supplying power to the library and to one staff house had stopped working only a few weeks after the upgrade due to technical problems. These systems have not been inspected by qualified technicians.

Tasmulum Dispensary

Tasmulum health clinic is located between the Tasmulum secondary school and the Tasmulum primary school. Tasmulum health clinic receives for patients from the nearby villages of Ipayato, Viuru, Tanovusivusi, Ukoro and Parisa. The clinic has a maternity ward, and labour ward, a treatment room and a consultation room. There are three nurses that serve at the clinic.

The solar PV system which was upgraded in November 2011 supplies power for basic lighting and an inverter with rating of 300VA supplies power to single phase loads within the power specifications of the inverter. There are two solar panels that power the clinic. Both the panels have 3x50W solar modules joined together.

The solar PV system supplies power for basic lighting and small loads.The system provides clean and reliable power for basic lighting to the maternity ward. Fuel savings have helped fund new projects and the clinic generates extra income by providing a mobile charging facility for the nearby community.

Malekula Projects[4]:

The solar rehabilitation in the Malekula health clinics was undertaken between 9th-18th November 2011. These systems were installed under various donor programmes and were non-functional due to a variety of reasons. The rehabilitation work involved replacement of dead batteries, faulty regulators, switches, 13 W CFLs replaced with 7 W CFLs and general maintenance of the PV modules.

- All Health Centre systems have 7 x 50 W PV panels and 4 batteries.
- Health centres involved: Leviamp Health Centre (HC), Tontar HC, Tenmaru HC, Vao HC and Tisman HC.
- All materials were initially stored in Luganville, Santo and had to be shipped to Malekula.
- The storage container in Luganville is leaking and needs urgent replacement/ repair. Some of the components/batteries risk being damaged/destroyed if subjected to rain water.
- It is imperative that some rudimentary training is provided to school/clinic staff.
- The photos below exemplify the impact of these solar projects. The maternity ward does not have to depend on torchlight in emergency situations at night anymore; the solar lighting provides a safe and secure environment. The staff and the community are very pleased with this development. This is an example of how energy access can play an important role in improving health services in remote areas

Figure 8: PV system at Tasmulum Dispensary

2. 75 kW micro-hydro project in Talise, Maewo Island

This project has been in the pipeline for some time now. Two feasibility studies have been done - first one in 2002 and again in 2009. Various factors have delayed the start of this project viz. remoteness of the area, geotechnical concerns and no qualified local contractors. Finally, in 2011, a contract was awarded to Pelena Pty Ltd. However, the contractor has decided to start from scratch[5]. A project advisory committee has been set up to assist the management committee in running the affairs of the hydro project. Energy Unit/ IUCN have conducted a number of awareness workshops/events for the community

About 300 people from 3 surrounding villages are hoping to benefit from this 75 kW hydro power station. This project has had lot of political support but the actual work started only after IUCN intervention. The contractor has sub-contracted the civil works to the local community. The community group first cleared the land for penstock between the intake weir and the powerhouse and by December first week, the penstock trench had been completed (photos below). The contractor is currently working on the turbines, which should be delivered early 2012.

4 This part is based on a report prepared by Mr. Jesse Benjamin of the Energy unit, Vanuatu.
5 The present contractor was part of the organization that performed 2002 feasibility study.

Issues

- The villagers work with bare hands and primitive tools. Obviously, the progress is very slow and there are OHS concerns. The contarctor had promised to bring in a jackhammer to ease the work
- The building materials for the powerhouse will have to be physically carried over a distance of 3 km by community members – a tough ask.
- According to Vanuatu Environment act 2002, approval must have been granted by the Department of environment prior to the start of any work. The preliminary work on the dam started in 2010. It must be mentioned that a conditional approval was given by the Department of Environment based on a preliminary EIA.
- The Environment Management and Monitoring Plan study was done in October 2011, after the civil work had started.The Talise river is home to an endemic species of fish, Sicyopus pentecost. The contractor will have to be careful in dam/ powerhouse design so as not to disrupt the migration of fish and prawns.
- According to the EMMP consultant, the powerhouse, access road and the tailrace might interfere with the natural drainage creating a flooding hazard.
- The project proposal envisaged electrification of three villages, Talise, Narovorovo and Nasawa. However, the funds available are just enough to transmit power to Talise village, and distribution will be the responsibility of the village.
- Unfortunately, there is no indication of how this access to electricity will help in income generation and increased productivity at the community level. The original proposal does mention possible income generation activities like grinding kava roots for consumption in kava bars, fish & meat storage and ice-making, lightings in local bungalow business, saw-milling and timber production.

Figure 9: Malekula Health Centre

3. Wind monitoring

This part of VREP entails setting up of wind monitoring systems in all six provinces. However, work on this component started only in December 2011 due to various reasons such as delay in release of funds leading to delay in signing the contract by the contractor. The contract was finally signed in April 2011 and the towers arrived in September 2011. The first tower was erected in Port Olry, Santo on 16th December 2011 with the rest still in storage.

Resource assessment plays a very important role in renewable energy development efforts. This work will help energy planners to consider wind energy development based on solid data and not guesswork. This and other similar work (for example USP/KOICA project) will help move Vanuatu Energy Roadmap forward.

Landowners' issues caused the Clay Energy personnel some difficulties during the installation process in December 2011. It is very important that these issues are sorted out before any work is undertaken.

Figure 10: The weir – Photo taken in 2010

Figure 11: Digging the trench for the Talise hydropower system (Photo taken in November 2011)

ISSUES AND IMPACTS

This section discusses the overall impacts of the EESLI projects and some of the challenges associated with their implementation.

GHG REDUCTION

The overarching objective of the EESLI is to reduce the impact of climate change through sustainable energy initiatives. This would translate into a net decrease in the GHG emissions after the intervention.

- For four of the countries (Tonga, Vanuatu, RMI and Tuvalu) the reduction is obvious since fossil fuels are being displaced while in the case of Samoa and Palau energy efficiency projects, GHG reduction calculations are not so straightforward.
- In Tonga, before the rehabilitation of the PV systems, the average kerosene consumption for lighting per household was on average 15L per month, and it can therefore be estimated that the project will reduce approximately 30 tonnes of CO_2e annually in the two islands where it has been implemented[6] ;
- In Tuvalu, the grid-connected 46kW PV system is expected to reduce GHG emission by 109 tonnes annually;
- The country project in Vanuatu envisages an annual GHG reduction of 118 tonnes, when all components are completed;
- Reduction figures for retrofitted light emitting diodes (LED) lamps in RMI are estimated to be 197 tonnes of CO_2;
- Careful monitoring and validation is required to ascertain the actual GHG reductions. This in many cases (PV systems in Vanuatu for example) would be difficult to achieve due to logistic reasons. It must be noted that PIGGAREP has offered its help in data collection and analysis which should generate the real reduction numbers.

Figure 12: Wind monitoring mast installation in Port Olry

ENVIROMENTAL/BIODIVERSITY IMPACTS

The impact of EESLI on environment and biodiversity is quite difficult to assess at this early stage besides the small GHG reductions. Only Talise 75 kW hydro project has the potential to impact on the environment/biodiversity in a significant way as the availability of RE based electricity will reduce the eco-footprint of energy access in the project area. However, the project developer should also take care of the negative impacts of this construction activity in this pristine area.

AWARENESS AND POLICY

One of the major impacts of EESLI has been in the area of awareness creation among the stakeholders and public. Projects in Samoa and Palau have a sizeable awareness component and they have been able to spread information regarding efficiency in the transport sector (Samoa) and the building sector (Palau). The Palau project has been able to generate interest among regional partners and this has brought very positive publicity to EESLI and IUCN ORO. The Vanuatu hydro project also has an awareness component associated with it, which should be fully utilized to help develop income generation activities.

Despite being a new actor in a crowded field, EESLI has helped IUCN energy office to quickly become an integral member of sustainable energy developers' fraternity in the Pacific. It is a member of the Pacific Energy Oversight Group (PEOG), the umbrella organization instrumental in developing the Framework for Action on Energy Security in the Pacific (FAESP) and its implementation plan. It is also a member of a committee that is involved in developing competency standards and certification scheme for renewable energy technicians in the Pacific[7] . The ORO has also been participating in Tonga Energy Road Map and more recently Vanuatu energy Road map consultative meetings. Participation in these meetings has allowed IUCN to present its ecocentric energy development vision for inclusion in national/regional policies.

6 The project is currently being implemented in the third island Lofanga.
7 This is being done in collaboration with the Sustainable Energy Industry Association of Pacific Islands (SEIAPI) and other regional partners.

The intention for gender mainstreaming into the country projects is commendable and ties well with IUCN's women and energy vision. Solar PV projects are helping women to increase their income generation activities in Tonga and provide better health services to expectant mothers in Vanuatu. Solar street lighting in Tuvalu and RMI has created safer environs and the Talise hydro project promises to bring all round development in the beneficiary communities.

LIVELIHOOD & OTHER SOCIAL IMPACTS

Solar lighting in rural Vanuatu has tremendously improved health services and learning/living conditions in schools. In Tonga, the islanders have been able to work at night .The largest livelihood impact is expected to come from the Talise hydro project and it would be interesting to see how the communities use the available electricity for income generation activities. As mentioned before, this would require continuous support from IUCN ORO and the national coordinator.

PROJECT DESIGN & IMPLEMENTATION

As highlighted in the Mid-term review report, the project designs were not very innovative save the Palau energy efficiency project. Two of the projects (Tonga and Vanuatu) involved rehabilitation of old PV solar projects, which had fallen in a state of disrepair. Without putting a strategy in place so that this does not happen again, the new systems might face the same fate. The project proponents should have come up with innovative ideas to make this initiative sustainable. There is very little evidence that such measures are in place.

There have been delays in starting some project components (Vanuatu hydro, wind monitoring) due to various reasons and one supposedly completed project does not have any tangible outcomes (Samoa EE). The project design for the Samoa project was weak and some of the expected results were not achieved- a case in point is the non-purchase of a pollution tester by the LTA, a basic requirement of the project. In addition, the communication gap between various in-country actors has been a concern. The ownership of a vehicle bought using Samoa EESLI funds is not clear. In RMI, MEC has been given the project bucket truck which is fine as the truck is essential for the installation and maintenance of LED lights.

SUSTAINABILITY

As mentioned before, two solar PV projects involve rehabilitation of old systems. It is imperative that measures are in place so as not to repeat the mistakes made. Tonga does have a maintenance plan in place but some training to the Vanuatu clinic/school staff on basic maintenance of the systems is a necessity. The Tuvalu project is already facing some problems and again appropriate training measure must be employed. Phase 2 of EESLI should have a training plan in system operation and maintenance. The proponents should be asked to prepare a detailed sustainability plan for their projects. The plan should also include an awareness campaign on energy efficiency targeting the beneficiaries. For Talise hydro project, special attention should be paid in developing income generating activities.

COLLABORATION

The country projects have benefitted from collaboration with other regional partners notably PIGGAREP which has been involved in renewable energy feasibility studies and capacity building[8] . IUCN and PIGGAREP have been holding their review meetings together saving costs and sharing experiences. These meetings are also attended by other regional and development partners.

The wind monitoring data being generated at various sites in Vanuatu will help the Energy Road Map to assess the wind potential and make a sensible decision on developing wind power.

8 PIGGAREP is also supporting capacity building for the Tuvalu PV project.

SPECIAL INITIATIVES

Besides the country projects, IUCN is involved in some related activities termed as special initiatives. A sum of Euro 250,000 was made available for small projects which would be aligned with the overall EESLI mission of biodiversity conservation and reducing the impacts of climate change. As mentioned in Section 2, four types of projects are eligible under this initiative: demonstration projects, information projects, Innovative approaches to sustainable energy and environment policy and Evaluation and Impact Assessment.

The following activities have been funded under this initiative:

Table 2 : Special Initiatives under EESLI

PROJECT	COUNTRY	STATUS
Demonstration projects		
Nahu community solar project	Solomon Islands	Completed
Tetepare solar project	Solomon Islands	Completed
Tavua town Solar streetlight	Fiji	Completed
Solar light bulbs (NoKero)	Solomon Islands & regional	Completed
Lifecyle Tonga Initiative	Tonga	Operational
Lifecyle Fiji Initiative	Fiji	Operational
National Trust of Fiji, Sigatoka Sand Dunes renewable energy project	Fiji	Scheduled for 2012
Information projects		
Pacific energy & gender training	Regional	Completed
EESLI Mid-term review	Regional	Completed
Sustainable Energy Resources Workshop	Regional (with USP & DOE)	Completed
International conference on renewable energy and climate change	International and regional (with USP)	Completed
Solar power for Vanuatu (DVD by GreenTV)	Vanuatu	Completed
Regional capacity development workshop on Clean Development Mechanism under the ACP MEA project	Regional	Completed
Innovative approaches to sustainable energy and environment policy		
Palau energy policy support	Palau	Completed
Tuvalu energy policy support	Tuvalu	Completed
Vanuatu energy policy support	Vanuatu	In progress
Tonga energy road map support	Tonga	In progress
Energy policy screening guidelines	Regional	In progress
MSG Environment and Climate Change meeting support	Regional	In progress
Evaluation and impact assessment		
Environmental and social impact assessment (ESIA) training workshop	Regional	Completed
Samoa biofuel invasiveness review	Samoa	Completed
Workshop for replication of the Palau Energy Loan program	Regional	Completed
ESIA factsheets (bioenergy, wind, solar, hydro)	Regional	In progress
Environmental management plan for Talise micro hydro project	Vanuatu	In progress

Through these special initiatives IUCN has been able to support some EE/RE related activities in Pacific Island Countries (even outside the six EESLI project countries). These projects were designed and executed by IUCN ORO. Some of the major impacts of these initiatives are shown below:

- The Tavua Town (Fiji) solar street lighting system proved its effectiveness during January 2012 floods when the electricity supply was interrupted throughout the western division and solar lamps were only source of lighting in the town centre.
- The Tetepare and Nahu solar projects in Solomon Islands have brought solar lighting to remote islands. In Nahu, 39 homes were the recipient of solar lights and would no longer use polluting, expensive and highly inefficient kerosene lamps or traditional lights (dried sap of a tree). This initiative has specially been beneficial to village women who now do not have to walk long distances in search of the sap.
- The NoKero™ light bulbs project has demonstrated the concepts of solar energy to a wider range of audience.
- The cycling initiatives in Tonga and Fiji have created awareness about effect of cycling on health, environment and energy conservation. Life cycle Tonga is collaborating with Ministry of Health and Tonga Health Association to promote cycling as a healthy habit.

  Although there is lot of interest[9] , more concerted action by all stakeholders and commitment by city/town authorities to develop cycling infrastructure would be needed to make this initiative effective in the long run. Involvement of school and university students would be highly beneficial.
- The information projects like Pacific Energy & Gender training and CDM capacity building workshops have been very useful in disseminating information on these topics.
- The Palau Development Financing Institution Workshop for the replication of the Palau Energy Loan Program was a very good initiative which hopefully will get other financial institutions follow the example of NDB, Palau.
- The Jatropha curcas invasiveness study in Samoa will help the government to make an informed decision regarding the biofuel development in Samoa.
- Environmental Social Impact Assessment (ESIA) Training Workshop and production of ESIA factsheets are very useful to all renewable energy practitioners.

CONCLUDING REMARKS AND RECOMMENDATIONS

The EESLI has helped establish IUCN Oceania as a major sustainable energy player in the region. The initiative has helped restart stalled projects (Talise hydro), brought lighting to hitherto unserved areas (Tonga, Vanuatu), reduced diesel dependence (Tuvalu and RMI) and promoted energy efficiency (Palau). The special initiatives, although small in terms of funding, have had significant impacts on the activities they were involved in. The project coordinators and IUCN ORO have presented project reports in a number of regional workshops/conferences (some of them IUCN supported) creating awareness about the initiative and its impacts.

The most important aspect of IUCN's involvement is to show that all projects help protect the ecosystem and improve the livelihood options of the beneficiary communities. This is easier said than done and will require a sustained presence in the project locations.

RECOMMENDATIONS

- Palau: Monitoring and evaluation of impacts should be done on a regular and methodical way. The renewable energy component should be intrinsically tied with the energy efficiency measures - EE first and then RE.
- Vanuatu: Some of the PV systems rehabilitated in 2010 are already non-functional and require immediate attention. The quality of workmanship should be monitored during restoration and post-installation measures should be in pace for all locations. For the Talise project, OHS issues and the impact on biodiversity need a careful evaluation by the project proponents/contractors. It is also important that the electricity available is put to productive use. The community should start developing ideas on income generation activities. Provisions should be made to connect all 3 communities to the electricity grid.
- Vanuatu: Land issues for wind monitoring sites need to be sorted out and a strategy should be in place for developing wind power at locations with good potential.

9 The President of Fiji launched the Fiji campaign (Life Cycle Fiji Initiative) on 1st May 2010, which was widely reported by local media.

- Tuvalu: The project was completed in 2010. However, since mid-2011, one of the battery banks is dysfunctional. There are issues with the maintenance and system monitoring. It is imperative that the technical issues are sorted out immediately[10] . Monitoring mechanism should be in place. Extra and unaccounted-for electrical loads have been added after the completion of PV system which would adversely affect the system performance – load management is essential.
- RMI: Monitoring and performance evaluation of LED lights should be done on a continuous basis. Remaining retrofitting tasks should be completed. Additional Funds (USD 150,000) allocated for solar lighting have remained unutilized for quite some time which is not an efficient use of resources. There is a good opportunity to collaborate with other projects namely ADMIRE and North REP.
- Tonga: There have been some delays in completing the last part of the Tongan solar project due to delivery of wrong solar panels. More care is required in ordering/receiving system components. Sustainability of systems is of paramount importance and lessons learnt in other islands should be given consideration. The project should have a good alignment with the Tonga Energy Road Map and help Tonga reach its 50% RE target.
- Samoa: The long-awaited air pollution analyser should be procured to get an idea of the GHG emissions from the vehicles. This would help the LTA to enforce its regulations more objectively. The coconut biodiesel work was useful but has come to a standstill. Jatropha based biofuel study is first of its kind in the region and would be interesting to see how it pans out in the coming days (provided funding is available). EESLI's commendable support for the assessment of Jatropha curcas invasiveness is very crucial for any future development.
- Concerns were raised over the efficiency of the payment system used by the Ministry of Finance for procuring items by the LTA - this should be looked at during the next phase of the project.
- There are opportunities for ORO to share its EESLI experience with the new projects being planned currently (e.g. SIDS-DOCK projects).
- EESLI Phase II should look to more closely support the sustainability measures and policy support for the phase I projects.
- Gender sensitive energy access is an area where IUCN ORO can have a major contribution. Access to energy would enable a multitude of women/girls to enhance their living conditions and improve their families' livelihoods.

GENERAL RECOMMENDATIONS

- The role of IUCN is much more than being just another energy services facilitator. The cardinal principle behind EESLI is to "support the development and implementation of environmentally sustainable energy policies and a number of renewable energy pilot projects focusing on ecosystem conservation and livelihood enhancement." It is imperative that IUCN stays and works with the beneficiaries of EESLI projects to use the available energy for income generation and improving their livelihoods. Although it is too early to assess the overall impact, some projects have shown the potential for reducing eco-footprint of energy access. Communities in Nahu (SI) used to spend long hours walking long distances to collect tree sap for lighting their homes. Availability of solar lighting systems has given them opportunity to use their time for other useful activities while enjoying clean and efficient lighting. It must be mentioned here that to make this special initiative sustainable, the communities must be asked to pay for the devices albeit in instalments. The provision of solar lighting in remote health clinics in Vanuatu has greatly improved the health services available to the communities. This would specially have a very positive impact on mother and child health.
- The 75 kW Talise hydro project would make power available for income generation activities and a detailed framework should be in place to achieve this[11] . IUCN should hold workshops/training courses on various possible undertaking the communities can engage in. It is not clear how collaboration with PIGGAREP's Productive Use of Renewable Energy (PURE) project is shaping up.
- The review should not be done towards the year-end when most of the stakeholders and project personnel are on Christmas break.

10 There is some support available now from another source.
11 The world bank study "Maximizing the productive use of electricity to increase the impact of rural electrification programme" would be very useful as a reference.

ANNEXES

COUNTRY PROJECTS: SUMMARY

COUNTRY PROJECT	PROJECT TECHNICAL DETAILS	COMMENTS
Tonga: Solar Rehabilitation		
This project involves rehabilitation of solar photovoltaic based electric systems for homes (solar home systems or SHS) in Mo'unga'one and Mango Islands, part of the Ha'apai group of islands. With the demise of previously installed SHS systems, the island had reverted to using kerosene lamps for its lighting needs and was completely dependent on imported and expensive fuels that had to be ferried over long distances. This project is coordinated by the Energy Division (ED) of Ministry of Lands, Survey, Natural Resources, and Environment. Budget: USD 206,000 Status: Installation in Mango and Mou'ngaone islands was completed in 2009. The project has been expanded to include Lofanga, the only island in Haa'pai group without solar electricity. The community is awaiting installation.	The project involved complete replacement of the old SHS systems (64 in all). Each system comprises two Kyocera 85 TS brand, 80Wp solar panels (connected in parallel), one Steca PR 1515 charge controller and one Hoppecke 12V OpzS deep cycle battery with a C10 capacity of 100 AH. The system is coupled to four 13 watt each Compact Fluorescent lamps (CFLs) and one 0.5 watt LED night-light via a 10 A circuit breaker. The total load is about 418 Wh per day. The system has a 5-day autonomy. The recipient households paid 200T$ installation fee and pay a monthly 13 T$ fee for O&M expenses. There are two local technicians in each island to troubleshoot systems and collect monthly payments. The householder is responsible for the section after the circuit breaker while the utility looks after the system before the circuit breaker (similar to a grid-connected system). The battery and the controller are housed in the same box and this might lead to some corrosion/malfunction of the charging system. The project manager Ofa Sefana is looking at this issue.	It is imperative that measures be put in place to ensure that the new system does not suffer the same fate as the previous one. Since the solar panels are warranted for at least 20 years, looking after the battery is the critical maintenance activity. With local technicians available and training provided by the Energy Planning Unit (EPU), it is hoped that the systems will be able to provide useful energy during their predicted lifetime. The Lofanga installations should be completed as soon as possible as the community has been waiting for quite some time.
Tuvalu: Grid connected PV system		
The objective of this project is to reduce Tuvalu's dependence on imported fossil fuel by installing a grid-connected Photovoltaic system in Vaitupu island. The project is being coordinated by the Tuvalu Electricity Corporation (TEC) and Tuvalu Department of Energy. A second initiative under this project was provision of solar street lighting in Motufoua school. Budget: 800,000 USD Status: completed	The island of Vaitupu (largest outer island in Tuvalu) is served by a diesel grid. This 46 kW photovoltaic system (with battery storage) feeds in to the grid .The system also provides power to Motufoua school which hitherto used to get part of its electricity requirement (in the evenings) from its own 130 kW diesel genset. The PV system also has a battery bank, which can be charged using one of the 3 sources-PV (normally), grid, or school's own generator. The energy requirements for the part of the school connected to the PV system are 160kWh/day The system is designed to save about 120 litres of diesel /day. The 10 solar straights have made the school environment much secure	This project will help Tuvalu to reach its desired goal of being 100% renewable. The expected reduction in GHG emission (109 tonnes CO2e) is achievable while saving the country millions of dollars through diesel savings. The capacity building exercise will help develop a pool of trained RE technicians in Tuvalu and beyond. The importance of maintenance of the battery bank and the inverter system cannot be emphasized enough. The project was commissioned in 2009. The capacity building is envisaged to be on "training by doing" methodology. It is important that a structured training plan is in place. The equipment was supplied and installed by Eco Kinetics, One of the battery banks is not functioning since in 2011 – This is unacceptable and should have been fixed immediately after the problem was discovered. There are issues with system monitoring with incomplete logs.

COUNTRY PROJECT	PROJECT TECHNICAL DETAILS	COMMENTS
Samoa: Greenhouse gas abatement through Energy Efficiency		
The Samoan project is a multi-component and muti-sectoral programme. The primary aim is to reduce emission of Green House Gases (GHGs) in the land transport sector through fuel switching (biodiesel), energy efficiency and promotion of non-motorized transport. This project is coordinated by the Renewable Energy division of the Ministry of Natural Resources and Environment (MNRE).There has been a change in the coordinator- ship of this project and the project manager is still to be appointed. Under the second phase of this project SROS plans to work on its Jatropha curcas based biofuel. Budget: USD 1.3 Million Status: Ongoing	In the Renewable Energy part of this project, the Scientific Research Organization of Samoa (SROS) has been looking at the production of bio-diesel from locally produced coconut oil. Under this initiative, 1000 L of oil was sent to Asia Bio-Fuel Tech company in Malaysia to be converted into coco- biodiesel using a SIP200 M biodiesel reactor. A company truck was used to test the biodiesel produced. There were no technical problems in the 3 days the test was done. SROS has now acquired the equipment (SIP200M reactor and accessories) and is now producing 200L a day batches of cocodiesel. The bio-diesel plant was showcased during the environment day celebrations on 25th November 2009. The pilot scale production of bio-diesel is continuing and B50(50% biodiesel+ 50% Diesel) mix is being used in two SROS vehicles,	While the technology of CNO biodiesel is certainly feasible, scaling-up to a full industrial scale will be a challenge. Supply chain issues and the comparative costs of coconut oil vis-à-vis diesel price will eventually decide the success of this initiative .It will be interesting to compare the economics of jatropha based fuel to CNO based one. Another major issue is the importation and storage of methanol and sodium hydro oxide –essential chemicals required for esterification. There have been a number of useful. awareness activities under this project. The LTA has been planning to purchase pollution check/control equipment to test the vehicles on Samoan roads. It is not clear why a system has not yet been acquired. The actual impact on GHG reduction is not very obvious for this project component.
Vanuatu: Renewable Energy projects		
This project has three components, all related to the development of renewable energy in Vanuatu: Vanuatu renewable Energy Project (VREP) 1. Wind assessment in all six provinces 2. Rehabilitation of PV system on the islands of Santo and Malekula. 3. Development of Talise micro-hydro scheme on the island of Maewo. The project is being coordinated by the Energy Unit (EU). There has been a delay in the project start up due to a number of reasons. Budget: USD 1 Million Status: On-going	This project envisages a reduction of 118 tonnes of CO2 on implementation of all components. 1. Installation of wind monitoring masts started in December in December 2011 (first one in Santo) 2. Solar rehabilitation project work started in 2010. Most of the targeted systems have been updated with a few still to be rehabilitated. 3. After a contractor was finally identified to carry out the work, the 75 kW Talise hydro project is slowly taking shape. The community is fully involved (sub contracted) in carrying of the civil work.	Compared to the other projects, this one has been very slow to take off. One of the main reasons is the delay was appointing a coordinator, which took place in 2010. 4 out of 6 wind masts are yet to be installed (January 2011) It is necessary to monitor wind regime for a minimum of 1 year to draw any reasonable conclusion. Once completed the data generated will help policy makers / investors to make an informed decision on wind power in Vanuatu. The solar rehabilitation tasks should be completed quickly. It is important that beneficiaries are imparted with a rudimentary technical training to look after the systems. These school/ health clinics based projects have profound impact on the living/working conditions of affected communities. The hydro project is finally moving on after long delays. Unfortunately current funds are just enough to connect only one village (Talise) to the power station .Further funding should be sought to connect the other two villages. The project is expected to be completed by September 2012.

COUNTRY PROJECT	PROJECT TECHNICAL DETAILS	COMMENTS
Palau: Energy efficiency subsidy programme (EESP)		
This project promotes energy efficiency in Palauan homes. It involves providing loans specifically targeted to introduce energy efficient devices and measures. The project coordinator is National Development Bank of Palau (NDBP) together with Department of Energy. Budget: USD 500,000 Status: On-going (until 2013)	The project's goal is to reduce home owners' electricity usage by 15% by implementing a number of efficiency measures. These include highly reflecting white roofs, radiant shields & insulation, efficient lights and appliances together with architectural improvements. Subsidy of up to $6,000.00 for First Time Home Owner building a home and incorporating program identified energy efficient measures in to the new house. By November 2011, 31 homes have been subsidized and it is expected that by 2013, 75-76 homes will be subsidized under this programme. One of the project's objectives is to develop EE related business activities in Palau.	This is a very promising project that promotes the concept of energy efficiency being the 'lowest hanging fruit' in the development of a national energy programme. It will be interesting to see this programme supporting itself without any outside help in the long term. This project is creating a ripple effect among other PICs. IUCN organized a workshop attended by 13 Pacific financing institutions in October 2011 where they learnt about Palau's experience in energy efficiency financing. This project has also helped initiate another subsidy programme –Renewable Energy Subsidy programme (RESP). These two programmes together will move Palau toward its 2020 goal of reducing its fossil fuel dependency by 50 % (20% RE+ 30% EE).
Republic of Marshall Islands: Efficient and renewable lighting		
This project has two components: 1. Retrofitting existing mercury or sodium vapour streetlights in Majuro and Ebeye with highly efficient Light Emitting Diode (LED) lights. 2. Installation of new solar lighting system in Majuro and Ebeye. The project proposal was a part of response to RMI government's proclamation of economic emergency in July 2008. The lead project coordinator is Ministry of Resource and Development with Ministry of Public Works and Marshalls Energy Company as partners. Budget: USD 1.09 Million Status: All lights in Ebeye and 90%of lights in Majuro have been replaced. The solar lighting component is yet to take off and other partners have joined this effort.	The main purpose of this project is to reduce electricity consumption by the public lighting system and to provide solar based street lighting in hitherto unlit areas of Majuro and Ebeye. In all, 775 lights are being retrofitted with LED lights and 150 solar lights are being installed. The project is expected to save about. USD 300,000 in fuel bill.	The highly efficient LED lights will definitely make an impact on the utility's fuel bill while solar lighting will make the unlit areas safer. While the efficient LED lights have a long lifetime and would require minimal maintenance, the solar lighting system will need periodic monitoring and maintenance. Accounting for anticipated battery replacements should ensure sustainability of the project. Monitoring and validation of GHG reduction will be important to show the impacts of this initiative.

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In addition, a large number of stakeholders were interviewed (students, parents, nurses, community members) during the visits to Vanuatu and Tuvalu project sites.

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