Report
“Capacity Needs Assessment for RE-based power generation in Fiji”

Fiji Renewable Energy Power Generation Project (FREPP)

10th November 2016
(VERSION 6)
Technical Oversight and Guidance

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Acknowledgements

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Disclaimer

The views expressed in this publication are those as presented by stakeholders and of the authors and do not necessarily represent those of the Government of Fiji, or of the United Nations, including United Nations Development Programme (UNDP), or their Member States.

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<th>Description</th>
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<tbody>
<tr>
<td>ESCO</td>
<td>Energy Service Company</td>
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<tr>
<td>FCC</td>
<td>Fiji Commerce Commission</td>
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<tr>
<td>(F) DOE</td>
<td>Fiji Department of Energy</td>
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<tr>
<td>FEA</td>
<td>Fiji Electricity Authority</td>
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<tr>
<td>FNU</td>
<td>Fiji National University</td>
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<td>FREPP</td>
<td>Fiji Renewable Energy Power Project</td>
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<td>GEF</td>
<td>Global Environment Facility</td>
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<td>G+H</td>
<td>Grue + Hornstrup</td>
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<tr>
<td>IPP</td>
<td>Independent Power Producer</td>
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<td>IRENA</td>
<td>International Renewable Energy Agency</td>
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<td>O&amp;M</td>
<td>Operation &amp; Maintenance</td>
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<tr>
<td>PPA</td>
<td>Power Purchase Agreement</td>
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<td>PPA</td>
<td>Pacific Power Association</td>
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<td>PPP</td>
<td>Public Private Partnership</td>
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<tr>
<td>PV</td>
<td>Photovoltaic</td>
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<tr>
<td>RE</td>
<td>Renewable Energy</td>
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<tr>
<td>SEIAPI</td>
<td>Sustainable Energy Industry Association of Pacific Islands</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>USD</td>
<td>United States Dollars</td>
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<tr>
<td>USP</td>
<td>University of the South Pacific</td>
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<td>VAT</td>
<td>Value Added Tax</td>
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1. **Introduction & overall objectives**

This report describes the results of the recently completed capacity needs assessment of Fijian stakeholders for the design, engineering, installation, operation and maintenance of renewable energy (RE) based power generation systems in Fiji. This capacity needs assessment is a central element of the Fiji Renewable Energy Power Project (FREPP) – a UNDP-GEF-Fiji Government funded project - whose main objective is the removal of barriers (policy, regulatory, market, finance and technical) to the wide-scale use of renewable energy resources for grid-connected power generation in Fiji.

This capacity needs assessment consisted of the following three components:

- **Component I:** Designing and conducting a detailed survey among local energy sector stakeholders and analysing the results to identify current capacity needs;

- **Component II:** Assessing and summarizing already existing information (literature, project reports, etc.) about potential existing capacity constraints and capacity needs in the area of RE power generation in Fiji;

- **Component III:** Preparing and conducting personal interviews with local stakeholders to further identify the specific and individual capacity needs.

Both, the survey results and the information received through the personal interviews will be used to prepare and conduct a capacity building workshop about RE power generation with local stakeholders in Fiji.

The overall objective of the capacity needs assessment is to assess existing capacities among stakeholders and to identify future capacity building needs. This assessment and the planned workshop will help direct future capacity building support efforts in those areas and institutions that are most important for improving and enabling the design, construction, operation and maintenance of RE resources for grid-connected power generation in Fiji.

2. **Component I: Capacity Needs Survey**

2.1 **Background and objectives of the survey**

The capacity needs survey focused on gaining information from local stakeholders involved in RE power generation systems in Fiji. The survey forms the central element of the capacity needs assessment and builds the basis for the subsequent capacity needs assessment steps (i.e. personal interviews, capacity building workshop). The results of the survey will be used to identify current capacity building needs, define future capacity building components for local stakeholders, and identify areas of concern that are most relevant for local stakeholders in regards to RE power generation.

2.2 **Survey method & approach**

The target audience for the survey was selected in close coordination with the Department of Energy (DOE) of Fiji. The list of stakeholders included those known to be involved in RE power generation in Fiji and, therefore, should participate in the survey. This list included 58 persons and organizations with contact details, email address, name of organization, and the respondents’ duties within their respective organization.

Multiple stakeholder groups within the RE sector in Fiji were selected and represented in the survey. Respondents on the survey stakeholder list were also characterized by the type
of organization they represent. The following table illustrates the different stakeholder groups participating in the survey.

<table>
<thead>
<tr>
<th>Type of organization</th>
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<tbody>
<tr>
<td>Power Producers and Associations</td>
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<tr>
<td>Technology suppliers and installers</td>
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<tr>
<td>Educational organizations</td>
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<tr>
<td>Governmental organizations and regulatory bodies</td>
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<tr>
<td>Project developers</td>
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<tr>
<td>Development and observer organizations</td>
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<tr>
<td>Consulting and engineering organizations</td>
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*Table 1: Stakeholder groups selected for the survey*

A comprehensive survey was developed and the survey was conducted between the 18th of February and the 30th of March 2016. The survey was conducted in form of an online survey by making use of a service provider for online surveys.

An introductory email was sent to each of the selected stakeholders. The letter provided a brief introduction of the FREPP project, the purpose and objectives of the survey, and a link to the survey. Reminders were sent to stakeholders who initially failed to respond.

The survey was structured into the following parts:

- Part I: Contact and company/institutional information
- Part II: General Questions
- Part III: Specific Components Questions
  - III.a: Education & Training
  - III.b: Project development
  - III.c: Implementation of RE Power Generation
- Written Comments

Part I dealt with general information about the person participating and the organization they represent. Part II asked for general experience, focus, satisfaction and general barriers for RE power generation in Fiji. Part III was divided in 3 different sub-sections. This part focused on specific aspects related to education and training, project development and implementation. Part III enabled the different stakeholder groups to provide more specific information depending on their focus area. At the end of the questionnaire, there was the opportunity to provide any further individual comments related to capacity needs.

The questionnaire included 49 questions of which the majority were multiple choice questions, which allowed for a comparably fast participation and an effective evaluation of results. Several questions though allowed for additional individual comments. The complete questionnaire is attached to this report in Annex 2 – Questionnaire.

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1 Just after starting the survey, the cyclone Winston hit Fiji. It was clear that many people in Fiji will be somehow impacted by this cyclone. After consultation with UNDP and the DOE, it was decided that the survey will be open longer than originally expected, to allow for a considerable number of responses.
The responses of each participant as well as a summary of all responses for each question were collected. The raw data of all responses was provided via the same online platform used for conducting the survey. Based on the raw data, a comprehensive quantitative and qualitative analysis of the survey results/responses was conducted along with figures and tables to better visualize the results.

In the following section, the main results of the survey are described and presented and summarized. A more detailed description of the results per category (i.e. per question or group of related questions) with figures and tables is provided in Annex 1 – Detailed survey results.

### 2.3 Key capacity needs identified from the survey

This section summarizes the key results of the survey. The results are presented according to different categories and focus areas of the survey. Each category or focus area has a separate sub-heading.

In total, 29 out of all 58 persons participated in the survey, which is a response rate of 50%. This response rate appears quite good and is remarkable when considering that the start of the survey and the devastating Fiji cyclone have overlapped in time. From the high level of participation, it can be assumed that the topic of renewable energy power generation is considered very important among those stakeholders and organizations in Fiji.

**General experience with RE power generation**

Per the survey results, the local organizations participating in the survey have already considerable experience with RE power generation projects. However, it seems that solar PV is the predominant technology in Fiji regarding existing experience and available know-how. More than 50% of the respondents stated that they have no experience with RE power generation in RE technologies such as small, mini and micro hydro, wind, biomass, biofuels. Only for solar PV the majority stated that general experience exists.

![Figure 1: Experience and current focus on RE Power generation](image_url)
Enabling Environment

More than 50% of participants stated that they are not satisfied with the enabling environment for RE power generation in Fiji. Major concerns noted included: “Difficulties in obtaining bankable Power Purchase Agreements (PPAs)” (69% of respondents), “Limited regulatory framework for Independent Power Producers (IPPs)” (66% of respondents), the “Lack of access to capital for investment” (59% of respondents) and the “Lack of qualified professionals” (59% of respondents) are among the key barriers mentioned.

Most participants further stated that the current system for securing power generation licenses including approvals and pre-approvals is not sufficient for any size of RE power generation projects across all technologies.

The clear majority further indicated that the process for securing development stage (before financial closure) Power Purchase Agreements (PPAs) for grid connected RE power generation is generally not sufficient for developing RE power generation projects in Fiji.

These findings clearly indicate that most respondents consider significant improvements of the enabling environment for RE power generation in Fiji as very important.

Current educational focus

Approximately 50% of both University and vocational/technically educated groups indicated that the current focus of education tends to be rather generic. From the individual technologies, most respondents of both education types (University 45%; Vocational/Technical 41%) stated solar PV is currently the focus technology.

For soft skills including project management and business/financial training, only 40% of all respondents consider the current educational focus to be adequate. The skills with the lowest levels of adequacy are “project management” and “business models/economic analysis” with only five favourable responses (17%) each.

Almost 40% of the participants stated that newly educated staff do not have the basic skills to perform their jobs in RE power generation in Fiji.

The clear majority of participants (83%) stated that higher education could improve in providing more “practical application of technologies and skills”. Still two-third of all respondents see an “advanced curriculum”, including engineering, economics and management, as an opportunity for significant improvement.

Public information/forum for RE power generation

Many local organizations have the feeling that the public information about RE sources is not sufficient. Almost half of all participants stated that publicly available information about RE sources in Fiji is inadequate for all RE types (RE technologies). Only solar PV (34%) and small hydro (31%) received modest acclamations that publicly available information is sufficient.

More than half of all respondents stated that there is no adequate forum for implementation of RE power generation projects, nor for operations and maintenance. This is clearly a significant bottleneck for local firms involved in the RE power generation sector.

Specific skills & know-how of local organizations

About one third of the respondents consider that the acquired experience and “know-how” of local organizations to develop bankable business models for RE power generation and
for mitigating environmental and social risks in Fiji is currently not sufficient. This is especially true in the case of Fiji for project management, business model development, and economic analysis. It was demonstrated that the lack of “skilled installers & technicians” and “skilled supervisory engineers” are currently key technical barriers for local organizations becoming more involved and skilled in RE power generation.

More than half of all respondents stated that there is sufficient opportunity from local organizations to gain project management services for solar PV. Conversely, for all other RE technologies only a minority of 20-30% see currently sufficient opportunities in Fiji.

Potential improvements inside own organizations

More than half of all respondents see highest improvement potential in improving three areas: “the level of education and training” (59%), “improving the dissemination of information and improving marketing capabilities” (55%), and in “changing or expanding the RE technology focus” (52%).

Many organizations stated that they have own staff responsible for operation and maintenance. However, only about half of these organizations provide detailed step-by-step procedures for operations & maintenance and monitoring procedures for RE power generation to the staff. Training on procedures for major maintenance activities seems to be a general lack.

The firms currently engaged in operation and maintenance of RE power generation systems do hold spare-parts for regular preventative and minor maintenance requirements. For larger maintenance requirements, about half of the organizations stated that they do hold at least some spare parts on hand.

Existing contributions of organizations to education

More than half of all organizations indicated that their organization contributes in some way to education. More than 50% of the organizations have internship programmes and further replied that they are contributing to any form of “cooperative education”. It is not fully clear whether those contributions are specifically for RE power generation or rather general or for other focus areas (e.g. general engineering). This would need to be further assessed during the personal interviews.
Financial aspects

More than 50% of the respondents mentioned that domestic financial institutions in Fiji lack adequate understanding to evaluate business plans for RE power generation.

Subsidies for RE and for RE power prices do not seem to be sufficient nor available at all in Fiji. It appears from the results of the survey that lack of sufficient financial support for RE power generation is a major barrier for the private sector. None (zero) of the financial instruments identified and listed in the survey were seen as sufficiently available by more than 50% of respondents.

![Figure 3: Availability of financial support instruments](image)

2.4 Initial recommendations based on survey results

The training, education, know-how, and business and financial capabilities of local organizations in most relevant RE technologies in Fiji need to be considerably strengthened. To leverage the true potential of RE technologies, including solar PV, and increase the diversification of RE power technologies in Fiji, stronger and focused attention needs to be paid to capacity building in these areas.

It became obvious that the regulatory framework for RE power generation needs significant improvements. This would necessarily include

- to remove current barriers for IPPs;
- increase the level of education and training for key personal involved in RE power generation (including practical and hands-on training e.g. for installers/technicians and supervisory engineers);
- ensure comprehensive information and data required for developing RE power generation projects for all types of RE. This information/data should be made publicly available;
• provide capacity building and awareness raising for central organizations (incl. ministries, banks, project developers) relevant for regulating, designing, financing, implementing and operating RE Power generation projects;

• support local organizations already engaged in RE power generation projects in improving their internal procedures for step-by-step guidance for operation & maintenance procedures and monitoring procedures.
3. Component II: Existing information and literature review

For ensuring that already existing information and results of other projects are being recognized and considered for results of this capacity needs assessment, a review of available literature about capacity needs in the RE power generation sector was conducted. The literature that was reviewed is listed in the table below and key findings summarized in the following paragraphs.

<table>
<thead>
<tr>
<th>Literature/Project outputs</th>
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<tr>
<td><strong>Current training Report (June 2015)</strong> – SPC-USP EU Pacific Technical Vocational Educational and training for Sustainable Energy and Climate Change Adaptation Project (EU-PacTVET) – SUSTAINABLE ENERGY TRAINING NEEDS/GAPS ANALYSIS ON SUSTAINABLE ENERGY IN PACIFIC ACP COUNTRIES</td>
</tr>
<tr>
<td><strong>Synthesis Report (Sept. 2015)</strong> – SPC-USP EU Pacific Technical Vocational Educational and training for Sustainable Energy and Climate Change Adaptation Project (EU-PacTVET) – SUSTAINABLE ENERGY TRAINING NEEDS/GAPS ANALYSIS ON SUSTAINABLE ENERGY IN PACIFIC ACP COUNTRIES</td>
</tr>
<tr>
<td><strong>Current and Future Markets and Training Needs Report (Sept. 2015)</strong> – SPC-USP EU Pacific Technical Vocational Educational and training for Sustainable Energy and Climate Change Adaptation Project (EU-PacTVET) – SUSTAINABLE ENERGY TRAINING NEEDS/GAPS ANALYSIS ON SUSTAINABLE ENERGY IN PACIFIC ACP COUNTRIES</td>
</tr>
<tr>
<td><strong>Fiji training needs Analysis Report</strong> – EU – Pacific Technical and Vocational Education and training Project</td>
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<tr>
<td><strong>Fiji Renewable Readiness Assessment (June 2015)</strong> – International Renewable Energy Agency (IRENA)</td>
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*Table 2: Literature reviewed*

The EU-PacTVET "Current training Report" (Global Sustainable Energy Solutions (GSES), 2015)

This report identified the current training institutes in Fiji and assessed the types of training on sustainable energy that has been conducted in the past 5 years, of which 14 courses were identified that were conducted in Fiji between 2010 and 2015.

The EU-PacTVET "Synthesis Report" (EU-PacTVET, 2015)

This report found that the focus of training courses conducted in Fiji over the past 5 years was predominantly on solar energy. The two main technical training locations that exist in Fiji are at the University of the South Pacific (USP) and the Fiji National University (FNU). The report strongly recommends that industry should work more closely together with the training centres at USP and FNU (e.g. perhaps as guest lecturers or trainers).

It was further noted that the Pacific Power Association (PPA) and the Sustainable Energy Industry Association of Pacific Islands (SEIAPI) have been developing four technical guidelines relating to the design and installation of grid connected solar PV systems and stand-alone (off-grid) solar PV systems. These efforts could help contribute towards filling current knowledge and capacity gaps.

Under the EU-PacTVET project, a sustainable energy questionnaire was conducted and the results are summarized in the “Synthesis Report” (EU-PacTVET, 2015). The target group of
the survey were energy officers, major utilities, and the RE investors, and hence somewhat
different to the stakeholder group of this capacity needs assessment. According to the
results of the survey under EU-PacTVET, less than 30% of the power utilities and energy
officers were of the opinion that there are good or moderate skills on RE resources
possessed by people within these same utilities and the energy industry. 45% of the same
group stated that the utilities and energy industry have very limited or unskilled people
working in the energy sector.

Similar to the results of this FREPP survey (compare results described in chapter 2), the
majority of people from the energy utilities and energy officers see a general and
concerning lack of project management skills in the region for RE power generation.

The following major constraints for the future growth of grid connected solar PV were
mentioned in the EU-PacTVET “Synthesis Report” survey as:

1. Lack of skilled labour;
2. Lack of manpower/mechanisms to sustain the schemes;
3. Lack of investment and high initial capital costs; and
4. No or limited market for RE in the country.

The same constraints were mentioned for other RE technologies including micro-hydro and
wind energy.

 Specifically regarding hydro energy, there seems to be very limited national expertise in
collecting, compiling and analysing hydrological data. Expertise in operation and
maintenance of micro-hydropower was identified as another major gap area in terms of
existing capacity.

The “Current and Future Markets and Training Needs Report” (Global Sustainable Energy
Solutions (GSES), 2015)

In this report the need for additional training courses in the installation, design and
maintenance areas for both off-grid and mini-grid solar PV systems was recognized. In
implementing these courses, it was further recommended to have certification-backed
approaches for such training. Ultimately such certified training could be required by the
local industry. Training needs for the installation, design, operation and maintenance for
other renewable energy sources (wind, micro hydro, biomass/biogas and geothermal) were
also identified as areas where additional improvement is needed.

“Fiji training needs Analysis Report” (Sakiti, 2015)

This report states that when compared to other RE technologies, only solar PV has been
widely introduced in the Fiji market. According to this report, wind energy lacks investor
confidence due to the less successful efforts of the one fully established wind park in Fiji
and points out the need for outside experts to conduct local training and installations, in
that case. In addition, the report indicated that skills in project management also present
a major gap for RE in Fiji. The report even highlighted that the lack of project management
skills in managing proposed projects has become a significant issue of concern with both
donors and recipients in Fiji.

IRENA “Fiji Renewable Readiness Assessment” (Chen, Gönül, & Zieroth, 2015)

The IRENA report broadly recommends that the enabling environment must be improved
to attract private sector investment in the renewable energy sector in Fiji. It is further
described that a more favourable enabling environment could remove much of the uncertainty and risks for prospective investors and their lenders. Establishing economically justified feed-in tariffs or similar mechanisms to provide incentives and reduce risks for electricity production from small-scale renewable sources for grid connected power generation was another central recommendation in the report.

The report further indicated that efforts to strengthen the transparency and effectiveness of the regulation of the electricity industry, including establishing a formal regulatory agency apart from the Fiji Electricity Authority (FEA) would help make all forms of electricity subsidies more transparent. Finally, the report recommended to establish a data repository on renewable energy resources that is accessible to the public and prospective investors helping to remove the information barrier to the private sector and other relevant project developers.


The report provides a summary of the Renewable Energy Investment Forum for Fiji 2015, that was held in April 2015 in Fiji. The Forum was organized by FDOE with support from UNDP and GEF in the context of the funded FREPP project. As per the report, one key objective of the Forum was to update knowledge and provide a platform for investors, project developers and governments and identify business opportunities in the renewable energy sector. The central focus was on investors and assessing investment potential.

Some interesting observation were made during the Forum, that may have some implications for the capacity needs assessment for renewable power generation in Fiji, and hence should be considered. The following aspects/findings of the Forum that are summarized in the report are considered most relevant in the context of the capacity needs assessment for RE-based power generation in Fiji.

The National Energy Policy (NEP) 2014-2020 includes the target to make all data on renewable energy resources available to the public and prospective investors.

It was pointed out during the Forum, that economically justified feed in tariffs or pricing frameworks (price differential system) as well as standardized PPA arrangements should be established and followed to help removing some of the key barriers for investors.

The report stated that an independent regulator would be a key requirement for attracting IPPs. It was further mentioned, that restructuring plans already exist for FEA. Key objectives of this restructuring are to deregulate the energy sector and reduce government obligations, and to have an efficient and vibrant energy sector that creates a platform for private sector participation. This should help to more consistent regulatory decision-making across the economy.
4. Component III: Personal Interviews with Key Stakeholders

4.1 Background and objectives of the interviews

After the analysis of the results of the capacity needs survey (Component I), personal interviews were held with a directed sample of different national level stakeholders. Conducting personal interviews allowed the consultants to interact with national stakeholders, allowing for direct follow up on both the results of the survey and the individual answers previously provided during the survey. This helped gain further insights and additional specific information for assessing the specific capacity needs for RE power generation in Fiji.

A main objective of the interviews was to further detail the specific capacity needs of the different stakeholder groups (i.e. project developers & engineering firms, education & training institutions, development organizations) as a means to clearly understand the most relevant capacity needs and current gaps that are seen by principal stakeholders already engaged in RE power generation in Fiji.

4.2 Method and Approach

Based on the results and analysis of the online survey, a questionnaire with a list of most relevant questions was developed for the personal interviews. The questionnaire consisted of two parts, with the first part dealing with aspects considered most relevant according to the overall survey results. With the second part focusing on questions seeking clarification to the stakeholder’s specific responses given during the survey.

All survey questions and answers can be generally summarized into four categories:

- Awareness, education, and exchange of RE power information;
- The enabling environment (including IPPs, PPAs, PPPs, Finance, and Land Use);
- Skills and capacities for operation & maintenance; and
- Practical experience and case studies.

From the 29 persons responding to the initial survey, 9 key stakeholders were further identified and interviewed in face-to-face meetings. The list of interviewees was agreed between DOE, UNDP and the consultants, taking into consideration that all major stakeholder groups (government, private businesses, academia, and development agencies) were represented. This group is thought to represent some of the best minds and most relevant experience on the status of RE in Fiji and RE’s capacity development needs.

Prior to the personal interviews each person received a short summary of key results from the survey and the questionnaire to be used during the personal interviews.

4.3 Key input from stakeholder interviews

The views presented and responses described below in this sub-section do not represent the unanimous opinion of all nine stakeholders interviewed. For the view to be mentioned in this section, the view must have been mentioned by at least two key stakeholders and subjectively supported by a majority group consensus. There were no diametrically opposing viewpoints expressed by the respondents, in the views presented below. In order to keep the results impartial and protect personal privacy, the results and answers are not personally identified.
It is important to start with noting that there is a common understanding among the interviewed stakeholders that effective capacity building activities in RE power generation should be continuous, built upon previous efforts, and be targeted toward the specific groups to be sustainable and meaningful for Fiji. This should include a clear overall strategy with step-by-step capacity building activities that build on each other and lead across the needs of the sector. It was noted by interviewed stakeholders that capacity building in the past has been intermittent, and often disconnected, occurring mainly through different projects funded by different donors. It was mentioned that the coordination of such activities did not take place and therefore did not build on each other.

**Practical experience with RE power generation in Fiji**

Interviewed stakeholders indicate that practical project implementation of RE power generation seems to work well in Fiji, in case of small off-grid solutions, where the private sector engages directly with the private sector in the form of Energy Service Companies (ESCOs), supplying captive solar PV / hybrid power generation at hotels and with telecommunication stations. Also at state owned companies who can sell excess electricity to the grid via their internal biomass co-generation at industrial facilities, it seems to work relatively fine.

Beyond the above, most stakeholders described a generalized lack of practical (hands on) experience with RE power generation in Fiji. This is especially true for dedicated grid-connected RE power generation projects (outside of state own companies) where little practical examples or experience is available in the country. The stakeholders uniformly called for greater implementation of grid based RE power generation in Fiji and the subsequent opportunity to learn from such domestic efforts.

The private commercial companies Sunergise and Clay Energy were mentioned as positive examples for private sector actors who have been able to capitalize on opportunities for RE power generation in Fiji, in solar PV power generation. It was especially remarkable that these companies have successfully developed their business under a domestic framework. This has shown that the private-to-private ESCO (Energy Service Company) business models used by these two companies inherently work well for RE power generation not connected to the grid. Private-to-private ESCO projects also avoid the time consuming and tedious administrative processes currently required for IPP’s. The barriers related to the “Enabling Environment for IPPs” are discussed later in this section.

Based on the results of the survey and the findings of the literature review, the interviewed stakeholders strongly indicated that adequate project management skills seem to be a clear constraint for realizing RE power generation projects in Fiji at larger scale. One deficit indicated is that graduates from universities and technicians do not have the basic skills for project management of RE power generation projects. While another contributing factor is that there are currently very few real projects where project management skills can be obtained from real-life examples in Fiji.

A further identified challenge to achieving quality project management, operations and maintenance, and technical training is that most operating RE projects are mainly off-grid RE power generation solutions located at remote project sites, and on multiple islands in Fiji. While the limited know-how and skills of local people in the communities, operating the technology, adds further to these challenges.

As highlighted in the broader initial survey, more than 50% of respondents stated that outside of solar PV, they have very little experience with RE power generation in RE technologies such as small, mini and micro hydro, wind, biomass, and biofuels. However, 72% of the 29 respondents did indicate they have some level of experience (not further defined) with solar PV power generation. Where interviewed stakeholders highlighted the increase in awareness of the advantages of power availability from solar PV power
generation technologies during the aftermath of the recent natural disaster caused by
cyclone Winston, and the related electricity short-fails.

**The Enabling Environment for Independent Power Producers**

Several organizational and structural challenges were identified during the personal
interviews with key national stakeholders. These issues include the enabling environments
for IPPs, PPAs, access to finance for RE power projects, land use rights, and potential
opportunities for RE projects to use the public-private partnership structure in Fiji. These
issues and the identified gaps and needs that could be met through capacity building efforts
will be briefly discussed in this section.

There are no fully private IPPs in Fiji that currently supply power to the grid. The personal
interviews helped to further specify the main reasons for this.

FEA is the central state-owned agency chartered to own and operate all grid-connected
power plants and the national grid(s) in Fiji. FEA also controls the regulation of the
electricity power market and approves all new grid-connected power plants. The in-depth
interviews noted that the long, arduous, and not so transparent FEA approval and power
purchase process for new grid-connected RE power projects strongly discourages IPPs.

Interviewed stakeholders indicated that the approval process for licenses and permits
required from FEA, especially, lacks transparency which creates many of the uncertainties
and risks faced by new IPPs. It was noted that for IPPs a number of requirements and
guarantees must be currently fulfilled in the process of agreeing on Power Purchase
Agreements (PPAs) with FEA, which are not fully conducive to RE power generation. One
such requirement indicated by the stakeholders is that IPPs should ensure a 24/7 supply of
electricity at a set capacity. This requirement creates an operational barrier for solar PV
and stand-alone biomass generation power projects, as meeting this requirement means
that adequate back-up capacity is needed and this effectively prevents grid-connected solar
PV projects from being established. As a result, it seems that the private sector has a high
level of frustration with establishing grid-connected RE power generation projects in Fiji.
One reasons for the greater success of off-grid or ESCO (private-to-private) RE power
generation models in Fiji is that they do not face the same challenges.

Another barrier indicated by stakeholder for IPPs is the way the price of PPAs are
determined. FEA currently uses the tariffs published by the Fiji Commerce Commission
(FCC) as the basis in negotiating PPAs. The FCC tariffs, however, are only considered to be
the minimum price for electricity from RE power generation. Using this value as a strict
reference for all projects, can mean that most RE based IPP projects will be unattractive to
investors. Interviewed stakeholders indicated that prices and conditions should reflect the
financial conditions of each individual RE based power generation project (e.g. actual
investment and operation cost, financing conditions, etc.). On this point, it was further
stated that the process for tariff setting and the calculation basis are not transparent for
the public nor for the private sector.

Related to electricity tariffs, it was stated by interviewed stakeholders, that the overall tariff
policy and payment conditions for all consumers (incl. residential users) needs to be revised
and improved. Where electricity tariffs should reflect the real costs of power generation and
distribution and insure that consumers are regularly paying for electricity used (e.g.
willingness to pay). This will help in reducing financial risk to IPPs.

As already discussed and highlighted during the UNDP FREPP Renewable Energy Investment
Forum for Fiji 2015 (see [ITP, 2015]), the majority of interviewed stakeholders indicated
that a separation of roles and responsibilities for the regulation and operation of the power
sector needs to be undertaken in Fiji to provide a more fair and transparent enabling
environment for IPPs and RE power generation in general. Currently FEA holds both
functions simultaneously.
Access to financing for grid-connected RE power generation projects is a major barrier in Fiji. Local banks have no or only little experience and resulting knowledge for the financing of RE power generation projects. Interviewed stakeholders indicate that national level banks consider RE power generation by the private sector as high risk investments, and thus require onerous pre-conditions and guarantees that are often difficult or impossible to fulfil by the private sector. It was further stated that the government is currently encouraging banks in Fiji to utilize 3% of their lending on RE power generation. However, it was argued, that this portion is almost entirely used for projects under the control of FEA, and this does not encourage lending to private companies. The limited awareness about necessary support mechanisms and tailored financial instruments for RE power generation among financial institutions is deemed limited by interviewed stakeholders.

Ensuring an enabling structure for land rights for potential IPPs was raised by interviewed stakeholders as one barrier to RE power generation. In the interviews, the situation was described as follows. The “i-Taukei Land Trust Board” (Native Land Trust Board) functions as the facilitator for land-use agreements, where the communities lease their land to the Native Land Trust Board and the Board then negotiates the land-use agreement with the private sector (e.g. IPP, investor). It is not clearly apparent to private sector parties how the rights of the land owner are thereby represented and protected, as well as for the investors.

Several stakeholders noted that the use of a Public Private Partnership (PPP) model, which has been successful in many developing countries for infrastructure and power generation projects, might be an attractive vehicle that fits the circumstances in Fiji. This PPP process should be further improved and shared with the stakeholders.

The stakeholders see a clear lack of information available to the private sector as a major barrier for further developing RE power generation projects in Fiji. This is considered one of the entry barriers for IPPs in Fiji. The stakeholders noted that consolidated information about existing projects, case studies, transparent information on necessary procedures and requirements (e.g. forms), contact details, technical and economic information are not readily accessible today. It is considered very difficult to find the information that is required to start the process of planning and developing grid-connected RE power generation projects in Fiji. This observation matches with the findings during the UNDP FREPP Renewable Energy Investment Forum for Fiji 2015 (ITP, 2015) and with the results of the survey (see chapter 2.3).

Authors Note: The authors of this report wish to note that one of the known challenges of grid-connected RE power generation is grid stabilisation (e.g. ensuring that instantaneous supply of electricity meets the demand), insofar that RE technologies can have wide instantaneous changes, especially solar PV power generation. Grid stabilisation requires either fix generation capacity supplying to the grid, or certain newer technologies that allow for instantaneous grid level communications between the various power generation assets connected to the grid and its demand side. Since FEA is responsible for the grid and supply to consumers, grid stability will be a primary concern to FEA when there is grid connected RE power generation. On top of this, FEA holds the financial responsibility of collecting the fees for the distribution and electricity sales to consumers at the regulated consumer price, which is only periodically set by FCC. Therefore, FEA acts as a financial pass through between consumers and IPPs, and FEA holds the risk in this pass through. The two issues addressed above are primary difficulties faced by FEA under the current structural setup in Fiji, and may not be fully understood or appreciated by other stakeholder groups.

Skills and capacities for operation & maintenance of RE power generation

Interviewed stakeholders indicate that local skills for conducting operations and maintenance (O&M) are not fully sufficient, and represent a major barrier for RE power
generation. The limited number and exposure to real-life RE power generation projects in Fiji severely limits the amount of experience which can be gained by local technicians and engineers in continuous O&M procedures for RE power generation.

About half of all stakeholders have stated in the online survey to have adequate documentation for step-by-step O&M procedures is in place. However, follow-up questions during the personal interviews revealed that the level of detail of documentation and procedures are extremely varied among stakeholders in terms of comprehensiveness. Project developers and RE power producers stated that general in-house training for O&M is provided to their internal staff, and that an O&M manual is followed by the staff. The in-house training is usually conducted by senior engineers/electricians and based on the RE project type under their own operation.

Interviewed stakeholders indicate that O&M procedures for RE power generation seem to be an integral part of the existing educational programmes provided for RE technologies in Fiji. However, practical training and real case examples are very limited in the educational programmes. Due to the limited exposure of students to real case examples for grid-connected RE power generation projects, the O&M procedures taught in educational programmes seem to be rather theoretically based.

For both, the private sector and the educational sector there is a clear desire to receive further specific support and expertise for O&M procedures, and a strong desire/need to have further exchanges between external experts (e.g. experienced engineers) on latest know-how and O&M experience.

For private sector stakeholders in Fiji a major barrier is that licensed electricians and technicians are rare. It was for example stated that accredited certification for boiler operators (for biomass co-generation) should be required and that safety standards for personal working on those projects needs to be improved.

Several stakeholders further indicated that improvements in the visibility and control (such as DCS systems) of RE power generation performance would help to operate and maintain those projects more efficiently. Due to the high dispersity of projects and the limited expertise of local staff operating the projects, it is often difficult to control the operation of projects and to act quickly in case of irregularities.

Education for RE power generation

In terms of education and academic capacity building needs, the two Fiji universities stated that they are already trying to provide the education that is required by the RE market. The demand for higher education in the RE power generation is still very limited in Fiji with only a few smaller to medium businesses engaged in the project development and engineering. The demand for jobs and higher education in RE power generation will undoubtedly change over time and the university respondents did demonstrate a willingness to further assess future RE power sector needs.

It was confirmed during stakeholder interviews that the knowledge that is currently being taught regarding RE power generation technologies is at rather broad level across all RE technologies. This is purposely done so that engineers obtain the fundamental basis for all RE technologies and can specialize in certain technologies or fields later in the job. There is a clear wish by the stakeholders (both educational and private sector) to establish a graduate engineer programme (master course) that focuses specifically on RE. In general, stakeholders would like to see a stronger focus of RE power generation technologies in educational programmes in Fiji. It was further noted that there is today no separate course(s) in current engineering and technical programs for project management as well as project development and related business fundamentals.

Both universities and the private sector stakeholders interviewed, indicated that they already engage in some type of vocational training / education via internships and the like.
Where the education institutions interviewed already have some type of formal internship programs, private sector stakeholders, however, noted that most internships are not providing any benefits to the host organizations, and require capacities and staff for coordinating and taking care of the interns. The private stakeholders indicated that this can be very difficult for smaller organizations and companies with limited capacities. These same stakeholders would like to see further incentives provided to the organisations and companies taking on the interns. However, overall potential for improvement was identified, for both collaboration between education institutions amongst themselves, and between education institutions and the private sector. Where one suggestion was to establish formal agreements between companies and education institutions to improve working together on lectures, courses, and programs.

**Information Forum for RE power generation**

The results of the on-line survey clearly showed that local stakeholders are not satisfied with the available information about RE power generation publicly available. During the interviews, stakeholders were asked for their preferred way to disseminate information on RE and what information would be of highest value.

The majority of interviewed stakeholders were of the opinion, that a website should be used as the central forum for publishing and sharing information on RE and related power generation in Fiji. Since the DOE already provides a website with some information on RE, there seems to be common understanding among the stakeholders that DOE would be the most appropriate institution to develop, host and maintain a comprehensive website. However, it was clearly argued by interviewed stakeholders that the current DOE website would need a general overhaul, and should be strengthened with the most relevant and needed RE information, such as information needed by IPPs for development. It was suggested that a website be the central information platform for local and foreign organizations/companies interested in RE power generation in Fiji.

The stakeholders stated that they would like to see the following information at the website:

- Technical information about new RE technologies and developments in Fiji;
- Successful case studies in Fiji (and possibly the Pacific region);
- Information about all RE power projects already commissioned and all other RE power projects planned;
- Feedback mechanism from project operators (currently lacking);
- Detailed legislative procedures and requirements needed for IPPs (e.g. licensing/permitting, land lease, setting of power purchase prices, etc.);
- Contact details / persons at relevant government departments and agencies;
- Data that is required for RE simulation and modelling;
- Resource library of results/studies/reports from research;
- A sharing platform for stakeholders.
5. **Recommendations & Next Steps for Capacity Development**

The overall objective of this capacity needs assessment is to identify capacity needs of national and relevant stakeholders for the development, design, engineering, installation, operation and maintenance of RE-based power generation projects in Fiji. Based on the key results drawn from the components of this capacity needs assessment (online survey, literature review, personal interviews), the recommendations for future capacity development are described in Section 5.2. Here it is noted that this capacity needs assessment did not focus on institutional capacity needs (e.g. government strategy, regulation, and implementation), however some fundamental barriers are addressed in Section 5.1.

During the survey and the personal interviews, it became very clear that some fundamental sector-level barriers exist in Fiji that significantly impede efforts towards the successful development of RE power generation projects (especially private sector grid-connected generation) in Fiji. From the literature review (see chapter 3) it seems that at least some of those barriers already exist for some time in Fiji and awareness seem to exist about them. It is considered important to forward the thoughts and opinions of national stakeholders on these issues obtained during the capacity needs assessment and to provide some initial ideas on what might be required for overcoming these barriers. The following two sub-sections provide recommendations for removing current fundamental sector level barriers and for fulfilling the capacity needs of stakeholders.

5.1 **Initial recommendations for removing current fundamental barriers**

The results of the online survey and the personal interviews identified a few fundamental, broad sector-level barriers that currently exist in Fiji, which impede the establishment of a wider market for RE power generation in the country. Proposing specific far-reaching recommendations for these broader fundamental (structural) barriers may go beyond the mandate of this project, and will eventually require a more comprehensive analysis of the current situation and ongoing and planned efforts to remove such barriers (e.g. policy reforms, new regulations, new or amended institutional and organizational changes).

The successful removal of these broader fundamental barriers is considered highly important for developing sustainable RE power generation capacities and a RE power market in Fiji. This in turn will have direct implications for the enabling environment and for providing favourable conditions for the private sector to engage in the Fiji RE market. Efforts on these issues will impact and possibly determine the direction of approaches and activities for capacity building in the future. That is why these barriers are briefly described below and only initial recommendations to help address these concerns are provided.

*Development of a long-term strategy for RE power generation*

Based on the responses from knowledgeable national stakeholders, an overarching national and sectoral strategy for RE power generation is currently less than fully defined, or in some components even insufficient or missing at all in Fiji.

In the mid- to long-term it is important that the Government of Fiji develops a clear development strategy for the national energy system, including RE power generation, that is fully aligned with, and reflects Fiji national objectives towards, sustainable development, green growth, and climate change (mitigation and adaptation). It should be closely aligned to the Fiji National Determined Contribution (NDC) developed as part of Fiji’s contribution to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC). The currently communicated Intended NDC (INDC) includes the target to “achieve a renewable energy share in electricity to be around 99% by 2030 from the 61% in 2013” (UNFCCC - Fiji INDC, 2015). How to get there (99% by 2030), from here (61% in 2013) is not well defined nor easily identified.
This long-term strategy should include quantitative targets and timelines for different RE technologies including an action plan with clear milestones for the short, mid, and long terms. Such a strategy would set the foundation for decision making processes towards RE power generation in Fiji. Public organizations, the private sector, as well as donors and development organizations could then align themselves and formulate decisions on their own strategies to support reaching these RE power generation targets. The educational sector could prepare to provide the necessary courses for matching the demand for engineers and technicians according to such targets.

Several recent analyses on the current enabling environment and policy context for energy and RE have already been carried out, or are ongoing, and their recommendations for policy reforms were provided to the Government of Fiji (Chen, Gönül, & Zieroth, 2015) (EU-PacTVET, 2015) (Global Sustainable Energy Solutions (GSES), 2015) (Sakiti, 2015). It is hoped that the results of this capacity needs assessment can be integrated with these previous efforts and thus provide additional insights and understanding to this body of literature.

Based on the online survey and interviews conducted in this assessment, the following initial recommendations and next steps are considered important to ensure that an overarching strategy for RE technologies in the power sector is developed and implemented:

- Assess existing studies and information about the energy sector and RE’s potential contribution in Fiji. The strategy needs to be based on a solid information/factual basis of the baseline scenario and a comprehensive analysis of technical potential of different RE resources;
- Conduct feasibility studies and analyses leading to the development of a more comprehensive national energy strategy which includes clear end quantitative targets for RE power generation, and rural electrification. Noting that such a strategy should not only focus on development and installation of RE power generation but also the sectoral capacity building needs;
- Support to the Government of Fiji in setting realistic RE targets with underlying step-by-step process and procedures for necessary steps for achieving the targets. This is important for being able to monitor the progress/success of Fiji’s efforts and for being able to amend the strategy ex-post if required;
- Provide legal and technical support to the Government of Fiji for supporting the process to formulate the more comprehensive energy policy/strategy;
- Provide support to obtain approvals and agreements on the national energy policy. So far, the approval and enactment process seems to be a key bottleneck as current policies and strategies are existing in draft status only without being implemented or enforced.

**Separation of asset operation and regulation in the power sector**

Further regulatory and institutional changes seem to be required before local and international companies will significantly further engage in the grid-connected RE power generation market in Fiji. Four of the nine knowledgeable national stakeholders in the detailed survey listed regulatory changes within the RE power generation sub-sector as the most significant barrier to its future development.

Currently FEA owns and operates the vast majority of power plants in Fiji, owns and controls the electricity distribution system, is the regulatory body for licensing, and is also responsible for integrating new power plants into the grid. For ensuring a fair and transparent approval process for PPAs and a transparent tariff setting procedure, it is highly recommended that the responsibilities for regulatory aspects (licensing, PPA approval and
tariff setting) are separated from the ownership and operation of power plants. The current institutional set-up and responsibilities (within FEA) are considered the major bottleneck for developing new grid-connected RE power generation projects.

Here it is noted that the process of separating these roles for FEA and divestment of generation assets has started in Fiji, though is only at the initial stage. There is also a planned program by the Asian Development Bank (ADB) to support the Government of Fiji in the process, which is supposed to start in 2017.

5.2 Recommendations for capacity needs of national stakeholders

The recommendations described in this section focus on the improvement of knowledge and capacities of national stakeholders engaged in the RE power generation sector. For each of the following categories recommendations are described including necessary pre-conditions and potential next steps:

- Enabling Environment – Finance and PPPs;
- Skills and capacities for operation & maintenance;
- Education and Public Information Forum.

Before providing specific recommendations per category, some general considerations should be described that have direct implications for all capacity building activities and require special attention.

Most capacity building activities that have been conducted in Fiji in the past were integrated elements of several specific government and donor funded projects. These activities were welcomed and well prepared, but in some cases were rather project specific and sometimes limited in scope and depth. They did not seem to follow an integrated overarching national strategy, and it as per the stakeholders the sustainability of these capacity building efforts and benefits remains at least questionable. It is highly recommended that future capacity building approaches in the RE power generation sector should be aligned and structured along a better defined long-term strategy. For ensuring an effective use of resources and a continuous and long-term sustainable improvement of knowledge and capacities among stakeholders, the capacity building activities should be aligned to the RE targets formulated by the Government (once revised) and be coordinated by a central organization like the DOE or Ministry of Economy’s Department of Planning.

It is further recommended that those capacity programmes ensure a continuity in terms of training provided and results achieved. National and relevant stakeholders participating in such training need to improve their know-how over time, therefore future capacity building projects and modules should build upon each other. Monitoring should ensure that progress is made and improvements are made and recognized. It is critical that the funding and resources devoted to capacity building be utilized in the most judicious and efficient manner and lead to recognizable improvements in national level capacities, and their sustainability over time.

A) Recommendations to improve the enabling environment for IPPs

Section 5.1 addressed recommendations for improving the enabling environment for RE power generation on the whole. This sub-section addresses some of the remaining capacity needs for national stakeholders related to establishing operational IPPs.
(A 1) Capacity building for financial institutions

Financing institutions (e.g. local banks) must be included in future capacity building programmes. Funding is one of the key barriers for realizing RE power projects in Fiji. Multiple responses indicate a general lack of RE power generation knowledge at local financial institutions. Capacity building efforts must address financial institutions and the need to increase awareness and knowledge about RE technologies and opportunities in this regard. An assessment should first determine whether it is more appropriate to have specific training for the financial institutions or to what extent they could be part of training provided to other stakeholder groups (especially in terms of technical & financial analysis and financial planning). Separately, it is recommended that the government and/or development organizations provide financial guarantees to banks to reduce the risks and lower their reluctance to provide finance to RE power generation projects (at least for the first series of full IPPs with RE power generation).

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<tr>
<th>Pre-conditions required</th>
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<tr>
<td>Certainty that the main barrier for IPPs, the difficult regulatory framework, will be removed</td>
<td>Assessment of appropriate capacity building approach for financial institutions</td>
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<tr>
<td>General willingness of banks to engage in such activities, outside of FEA. The government should play a key role in encouraging the banks to participate.</td>
<td>Assessment of status of capacities and knowledge within local financial institutions</td>
</tr>
<tr>
<td>Potentially: A long term strategy by the government with clear targets for RE including potential financial and tax incentives for RE energy generation, which reduce risk and make financing more attractive.</td>
<td>Developing a targeted capacity building program (this could be a combination of workshops in RE financing specifically for financial institutions, field visits, integration of representatives of financial institutions to general capacity building trainings).</td>
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(A 2) Revised mechanisms for tariff setting (technical and financial conditions)

A new tariff setting mechanism under a new regulated scheme or PPA negotiation process is needed to reflect the conditions of operation of RE power generation and its financing. This tariff setting mechanism would be a departure of setting minimum RE tariffs and bilateral negotiations between IPPs and FEA. It would setup a fixed semi-independent system for determining short and long term purchase prices for RE power generated from IPPs. This mechanism would directly take into account the physical operating conditions of each RE power generator (IPP) and their finance structure. It would setup a fixed semi-independent system for determining short and long term purchase prices for RE power generated from IPPs. This mechanism would specifically take into account the physical operating conditions of each RE power generator (IPP) and their finance structure. For example, such mechanism often has capacity charge and an operating charge, and allow for fix equity returns and changes in currency exchange. An example of such a tariff setting mechanism can be found in several countries (most notably Pakistan’s National Electric Power Regulatory Authority).

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<tr>
<td>Restructuring of FEA’s roles</td>
<td>Comprehensive review of technical and financial conditions needed for successful IPPs and PPPs for RE power generation in Fiji.</td>
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<tr>
<td>Setup of an independent power or utilities regulatory authority</td>
<td>Review of successful international best practices in tariff setting and delivery conditions in connection to regulated markets.</td>
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<tr>
<td>Clarity about mandate and responsibilities of new regulatory authority</td>
<td>Assisting the authority in setting up and implementing a process of individual technical &amp; financial evaluation of RE IPPs and PPPs and related tariff setting procedures.</td>
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(A 3) Develop and establish Public Private Partnership Model for RE

As long as the pre-conditions for the development of an independent market for RE power generation in Fiji exist, it is recommended to continue working on establishing Public Private Partnerships (PPP) for RE power generation projects. Especially in the event of separating the roles for FEA and divestment. This will help to build trust among national stakeholder groups (public, private, financial institutions) and to demonstrate that RE power projects can be built, owned, operated and maintained under economically feasible conditions.

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<tr>
<td>Know-how and awareness about PPP approaches and fundamental energy economics</td>
<td>Develop standard policies and procedures that allow for government participation in PPP</td>
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</table>
Lack of technical and managerial skills in RE power generation projects was frequently cited as a major barrier and an important capacity need among most of the 9 national stakeholders interviewed. Some specialized and specific skills are required by national stakeholders engaged in operating and maintaining RE power generation projects. The following table provides several key recommendations to address key capacity needs identified during the survey and the interviews.

### (B 1) Training for existing installers & technicians

Specific training to be provided for existing installers and technicians already involved in RE power projects in Fiji needs to focus on procedures for operation and maintenance of the projects as well as the procedures for properly monitoring of the project. The actual needs of the installers and technicians will need to be assessed and a tailor-made and targeted training programme developed. Whenever possible the training should include practical and real-life training components at existing plants and demonstration plants (locally and internationally). It is further recommended that experienced and well qualified international experts are part of the training programme to share latest know-how about technical aspects and operation and maintenance. As most installers and technicians lack certification in Fiji, a training programme with certification would be ideal. Certification provides great incentives to the students. It would need to be assessed for which RE technologies and which skills a certification could be provided.

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<tr>
<td>• Assessment of specific needs of local installers and technicians</td>
<td>• Identification and assessment of specific needs of local installers and technicians</td>
</tr>
<tr>
<td>• Coordination with the EU-PacTVET program to use synergies and avoid unnecessary duplication</td>
<td>• Development of a targeted training program for installers and technicians and identification of a mechanism to provide certification for such training.</td>
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### (B 2) Guidance/Standard for O&M monitoring procedures

Skills on operation and maintenance (O&M) seems one of the key capacities lacking among national stakeholders. This is mainly due to little experience with RE power generation projects and lack of training provided. Currently not all stakeholders involved in O&M for RE power generation projects have step-by-step procedures for O&M and monitoring. Those who have developed such procedures have done so internally mainly by themselves based on their internal know-how and their specific needs.

It is recommended to develop a standard set of procedures (i.e. a guidebook, manual) for O&M and monitoring of key RE power generation technologies relevant for Fiji. This is effectively a de-risking element of commercial operations. Such a standard should include step-by-step procedures for most relevant RE power generation technologies. Some steps may be relevant for all or a group of technologies/firms, other steps would need to be specifically described for certain technologies.

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<tr>
<td>• Assessment of key technologies/RE power generation projects</td>
<td>• Development of a guidebook/manual for O&amp;M and monitoring procedures for such key RE technologies</td>
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**Table 3: Recommendations for the Enabling Environment**

**Table 4: Recommendations for specific skills**
C) Recommendations: Education and Information Forum.

Both the initial survey and the subsequent detailed national stakeholder survey identified a broad lack of awareness of RE technologies and RE’s benefits across Fiji. Educational institutions and programmes do and will play an important role for the capacity development in RE power generation in the future. While previous RE projects have provided some capacity building information and existing academic programmes for RE technologies have ongoing collaborations between educational institutions and the private sector, a number of additional capacity needs were identified. Key recommendations for the educational sector and for information sharing are provided in the table below.

(C 1) Improve real-life equipment/practical training

Both at USP and FNU there seems to be a desire to increase exposure to real-life RE operation that can be used for practical, hands on training in the field of RE power generation. In the capacity needs assessment, exposure to real-life examples and demonstration projects was identified as a key gap among stakeholders. Cooperation between USP and FNU may lead to combined resources for realizing such equipment and would increase the exposure of students with demonstration projects altogether. Such equipment would lead to more exposure to real-life training for students and prepare the students better for the jobs (e.g. O&M procedures could be practically trained on real equipment/projects instead of primarily theoretical training). As funding for such equipment is a major barrier, it is recommended that an assessment of the most relevant technology/equipment for Fiji is conducted. The equipment that is being used should reflect the major market and potential for RE power generation in Fiji. Thereby providing practical, hands-on training for RE technologies that are most relevant.

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<tr>
<td>• Available funding for equipment</td>
<td>• Assessment of most relevant technologies for Fiji for real-life equipment/demonstration projects.</td>
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<tr>
<td>• Potential governmental and grant support</td>
<td>• Development of a coordinating office, and split between technology equipment training in “class” and with companies operating the technologies.</td>
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<tr>
<td>• Coordination with the EU-PacTVET program and other donor organisations to use synergies</td>
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</table>

(C 2) Improve assessment of market needs and skills

Educational institutions in Fiji attempt to assess skills that the market requires on a continuing basis and then consider these for their courses and training they provide. According to the stakeholder responses during the capacity needs assessment, there seems to be further room for improvements in this process as the analysis is not institutionalized yet. It is recommended to further institutionalize the approach for assessing current and potential future market demand in the field of RE power generation and share this information with relevant government, other academic institutions and development agencies. One element that should be further developed is a closer collaboration with the private sector stakeholders and exchange information in a more formal way on a regular basis.

<table>
<thead>
<tr>
<th>Pre-conditions required</th>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Facilitate an exchange of RE related training needs and information between relevant government, private sector, and academic institutions.</td>
<td>• Assessment of current procedures for analyzing the market needs for graduates from educational institutions.</td>
</tr>
<tr>
<td>• Coordination with the EU-PacTVET program to use synergies and avoid duplications.</td>
<td>• Develop a standard procedure for institutionalizing the market needs assessment.</td>
</tr>
</tbody>
</table>
**(C 3) Intensify cooperation between education and private sector**

There is an existing level of cooperation between educational institutions and the private sector, mostly in form of internships and occasional guest lecturers. This cooperation should be encouraged and accelerated. Both the academic and private sector groups have generally welcomed a closer collaboration and see clear advantages for each group. One idea is to develop and establish Memorandum of Understandings (MoUs) between the two parties to work more closely together and achieve common targets. This could include a higher number of internships for students. Such an internship programme would need to be carefully designed and planned so that both parties and the student benefits from it. The higher exposure with real-life experience can lead to more hands-on experience of the student and better skills when starting the professional career. At the same time, it needs to be ensured that the internship programme is not causing an unwelcomed burden on the private sector in terms of resources and personnel. It is recommended that interns create a certain output (even a small one) that is of some tangible benefit to the institution/company in charge of the intern.

Another option for a closer collaboration is related to the real-life equipment. An agreement could be made to own, build and/or operate a demonstration project for RE power generation. There are different approaches how it could be set up. The project may be developed and operated by the private company and an agreement is being made that groups of students would be allowed to visit and conduct training on the project. The training may be conducted in combination of the educational institution and the private company.

**Pre-conditions required**
- Willingness of both parties, educational institution and private sector, for increased collaboration on RE courses provided, internships, and demonstration equipment/projects.

**Next steps**
- Conducting a workshop with both stakeholder groups to discuss potential ways of further collaborations.
- Development of a coordinating office, and implement a sustainable program for securing cooperation.

---

**Pre-conditions required**
- Assessment of specific staff requirements and needs of national stakeholders, private industry, and financial institutions.
- Coordination with the EU-PacTVET program and other ongoing and planned projects/program to use synergies and avoid duplications.

**Next steps**
- Development of a targeted training program for project management and business development.
- The training program could be divided into two, for the continuing education of professionals, and for university education as a course(s).
(C 5) Central forum (website) for RE power generation

There is currently no publicly available central repository or forum for RE related information with consolidated and sufficient information available for stakeholders interested in RE power generation in Fiji. Information on RE project developments, RE resources, investment opportunities, IPPs, PPAs, and PPPs comes quickly to mind. A ‘one stop shop’ for such information, publicly available, would be a tremendous resource to these stakeholders. Based on the interviews, it seems that the DOE website providing government related information needs to be strengthened and updated. An analysis of the website structure and content would need to be performed, followed by an assessment of the structure, information and data required by the different stakeholder groups. User ease and friendliness, accessibility and transparency are desired qualities for the website. Procedures for required maintenance, operations and updates would need to be developed. The platform(s) need to be regularly maintained and updated.

Several suggestions from the surveys and interviews were given for the content of the website. The following list provides some initial recommendations for information and content that the website should provide:

- A database as central source for RE power generation projects;
- Required forms and templates for IPPs, project developers;
- Fees and tariffs (including tariff setting procedures);
- Contact information of national stakeholders;
- Step by step procedures for applicants for IPP, funding, etc. (e.g. Where to go? What to do? What licenses are required?);
- Legal requirement for RE (grid-connected);
- Relevant studies and reports;
- Non-economic information/data.

<table>
<thead>
<tr>
<th>Pre-conditions required</th>
<th>Next steps</th>
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<tbody>
<tr>
<td>Institutional mandate for DOE to host and support the forum/website</td>
<td>Conduct analysis of the current website structure and content</td>
</tr>
<tr>
<td></td>
<td>Assess the structure, information and data required for new/updated website</td>
</tr>
<tr>
<td></td>
<td>Develop procedures maintaining, operating and updating the website</td>
</tr>
<tr>
<td></td>
<td>Develop, structure, and update the information needed for the website</td>
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</tbody>
</table>

Table 5: Recommendations for education and knowledge sharing

5.3 Initial Prioritization of Recommendations

As resources are limited for addressing and implementing the different recommendations, a prioritization of recommended activities is advisable. This prioritization may be different for different stakeholders and depending on the individual priorities and resources available. As a first indication and approach, a qualitative assessment of the different recommendations has been conducted. This may help to rank the different recommendations according to resources and time required to achieve tangible outputs. It should be considered that the qualitative assessment at this stage is an indicative approach only. For a more solid prioritization process, further work would be required to detail out the specific needs of each recommendation and to assess the real costs, other resources (e.g. personal capacities) and time required for implementing and finalizing the recommended actions. For recommendation "(A1) Capacity Building for financial institutions", a detailed assessment of specific needs and current status of know-how (e.g. how many financial institutions, who are the persons to be trained, what is the level of know-how, what type of training is required, what is the most effective approach to conduct the training, how many training sessions are required over what period of time, etc.) would be required. Such an assess is not part of this study and would need to be done separately.
All ten recommendations presented under section 5.2 are considered important for ensuring a targeted and effective improvement of local capacities and skills in the RE power generation sector in Fiji. Each recommended action has its relevance and should be considered in any future capacity building activities planned in the RE power sector in Fiji. There may just be differences in terms of minimum costs and time required and on the overall impact for IPPs. Some of the activities require certain pre-conditions that would need to be met before starting to implement the specific actions and some recommendations may even build on each other. For each recommendation, the specific pre-requirement are also stated in the tables of section 5.2. Other recommendations may require more time to be implemented, whereas other activities could be addressed immediately without much preparation.

The criteria used have a scale of 1-5, with 1 best and 5 worst rating. As an example, if the level of dependencies/pre-requirements is 1, then no or only minimum dependencies/pre-requirements exist for starting and implementing the recommended actions. If it is 5, then there are major barriers that would need to be removed first before starting the action. The individual definitions of each criteria are described at the bottom of Table 6. These criteria would need to be considered when planning to support or implement the different recommended actions.

The following table summarizes the indicative qualitative assessment of recommended actions:

<table>
<thead>
<tr>
<th>Area of recommendation</th>
<th>Specific recommendation</th>
<th>Criteria for qualitative prioritization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level of Dependencies/Pre-requirements</td>
</tr>
<tr>
<td>A) Enabling Environment</td>
<td>(A 1) Capacity building for financial institutions</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>(A 2) Revised mechanisms for tariff setting (technical and financial conditions)</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>(A 3) Develop and establish Public Private Partnership Model for RE</td>
<td></td>
</tr>
<tr>
<td>B) Skills for installation and O&amp;M</td>
<td>(B 1) Training for existing installers &amp; technicians</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(B 2) Guidance/Standard for O&amp;M and monitoring procedures</td>
<td>2</td>
</tr>
<tr>
<td>C) Education and Forum</td>
<td>(C 1) Improve real-life equipment/practical training</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(C 2) Improve assessment of market needs and skills</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(C 3) Intensify cooperation between education and private sector</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(C 4) Training on project management and business development</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(C 5) Central forum (website) for RE power generation</td>
<td>1</td>
</tr>
</tbody>
</table>

Level of Dependencies (1=no; 2=minor; 3=medium; 4=great; 5=major);
Expected minimum costs (1=0-50kUSD; 2=51-100kUSD; 3=101-200kUSD; 4=201-300kUSD; 5=301-500USD)
Expected min. time to start (1=immediately; 2=within 1-2 months; 3=within 3-6 months; 4=within 7-12 months; 5= more than 1 year);
Expected min. time to finalize (1=within 3months; 2=within 4-6 months; 3=within 7-12 months; 4=within 13-18 months; 5=more than 1.5 years)
Impact for IPPs (1=removal of major barrier; 2=very significant; 3=high relevance; 4=relevant; 5=only relevant in combination with other actions)

Some of the recommendations that would remove major barriers for IPPs in Fiji (Impact for IPPs=1) may need some preparatory work (e.g. initial assessment on most suitable approach) or would require some pre-conditions to be met (e.g. that independent regulator for power tariffs is being announced and/or established) before starting the process for
implementing the recommended actions. In contrast, other recommendations, even though not as significant, could be started immediately without much costs and efforts. The impacts may not be as significant but still very important for the overall improvement of the enabling environment and to foster RE power generation in Fiji. Therefore it is difficult to come up with a clear ranking for the different recommendations.

However, from the results of the capacity needs assessment and the indicative qualitative assessment the following recommendations should lead to the removal of key barriers for IPPs:

- (A 2) Revised mechanisms for tariff setting (technical and financial conditions);
- (B 1) Training for existing installers & technicians;
- (C 1) Improve real-life equipment/practical training;
- (C 4) Training on project management and business development.

For addressing these recommendations, some pre-conditions would need to be fulfilled (see also section 5.2) and quite significant costs and time would be required to start and finalize the recommended actions.

The following recommendations could be implemented without major delays and could lead to improvements for the enabling environment for IPPs in Fiji in the short run:

- (A 1) Capacity building for financial institutions;
- (A 3) Develop and establish Public Private Partnership Model for RE;
- (B 2) Guidance/Standard for O&M and monitoring procedures;
- (C 5) Central forum (website) for RE power generation.

These recommendations have would have a very significant or high impact for IPPs as well, but may require less preparations and costs. Implementing those recommendations would help to improve the overall capacities of local stakeholders and improve the enabling environment for RE power generation and IPPs in Fiji.

Even though recommendations "(C 2) Improve assessment of market needs and skills" and "(C 3) Intensify cooperation between education and private sector" are relevant for local stakeholders, the direct impact for IPPs is considered less significant and should not be necessarily the first priority.
6. Observations and Some Conclusions

Several observations and summary conclusions are in order. The first of these is that there is a broad and widespread general understanding and knowledge of renewable energy, RE technologies, and the benefits of RE in Fiji and its power sector stakeholders. Where, the strongest knowhow is with solar PV power generation, but weak for other types of RE power generation. This is understandable based on the very limited number of RE projects in the country. There is still a lack of knowledge which extends, not only to the general population, but apart from a few isolated pockets in private industry and a few government ministries, within the private sector, education institutions, and government as well. This is not an uncommon phenomenon in developing countries who are pushing for greater inclusion of RE power generation. There is wealth of examples of successful efforts to address this broad ‘awareness’ challenge, much found within the efforts and literature of development agencies efforts around the world. The entire population of Fiji, nor all government and private sector stakeholders, can be educated through capacity building efforts at the same time. What must be accomplished, however, is that a comprehensive long term plan for capacity building must be developed that integrates all currently foreseen capacity building needs and requirements, and consistent with resource availability, and coordinated between government and development agencies.

Second, several serious structural issues within the government policies and ministries exist that provide some of the major challenges to further RE power generation development. Chief among these are a transparent, easily accessible consolidated source on regulations and processes for IPPs, PPAs, licensing, and permitting requirements for new RE power (and other) generation projects. Procedures for public-private partnerships (PPP) in the RE subsector need to be included. It has been suggested that the regulatory, rate setting, and operational responsibilities of the FEA be split into two separate bodies. Which is to take place under an ADB supported project, which is to start in 2017. This last requirement may take considerable time. A transparent and accessible source of RE information should be addressed in the capacity building planning as an early priority.

Included in these structural issues is the need for the government to better define a national RE power generation policy and implementation plan that addresses Fiji’s needs and commitments. Incentives may be required for RE to begin the process. Special investment and tax incentives for RE are common in the developing world.

Third, access to finance for RE related power generation projects remains an enduring and prevalent barrier throughout the developing world. Fiji will be no different. Capacity building efforts in RE must include local banks, financial institutions, and private investors from the very beginning.

Fourth, the greatest impetus (accelerator) to the successful and sustainable development of RE power generation in Fiji is the implementation of more grid-connected RE power generation plants (probably a large scale solar PV facility and fully private biomass generator) that is occasionally made accessible to academia, government officials, and the general public through various agreements. That “real world” example addresses many of the cross-cutting needs for sustainable capacity development: increased public and government awareness of RE power generation technologies, opportunities for ‘hands-on’ training and certification, increased interest from financial institutions and improved risk tolerances, and increased knowledge and support for academic program development and student demand. The first comprehensive capacity building plan for RE in Fiji should include, as one priority, support to implement further demonstration projects in Fiji and to promote those already in operation.
In conclusion, Fiji’s capacity building requirements for RE power generation are not unique. Fiji’s cultural, geographical, and economic environment is unique. The challenges the country faces in terms of developing its RE power generation resources are not unique. Many developing countries are currently going through the same process of developing capacity assessments and comprehensive capacity building plans, much with the assistance of development agencies, throughout the developing world. Even in the developed world there is constant change in know-how for introduction of greater shares of RE in power generation. Financial assistance is available from donor organizations for capacity building, and for implementation as co-investments. To obtain such assistance, however, Fiji must demonstrate its commitment to RE and sectoral reform, through its national policy and related actions, and begin preliminary assessments and planning for meeting its identified capacity building needs. This should be followed by a clear long term action plan or capacity building, and most importantly the long-term coordination of this (preferably through one government appointed entity).

The results of the capacity needs assessment and the recommendations made based on the results of the assessment (see chapter 5.2), were presented and discussed with the key local stakeholders during the “Capacity Building Workshop for Local Stakeholders on the Development of Renewable Energy Power Generation Systems”. There was general agreement and consensus that the proposed recommendations capture the most relevant needs for improving the enabling environment (including the education) for grid-connected renewable power generation in Fiji and to improve the specific skills and capacities required by local stakeholders for installing and operating and maintaining RE power generation projects.

It is hoped that this assessment of capacity needs for RE-based power generation in Fiji helps support these on-going efforts and end goal to increase the share of RE in the power mix.

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2 For further information see: (Marr & Marett, 2016)
7. Literature and References


Annexes

Annex 1 – Detailed survey results

**Type of Organization**

A wide variety of organizations are represented by the survey results, ranging from government agencies, development or educational institutions, technology providers, project developers and technical and engineering service providers. Independent power producers represent 28%; 8 respondents, of all respondents.

![Bar chart showing the distribution of types of organizations in the survey.]

*Figure 4: Type of Organization participating in the survey*

The majority of organizations that participated in the survey have 10 or less employees (44%, 13 responses), followed by 8 organizations (28%) with 11-20 employees, 5 organizations (17%) with more than 20 but less than 50 employees, and only 3 organizations (10%) with more than 50 employees.

**Experience with and current focus of Renewable Energy Power Generation**

More than two-third of all respondents (72%) indicated that their organization has experience with solar PV (photovoltaic), followed by small, mini and micro Hydro (55%), wind energy (48%) and bioenergy (biomass and biofuels), representing 45% each. This means that roughly one-half of the represented organizations have no current focus on RE technologies outside of solar PV. As might be expected due to the topography in Fiji, large hydro is the technology where only 17% of respondents stated that some level of experience exists.
Regarding the geographical experience, of all respondents, 90% stated that they already have general experience working with RE power generation in Fiji itself. In addition, 50% stated that they have experience in other counties in the South Pacific region and 45% stated that they have also work experience elsewhere.

**Is Renewable Energy power generation a central focus of the organization**

About two-third of all respondents (69%) indicated that RE power generation is a central focus within their organization. Whereas 28% responded that RE power generation is not a central focus.

**Satisfaction with enabling environment for RE power generation in Fiji**

When asked for the level of satisfaction with the enabling environment (including ease of business) for RE power generation in Fiji, more than 50% answered that their level of satisfaction is either low (41%) or very low (10%). In contrast, only 20% answered that they have either a high (17%) or very high (3%)
satisfaction level. This clearly highlights the fact that the majority of respondents see significant room for improvements concerning the enabling environment in RE power generation in Fiji.

Figure 7: Level of satisfaction with enabling environment for RE power generation

Key Barriers for RE power generation in Fiji

A number of different barriers hindering the implementation and operation of power generation from RE in Fiji were mentioned by the respondents. The most frequently mentioned barriers relate to aspects relevant for private businesses. About two-third (69%) answered that they see “difficulties in obtaining bankable Power Purchase Agreements (PPAs)” as a key barrier. In addition, a similar proportion (66%) see a “limited regulatory framework for Independent Power Producers (IPPs)” as a key barrier. The “lack of access to capital for investment” and the “lack of qualified professionals” are both mentioned by (59%) of the respondents. A “limited investment potential” and a “lack of skilled labour and technical staff” are both mentioned by almost half of the respondents (48%). Barriers related to “difficulties in obtaining licenses for power generation” and “limited technological application - demonstration in Fiji” are mentioned by more than a third of the respondents (38%). Barriers related to “difficulties in obtaining licences for business operation” (17%) and “limitation of renewable resources (fuel/energy supply)” (14%) are only considered as barriers by a much smaller group of respondents.

Potential for further improvement inside own organization

Within their own organizations, more than half of all respondents see highest improvement potential in improving the level of education and training (59%), improving the dissemination of information and improving marketing capabilities (55%) and in changing or expanding the RE technology focus (52%). About one third of the respondents consider potential improvements in acquiring staff with new skills/knowhow, access to capital for investment and development and improving business models as beneficial goals. Of all respondents, only 24% see improvement coming from changing or expanding their geographical focus.
Sufficient interest for career in RE

Just over half of all respondents see adequate interest in the professional and labor market for persons in Fiji wanting to make a career in the area of RE power generation (55%). 28% answered with "No" and 17% responded with "Not Applicable". Considering that the target audience for this survey already includes the key organizations involved in the RE power generation sector in Fiji, it might be assumed that other non-industry people in Fiji consider RE power generation as even less attractive for making a career.

Focus of higher education

It was asked "What is the power generation technology focus of the higher education?" A differentiation was made between universities and technical/vocational education programs. The results per technology are presented in Figure 9. According to the responses, for both university and vocational/technical education types, around 50% answered that the focus is rather generic including all basic types of RE. In terms of specific technologies, 45% of university and 41% of vocational/technical education practitioners stated solar PV is the focus technology.
For all other technologies, the responses slightly differ between both education programs. The technical/vocational education programs seem to have a slightly stronger focus on RE technologies compared to the universities. In contrast, it seems that the fossil fuel technologies have a slightly stronger focus at universities (28% of all respondents) compared to technical/vocational education (17% of all respondents).

When asked whether higher education in Fiji has an adequate focus on the softer management and business skills relevant for RE power generation, less than 40% of all respondents indicated that the focus for these skills is adequate. The skills with the lowest level of adequacy according to the respondents are “project management” and “business models/economic analysis” with only 5 responses (17%) each. Skills about “Environmental impact” were deemed adequate by 24% of the respondents and “social and economic impacts on communities” skills were viewed by 34% as adequate.

Adequate basic RE skills of newly educated staff

Almost 40% of the participants stated that newly educated staff have not (or rather not) adequate basic skills to perform their jobs in RE power generation. 17% even stated a clear “No” and 21% stated “Rather no”. Only a slightly higher share of respondents was of the opinion that newly educated staff have even the basic skills to perform their jobs in RE power generation.
Where can higher education improve?

The vast majority of participants (83%) stated that higher education could improve its collective efforts in providing more "practical application of technologies and skills". Still two-thirds of all respondents see an "advanced curriculum which includes engineering, economics and management" as a significant improvement opportunity. Other areas felt to be of significant improvement potential include: "theoretical application of technologies and skills" (48%) and in the "basic fundamental curriculums including language, communication, science, and math" (38%). The "Enrolment and completion rates of students" was considered as a potential area for improvement by a minority of 14% of all respondents.

Contribution to education

The participants were asked whether, and in what way, their organizations are contributing to education of persons in the field of RE power generation. Over 60% of all participants stated that the organizations they represent participate in or promote internships. A considerable number of respondents (55%) stated that their organization participates or promotes "cooperative education".3 The majority of organizations (around 60%) have a formal training program for new staff and/or a continuing training program for existing staff on an in-house or external basis. A similar portion of respondents indicated that their organization directly contributes to higher education.

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3 A student works for the organization for more than one short period, for example two or three periods of 3-4 months each, usually for on and off semesters.
Skills available for implementing RE power generation in Fiji

Only in terms of solar PV did more than half of all respondents state that there is sufficient opportunity from local organizations to gain project management services. For all other RE technologies (except for large hydro) between 20-30% of all respondents see sufficient opportunity to gain project management skills from local organizations. As could be expected due to the topography in Fiji and the limited technical potential for large hydro, only 1 participant (3%) sees sufficient opportunity.

In terms of availability of experience and “know-how” from local organizations in Fiji to develop bankable business models for RE power generation projects, almost two-third of all respondents (62%) stated that there exists sufficient know-how in Fiji. Less than one-third (28%) stated that the availability of know-how is not sufficient. The remaining 10% stated “Not applicable”.

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*Figure 11: Contribution to Education*

*Figure 12: Project Development skills for RE*
Most respondents (59%) stated that local organizations have sufficient know-how to adequately define and mitigate environmental and social risks associated with RE power generation in Fiji. One-quarter of all respondents (24%) are of the opinion that there is not sufficient know-how to address these matters.

**Information publicly available and information exchange**

Almost half of all participants are of the opinion that the publicly available information about RE sources in Fiji is inadequate for all RE types (RE technologies). Only for solar PV (34%) and small hydro (31%) a quite considerable portion of respondents see the publicly available information as sufficient. For all other technologies only between 14% and 21% see sufficient public information available. This clearly indicates that even the key local organizations in the RE power generation sector have the feeling that the public information about RE sources is rather not sufficient.

![Figure 13: Public information available for RE technologies](image)

It was asked whether there exist adequate forums for organizations involved in RE power generation (differentiated by organizations involved in the implementation and organizations involved in operation and maintenance) in Fiji to share experience and know-how. More than half of all respondents (52%) stated that there is no adequate forum for implementation of RE power generation projects. Only around one-third of respondents (34%) think that there is an adequate forum for this. When it comes to the operation and maintenance of RE power generation projects, 55% feel that there are insufficient forums in Fiji. Only a minority of 21% is of the opinion that adequate forums exist.

**Financial support available**

When asked about the availability of financial support instruments and incentives for RE in Fiji, only “free import duty and/or VAT on RE technologies” (48%) and tax holidays (38%) were mentioned by a significant number of respondents. A minority of participants stated that “loans for primary debt” (17%) and “export or import guarantees” (14%) are sufficiently available as financial support instruments. According to the survey responses, subsidies on RE and on power prices do not seem to be sufficiently available. Of all the respondents, 17% stated that all types of financial support instruments are not sufficiently available for RE in Fiji.
A majority (55%) of all respondents are of the opinion that domestic financial institutions are lacking an adequate understanding to evaluate business plans for RE power generation in Fiji. In contrast, only 21% answered that in their view such understanding exists.

**Other support available**

For other potential supporting mechanisms for RE power generation in Fiji, the responses were:

About one-quarter of all participants (24%) are of the opinion that the system or instruments to secure adequate long term land rights (either freehold or leasing) for developing and operating RE power generation projects is not sufficient for any size of RE project. However, a considerable number of respondents stated that these land rights are at least sufficient for small RE projects (45%). Around one-third (31%) indicated that this would be the case for medium to large projects.
When it comes to support for securing power generation licenses including approvals and pre-approvals, most participants (41%) responded that the current system is not sufficient for any size of projects. According to the responses given, at least 34% stated that the system is sufficient for on-grid projects. For off-grid projects, specifically, this portion of responses was slightly lower (28%).

![Image of bar chart]

**Figure 16: Adequate system to secure license/approvals for RE**

The clear majority of respondents (72%) indicated that the process for securing development stage (before financial closure) Power Purchase Agreements (PPAs) for grid connected RE power generation is not sufficient for developing RE power generation projects in Fiji. In contrast, only 17% of all respondents are of the opinion that the process is sufficient.

**Availability of services from local organizations**

It is important to understand to what extent local organizations involved in RE power generation in Fiji can provide services for engineering design, operation and maintenance already today. Figure 17 summarizes the results of the survey on these matters for the different RE technologies. According to the responses, solar PV was most mentioned from all RE technologies, followed by small hydro, wind and biomass/biofuel. In general, the respondents were of the opinion that services for operation and maintenance can be better provided by existing local organizations when compared to engineering design services.

About 40% of all participants stated that engineering design services would need to be provided internationally. For operation and maintenance services slightly less than 30% of all respondents think that those services need to be gained internationally.
Non-technical & technical barriers in RE implementation

A number of potential technical and non-technical barriers where provided in the survey and the respondents could select a multiple number of these barriers.

Concerning technical barriers, the following Figure 18 shows the results.
The three most frequently selected technical barriers were "skilled installers & technicians" (52%), "skilled supervisory engineers" (48%) and the lack of "national standards for equipment and RE technology" (38%). The barriers "unskilled labour", warranties and guarantees for supplied technologies and services, and the "power infrastructure" were identified as technical barriers by approximately 20% of all respondents.

With regard to non-technical barriers, "inadequate off-take and Power Purchase Agreements" (52%) and "national power regulations" (45%) were mentioned by most respondents. Around one third of all respondents consider "political/government support" (34%), "land use agreements/disputes" (31%) and "international banking transfers and payments" (28%) as formidable non-technical barriers. Figure 19 summarizes the share of responses per barrier for the non-technical barriers.

![Figure 19: Non-technical barriers for RE implementation](image)

Only 7% (2 respondents) stated that no barriers (either technical and non-technical barriers) are present for RE implementation in Fiji.

**Own operation staff and internal training of staff**

The vast majority of organizations (76%) indicated that their organization has their own operations staff. When asked about training provided to the internal operation and maintenance staff, almost half of all respondents (45%) answered that this is "Not Applicable" for them. About half of the remaining respondents (48%) stated that within their organization the internal operation and maintenance staff is already trained prior to entering the job. More than half of all remaining respondents 52% stated that the operation and maintenance staff is trained at least on an annual basis.

It appears that the majority of organizations have their own staff trained for minor maintenance (59% of respondents), whereas only 38% of respondents stated that their organization has its own maintenance staff trained also for major maintenance.

**Internal procedures**

It was asked if the organizations have adequate documentation for step-by-step procedures in operation and maintenance (O&M) and monitoring procedures for the execution and documentation of daily operation and maintenance. In large parts of the organizations (55% of all respondents) adequate documentation for step-by-step O&M procedures seems to be available. Only a very small portion of respondents (7%) indicated that no such documentation exists within their organization.
For monitoring procedures of daily O&M, a slightly lower proportion of respondents (48%) indicated that documentation for such procedures exist within their organization. Conversely, 14% indicated that no such monitoring procedures are available within their organization.

![Figure 20: Availability of internal procedures for own staff]

**Availability of spare parts and order times**

About 40% of respondents stated that they do not maintain spare parts for RE power generation for their organization. For known annual maintenance requirements, 75% indicated that their organization does keep spare parts on hand for regular maintenance (maintenance which occurs on an annual basis). In contrast, for spare parts for major maintenance (maintenance which occurs every few years) only 50% stated that some of these parts are kept on hand by their organization. Almost half (50%) of respondents stated that their organization is not keeping major maintenance spare parts on hand.

The following figures (Figure 21 and Figure 22) summarize the share of responses related to the experience of local organizations with order times for replacement parts (for minor and major replacement parts).

![Figure 21: Order time for minor replacement parts]
**Comments**

The respondents were given the opportunity to provide additional written comments regarding any issue they felt important. The table below provides a summary of the most relevant comments provided.

<table>
<thead>
<tr>
<th>Category</th>
<th>Comment provided</th>
</tr>
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<tbody>
<tr>
<td>Forum, information exchange</td>
<td>&quot;what we need is a renewable energy member organization formed in Fiji, where a lot of discussions can be done, benchmarks can be set on which quality equipment can be brought into Fiji”</td>
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<td>&quot;The are some companies in Fiji that install Grid-Connected Solar units who have their technicians/installers mount the solar arrays etc. and the relevant switchboards but the actual connections of the system is a closely guarded secret done by those in the higher echelon of the company, sometimes the owners themselves so that the techs will not be able to do so. For the very basic solar installations, the technicians are able to do the complete installations.”</td>
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<td>&quot;...there should be knowledge sharing forums so the private and public sector can share their experiences on renewable energy projects and its implementation etc.”</td>
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<tr>
<td>Coordination and training</td>
<td>&quot;...there is capacity within Fiji to achieve all that is required - coordination is lacking…”</td>
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<td>&quot;More training and exposure is required for local people for operation and maintenance to the RE Power generation plants. Also lot of RE workshops to be held into the country.”</td>
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<td></td>
<td>&quot;...international expertise&quot; is not necessarily the best answer…”</td>
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<tr>
<td>Regulatory aspects</td>
<td>&quot;Regulations on RE generation need to be updated to adequately cover IPP both on and off-grid as they appear to be based on older centralised and government owned implementation rather than the newer business models being developed for RE companies to develop their own RE power generation projects”</td>
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<tr>
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<td>&quot;Uncertainty in government decision making &amp; willingness has in the past limited new forms of business models to enter into the market in”</td>
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</table>
Fiji. This includes PPPs and IPPs. These effectively means that both the enabling environment and final decisions (or none decisions making) have been week in the past, thus not allowing for the conditions needed for international capital to enter the market in Fiji.”

"...the IPPs frameworks (regulations, standard PPA, guarantees) needs to be strengthened.”

"More consultation and transition period is required from regulatory bodies for changes made to regulations”

"FREPP or similar industry body to make submissions to regulatory bodies on the impacts of regulatory changes on the customers, members and Fiji's RE targets.”

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<th>Comment provided</th>
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</tr>
<tr>
<td>Financial aspects/Funding</td>
<td>&quot;If possible Funding can be arranged to public and other companies for RE projects.”</td>
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<td></td>
<td>&quot;Financing of RE (RE) is a key barrier”</td>
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<tr>
<td></td>
<td>&quot;Tax exemption (both direct and indirect tax) for RE companies are not clear”</td>
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<tr>
<td>Other</td>
<td>&quot;...international expertise&quot; is not necessarily the best answer…”</td>
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Table 7: Selection of individual comments provided
Annex 2 – Questionnaire of online Survey

Introduction

Dear Stakeholder in the Fiji Renewable Energy Sub-Sector:

The Department of Energy (DOE) is managing a UNDP-GEF and Fiji Government funded Project called the Fiji Renewable Energy Power Project (FREPP), which has been supporting national efforts in renewable energy since 2012. FREPP’s main objective is the removal of barriers (policy, regulatory, market, finance, and technical) to the wide-scale use of renewable energy resources for grid-connected power generation in Fiji. One of the activities under FREPP is to address capacity building for Fijian companies in RE-based power generation systems, in terms of existing capacities and future capacity needs. A core part of this component is a survey to determine and evaluate the current level of capacity of local service providers to develop, design, engineer, install, operate and maintain RE-based power generation systems.

In this context, DOE would appreciate the participation in the below survey of stakeholders in the Fiji renewable energy sub-sector. Your attention to this survey will not only help bring more transparency to the capacity and needs for the renewable energy sub-sector, but also to allow for a platform to build upon for future supported actions within the sub-sector. The results of the survey are expected to be published on the website of DOE by mid-2016.

The structure of the survey is:

- Part I: Contact information
- Part II: General questions about private sector capacity in the sub-sector
- Part III: Specific questions for capacity in the sub-sector
  - Education & Training
  - Project Development (incl. finance)
  - Project implementation (incl. engineering)
  - Operation and Maintenance
- Part IV: Written comments

DOE would like to thank you in advance for your participation and interest in this FREPP activity.

(This information will not be published, and used only by the consulting company conducting the survey in the case that direct contact is warranted based on the survey results)
Part I: Contact and company/institutional information

- **Your name**
- **Organisation**
- **Your position in the Organization**
- **Your position in the Organization**
- **Type of organisation that you represent**
  - Development institution
  - Financial institution
  - Higher education (technical/vocational)
  - Higher education (University at bachelors or master level)
  - State owned power producer
  - Independent power producer
  - Technology Provider (including turnkey solutions)
  - Technical services provider
  - Engineering services provider
  - Project developer
- **Number of employees working on RE related topics**

Part II: General Questions

- **Your organisation has experience in the following RE Technologies in power generation**
  - Hydro (large)
  - Hydro (small, mini and micro)
  - Biomass
  - Solar PV
  - Biofuels
  - Wind
  - Other
- **Your organisation has experience in working with RE power generation and related topics in**
  - Fiji
  - Elsewhere
  - Other countries in South Pacific
  - No experience
- **Is RE power generation a central focus of your organization?**
  - Yes
  - No
  - Not Applicable
- **Please indicate your level of satisfaction with the enabling environment (incl. ease of business) for RE power generation in Fiji?**
  - 1 - Very low
  - 2 – Low
  - 3 – Medium
  - 4 – High
  - 5 – Very high
- **Where do you see the key barriers for RE power generation in Fiji?**
  - Lack of qualified professionals (e.g. engineering and management staff and consultants)
  - Lack of skilled labour (technical staff)
  - Limited technological application - demonstration in Fiji
  - Limitation of renewable resources (fuel/energy supply)
  - Limited investment potential
  - Lack of access to capital for investment
Limited regulatory framework for Independent Power Producers (IPPs)
- Difficulties in obtaining bankable Power Purchase Agreements (PPAs)
- Difficulties in obtaining licences for power generation
- Difficulties in obtaining licences for business operation
- Other

Please indicate areas where your organization can further improve to support RE power generation in Fiji
- Improve business model(s)
- Change or expand geographical focus
- Change or expand RE technology focus
- Improve the level of education & training
- Acquire staff with new skills and/or knowhow
- Improve access to capital for development
- Improve access to capital for investment
- Improve information dissemination / marketing capabilities
- Other

Part III: Specific Components Questions

In case of questions that cannot be answered by you due to your type of organization or any other reason, please click "Not applicable" (if this option is available).

III.a: Education & Training

- Is there adequate interest of persons wanting to make RE power generation a career (e.g. does enrolment and completion rates in education & training programmes meet the demand for trained persons in the sector)?
  - Yes
  - No
  - Not Applicable

- What is the power generation technology focus of technical / vocational (higher) education in Fiji?
  - Rather Generic (basic of all types)
  - Fossil Fuel
  - Hydro (large)
  - Hydro (small, mini and micro)
  - Biomass
  - Solar PV
  - Biofuels
  - Wind
  - Other

- What is the power generation technology focus of university (higher) education in Fiji?
  - Rather Generic (basic of all types)
  - Fossil Fuel
  - Hydro (large)
  - Hydro (small, mini and micro)
  - Biomass
  - Solar PV
  - Biofuels
  - Wind
  - Other
• Do you feel that newly educated organization staff, have adequate basic skills to perform their jobs in RE power generation?
  o No
  o Rather No
  o Rather Yes
  o Yes
  o Not Applicable

• Do you feel that higher education (technical / vocational and university) in Fiji has adequate focus on the following softer sides of RE power generation?
  o Project Management
  o Environmental impacts
  o Business models/ economic analysis
  o Social and economic impacts on communities
  o Not Applicable
  o Other

• Where can technical / vocational and university (higher) education in RE power generation be improved?
  o Enrolment and completion rates of students
  o Basic curriculum (language/communication, science, math)
  o Advanced curriculum (engineering subjects, economics, management)
  o Theoretical application of technologies and skills
  o Practical application of technologies and skills
  o Not Applicable
  o Other

• Does your organization promote / participate in internships (individual short-term student jobs working on organization assignments)?
  o Yes
  o No
  o Not Applicable

• Does your organization promote / participate in cooperative education (a student works for the organization for more than one short period, for example two or three periods of 3-4 months each, usually for on and off semesters)?
  o Yes
  o No
  o Not Applicable

• Does your organization have a formal program for training new staff, or re-training existing staff, as in-house or external training?
  o Yes
  o No
  o Not Applicable

• Does your organization promote / participate in lecturing, teaching, or showcasing activities, at institutions for higher education?
  o Yes
  o No
  o Not Applicable

### III.b: Project Development

• Do you feel there is sufficient opportunity to gain Project Development services from your organization or others in Fiji for the following RE generation technologies?
  o Hydro (large)
  o Hydro (small, mini and micro)
  o Biomass
  o Solar PV
  o Biofuels
Do you feel your organization or another local organization has sufficient know-how to develop bankable business models for RE power generation in Fiji?
- Yes
- No, it must be gained internationally
- Not Applicable

Do you feel your organization or another local organization has sufficient know-how to adequately define and mitigate environmental and social risks associated with the RE power generation in Fiji?
- Yes
- No, it must be gained internationally
- Not Applicable

Do you feel that there is sufficient information publicly available on RE resources in Fiji, for one or more of the following?
- Hydro (large)
- Hydro (small, mini and micro)
- Biomass
- Solar PV
- Biofuels
- Wind
- Inadequate in all RE types
- Not Applicable

Do you feel that there is sufficient availability of the following financial support instruments for RE in Fiji?
- Grants or subsidies for business development (focus on business models, technical/economic feasibility, legal services...etc.)
- Subsidies on power prices (higher power price)
- Subsidies on renewable fuels (lowered fuel costs)
- Grants for partial equity finance
- Loans for subordinate debt
- Loans for primary debt
- Export or Import guarantees
- Currency exchange / hedging instruments
- Free import duty and/or VAT on RE technologies
- Tax holidays
- Payment guarantees (for power delivered)
- Unavailable for all types
- Not Applicable

Do you feel that there is sufficient availability of the following financial support instruments for RE in Fiji?
- Yes
- No, it must be gained internationally
- Not Applicable

Do you feel that the system and agreements/instruments to secure adequate long term land rights (either freehold or leasing) is sufficient for developing, and eventually operating, RE power generation projects?
- Sufficient for small projects
- Sufficient for medium and large projects
- Not sufficient for any size of project
- Not Applicable

Do you feel that the system to secure power generation license, approvals and/or pre-approvals, is sufficient for developing RE power generation projects in Fiji?
- Sufficient for off-grid projects
• Do you feel that the process to secure development stage (before financial closure) Power Purchase Agreements for grid connected RE power generation is sufficient for developing RE power generation projects in Fiji?
  o Yes
  o No
  o Not Applicable

III.c: Implementation of RE Power Generation

• Is there sufficient opportunity to gain Engineering Design services from your organization or others in Fiji for the following RE generation technologies?
  o Hydro (large)
  o Hydro (small, mini and micro)
  o Biomass
  o Solar PV
  o Biofuels
  o Wind
  o No, it must be gained internationally
  o Not Applicable

• What are the key categories of non-technical barriers your organization or others face in the implementation of RE power generation in Fiji?
  o Own administration capability / capacity
  o Political / Government support
  o National power regulations (license and approvals)
  o Land use agreements / disputes (leases or freehold)
  o Inadequate off-take and/or Power Purchase Agreements
  o Domestic business regulations
  o Domestic employment regulations
  o Import and tax regulations
  o Enforcement of commercial agreements
  o International banking (transfers and payments)
  o No barriers faced
  o Other

• What are the key categories of technical barriers your organization or others face in the implementation of RE power generation in Fiji?
  o National standards for equipment / RE technology (adapted to conditions in Fiji)
  o Warranties and guarantees on supplied technology
  o Warranties and guarantees on supplied services
  o Unskilled labour
  o Skilled civil works companies
  o Skilled installers & technicians
  o Skilled supervisory engineers
  o Transport infrastructure
  o Power infrastructure
  o Water infrastructure
  o No barriers faced
  o Other

• Is there an adequate forum or mechanism for organizations involved with the implementation of RE power generation to share experiences and knowhow in Fiji?
III.d: Operation and Maintenance of RE Power Generation

- **Is there sufficient opportunity to gain Operational services from your organization or others in Fiji for the following RE generation technologies?**
  - Hydro (large)
  - Hydro (small, mini and micro)
  - Biomass
  - Solar PV
  - Biofuels
  - Wind
  - No, it must be gained internationally
  - Not Applicable

- **Is there sufficient opportunity to gain Maintenance services from your organization or others in Fiji for the following RE generation technologies?**
  - Hydro (large)
  - Hydro (small, mini and micro)
  - Biomass
  - Solar PV
  - Biofuels
  - Wind
  - No, it must be gained internationally
  - Not Applicable

- **Does your organisation have its own daily operation staff?**
  - Yes
  - No
  - Not Applicable

- **When is your operation and maintenance staff trained for their job?**
  - When entering the job
  - At least on an annual basis
  - Not Applicable

- **Does your organization have adequate documentation for step-by-step procedures in the operation and maintenance of the applicable RE generation technologies?**
  - Yes
  - No
  - Not Applicable

- **Does your organization have monitoring procedures for the documentation of daily operation and maintenance of the applicable RE generation technologies?**
  - Yes
  - No
  - Not Applicable

- **Does your organisation have its own maintenance staff trained for minor maintenance?**
  - Yes
  - No
  - Not Applicable

- **Does your organisation have its own maintenance staff trained for major maintenance?**
  - Yes
  - No
  - Not Applicable
• Does your organisation keep on hand spare parts for regular maintenance (that maintenance which occurs on an annual basis)?
  o Yes
  o No
  o Not Applicable

• Does your organisation keep on hand spare parts for major maintenance (that maintenance which occurs every few years)?
  o Yes
  o No
  o Not Applicable

• What is your organization’s or others experience in the time it takes to order, receive, and install minor replacement parts?
  o Less than two days
  o Two days to one week
  o One week to two weeks
  o Two weeks to one month
  o Exceeding one month
  o Not Applicable

• What is your organization’s or others experience in the time it takes to order, receive, and install major replacement parts?
  o Up to two weeks
  o Two weeks to one month
  o One to two months
  o Two to three months
  o Exceeding three months
  o Not applicable

• Is there an adequate forum or mechanism for organizations involved with the operation and maintenance of RE power generation to share experiences and know-how in Fiji?
  o Yes
  o No
  o Not Applicable

Written comments

(Please provide any relevant comment)