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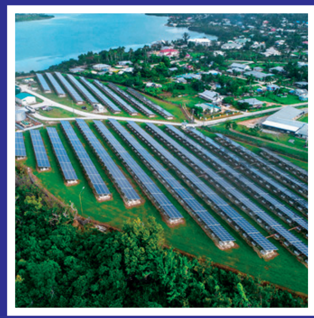

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Pacific Power Association, Suva, Fiji Islands. The PPA is an inter-governmental agency and member of the Council of Regional Organisations in the Pacific (CROP) established to promote the direct cooperation of the Pacific Island Power Utilities in technical training, exchange of information, sharing of senior managment and engineering expertise and other activities of benefit to the members.

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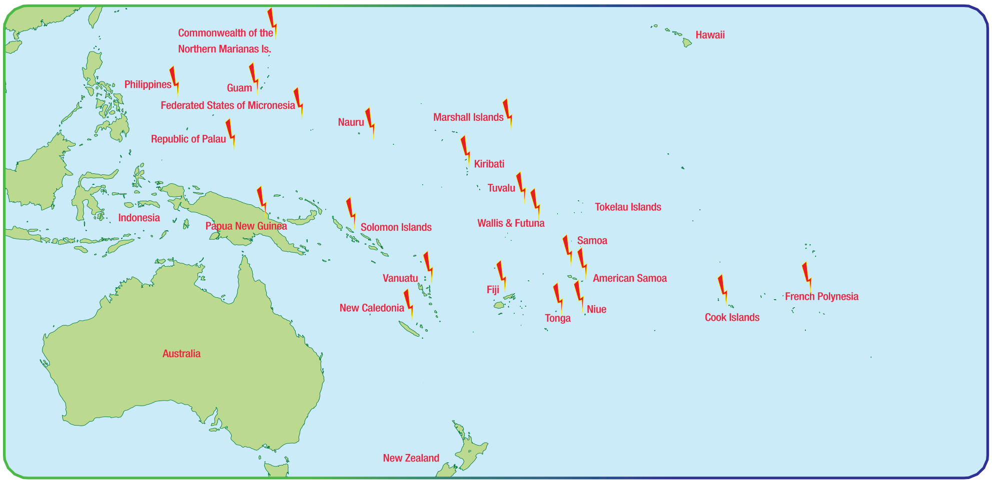

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Editor's Note

Andrew D. Daka
Executive Director

The year so far has been anything but normal. The declaration of the COVID-19 pandemic has had a global impact on every aspect of life as we know. The effect of the COVID-19 pandemic has been severe travel restrictions, lockdowns in the majority of the Pacific countries much like the rest of the world.

Whilst a number of our Pacific Island Countries have so far been untouched by the pandemic, our neighbors; Fiji, French Polynesia, New Caledonia, Guam as well as Australia and New Zealand have not been so lucky with the reported positive cases and fatalities.

Economic activity has contracted sharply for the region as well as globally, aviation services are yet to recover and this has impacted on the economies of the Pacific Island countries that depended a lot on tourism. We have seen a significant reduction in the employment numbers in these sectors.

The economic cost from COVID-19 is unprecedented. The utilities like the rest of the business community are not immune to the impacts of the pandemic with significant reduction in electricity demand as businesses have had to close or reduce operating hours in line with government directives.

These economic costs are compounded for a number of Pacific Island countries by the cost of damage of TC Harold during the same period.

The impact on utility as well as public finances are projected to be massive. It is worth noting that utilities are supporting government led initiatives to provide some relief to residents and businesses during these difficult times. A number of utilities have put in place measures such as subsidies, reduced tariffs, extended payment periods and flexible payment plans to provide relief to customers.

The pandemic has also brought to the fore the importance of technology to conduct business especially the use of virtual business meetings, workshops and trainings.

The severe restrictions on travel meant that the Association had to cancel its 29th Annual Conference and Trade Exhibition. The Association's premier event was schedule to be held in Kolonia, Pohnpei from 6 - 10 July 2020.

The challenge for utilities now is to look at the impact of COVID-19 on the utility operations and determine how different this role will be post-COVID-19.

Stay Safe all.

Renewable Energy Integration Studies In Islands

Manuel Coxe, Gayathri Nair & Laura Casado
International Renewable Energy Agency (IRENA)

Abstract
Integration of variable renewable energy in the electrical power system introduces new challenges in both planning and operating the grid, mainly for smaller and isolated power systems. Power system operation with high share of variable renewable energy requires operational measures to cope with the inherent intermittency and the geographical diversity. Integrating variable renewable energy may imply investment on enablers and grid infrastructure to assure system quality. However, many power systems in their existing form without investments on enablers and grid infrastructure can allow connection of new generation units, regardless of whether the new generation is conventional or renewable. To carry out generation expansion with the existing grid topology, there is a need to perform grid studies which assess the preparedness of the power system to incorporate new generation in terms of the stability and grid infrastructure which is known as the hosting capacity of the system. This paper presents the methodology that IRENA applied, to analyse the hosting capacity for utility scale and roof top solar PV integration in the island of Viti Levu in the Republic of the Fiji Islands.

I. Background

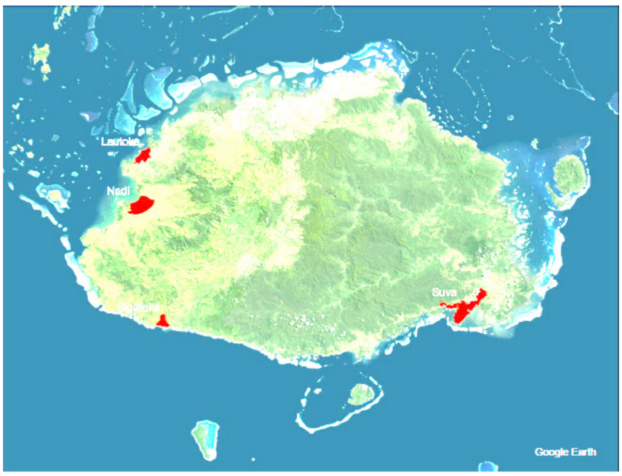
The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that promotes and supports member nations in their transition to a sustainable energy future. IRENA undertook the study to assist the Republic of Fiji Islands in facilitating and developing policies for the implementation of its Nationally Determined Contribution by increasing shares of renewable energy in the optimal generation mix of its power system. This was aimed to assist Fiji in moving forward with its diversification of power resources by assessing the impacts and technical constraints to the integration of high shares of solar photovoltaic (PV) generation in the island of Viti Levu, the main island of Fiji.

The hosting capacity of the existing power system in the island of Viti Levu is assessed and recommendations provided that will allow the Department of Energy (DoE) and Energy Fiji Limited (EFL) to plan strategies for increasing the share of solar PV beyond what has been identified in the hosting capacity. The scope of this study also included the provision of guidance to DoE and EFL on identifying the potential locations for the deployment of solar PV, the type of solar PV (centralised or distributed) to be implemented, the capacity of the actual power system to host PV generation and the required upgrades as well as inter-connection requirements that new PV generation should meet before being connected to the grid in four different zones of the main island.

II. Solar resource assessment, location of the and topology of the grid

Time series of solar irradiation or generation profiles of wind were generated, using the Weather Research and Forecasting model, a leading open-source community numerical weather prediction model. In the absence of actual data, historical meteorological conditions were simulated over the surface area of the island of Viti Levu. Data model was adjusted using concurrent observed data from three stations to remove potential biases before modelling power generation. Several locations of interest were identified for utility-scale and distributed rooftop PV development.

Figure 1: The four regions for deployment of DPV (Source: google map and AWS Truepower LLC).

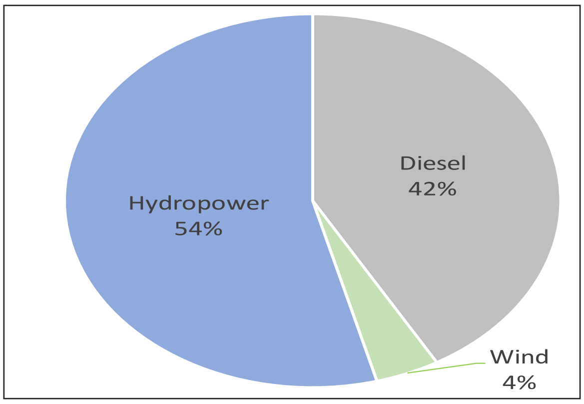


It was decided between IRENA, DOE and EFL that the utility scale PV generation should be fixed at 25 MW and be distributed in three zones namely Nalovo/Navutu, Nabau/Voua/Sigatoka and Vuda/Lautoka.

Information regarding the geographical location of distributed PV (DPV) in the four zones (Lautoka, Nadi, Sigatoka, and Suva, as depicted in Figure 1) was obtained from AWS Truepower LLC whilst the data of demand and generation, and the network infrastructure and topology were obtained from the EFL.

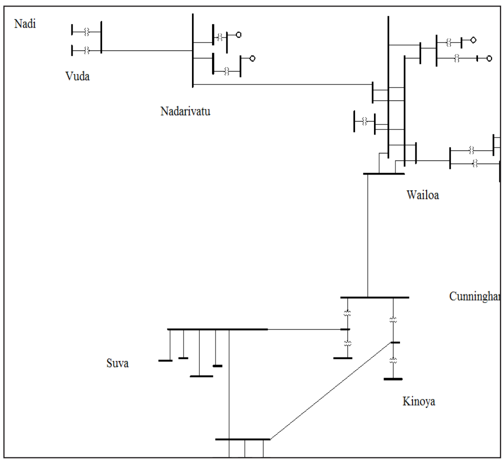
The power system in the island of Viti Levu has voltage levels of 132 kV, 33 kV and 11 kV and 0.415 kV. According to relevant data obtained, the lowest demand recorded in 2017 is 63 MW and peak demand is 160 MW. Generation mix as of 2017 is illustrated in Figure 2.

Figure 2: Installed capacity mix in the island of Viti Levu as of 2017.



A simplified topology of the 132 kV system, without depicting the power stations and the respective feeders, is presented in Figure 3.

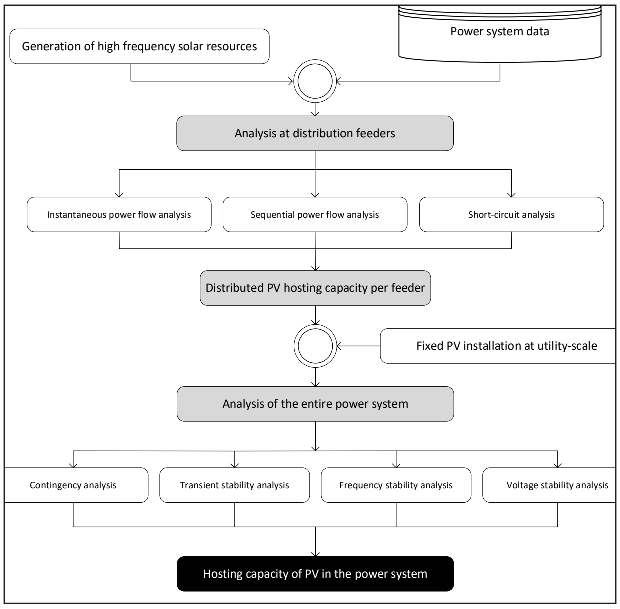
Figure 3: Simplified topology of the 132 kV network.



III. Methodology of the analysis

Figure 4 illustrates the different steps followed to realise the study, from data collection to definition of hosting capacity. The study of the system at feeder level was independent from the generation connected at utility-scale network whilst the study of the power system at the utility-scale level considered different scenarios that take into consideration the DPV connected onto the feeders.

Figure 4: Steps of assessment to define the hosting capacity in the power system of Viti Levu.



III.1. Analysis at representative distribution feeders

The representative feeders were categorized based on the demand they are connected to: residential, commercial or industrial.

The assessment of the hosting capacity of the feeders to integrate DPV consisted on placing DPV in different locations of the feeder, considering different levels of demand (high demand, low demand and no-demand) and having them connected at the different locations on the feeder. In each of the scenarios the following analysis were carried out:

A. Instantaneous power-flow analysis:

- Identification of potential problems related to over-voltages and overloading caused by DPV.
- Assessment of high demand and low demand snapshots based on data obtained

from EFL.

- Assessment of different scenarios of PV penetration on the feeders aiming to give useful insight regarding the location of the PV units.

B. Sequential power-flow analysis:

- Identification of potential problems related to undesired changes on the tap changer of the main power transformer of the substation.

C. Short-circuit analysis:

- Impact of short-circuit currents (applied to the distribution substation) with PV integration.

III.2. Generalised assessment at all distribution feeders

In cases where the power system is comprised of a significant number of feeders or data for each feeder and the corresponding information of the transformers are not available, it becomes imperative to estimate the hosting capacity.

To estimate the hosting capacity of the feeders, the information gathered from the analysis of the representative feeders are used and appropriate coefficients (indices) are defined. Using these indices, heuristic rules are defined which allow obtaining the maximum hosting capacity of DPV in distribution feeders in Viti Levu, without performing a detailed technical analysis. The following points were considered:

- Heuristic rules are as generic as possible so that they can provide useful insight about the maximum hosting capacity of DPV in all distribution feeders in the island of Viti Levu.
- The maximum hosting capacity obtained from proposed rules follow a conservative approach in the sense that deployment would be progressive. Nonetheless, even conservative proposals for PV deployment are likely to imply significant amounts of PV.
- Relevant particularities regarding the type of feeder (i.e. residential, commercial or industrial customers) are captured in the proposed heuristic rules.

Three performance indices are proposed to analyse the maximum DPV penetration level on a feeder and generalise the conclusions obtained from the detailed analysis on representative feeders to determine the values for the feeders that were not studied.

Figure 5a presents representative profiles of higher and lower demand observed in a year and the DPV generation over 24 hours of a typical sunny day (considering that the higher irradiation is observed at 12:00) and Figure 5b shows the location of the first line of the feeder connected to the sub-station.

III.2.1. Definition of indices

The proposed indices are calculated for a single feeder ***i*** and are defined as follows:

Index 1 (φ_{1i}):

The first index is defined as index φ_{1k} which quantifies how much DPV generation does a feeder admit, in comparison with the minimum value between the rating of the first line of the feeder and the sum of ratings of transformers and will always be less than or equal to a unit:

$$\varphi_{1i}^{N} = \frac{P_{PV(i)}^{max}}{\mathrm{Min}\left(S_{ij,first}^{N};\, S_{TR,tot}\right)} \leq 1 \qquad [1]$$

Where

- $P_{PV(i)}^{max}$ is the DPV penetration level (MW).
- $S_{ij,first}^{N}$ is the rating of the first line of the feeder (the one which is closer to the substation) (MVA).
- $S_{TR,tot} = \sum_{ik} S_{TR(ik)}^{M}$ is the sum of the ratings of 11/0.415 kV transformers (MVA).

The value of Min $\left(S_{ij,first}^{N}, S_{TR,tot}\right)$ can be used as an upper bound for DPV deployment in a feeder, subject to voltage and thermal limits on the feeder. Given that Min $\left(S_{ij,first}^{N}, S_{TR,tot}\right)$ determines the upper bound for DPV deployment in a feeder, the value of $P_{PV(i)}^{max}$ cannot exceed that upper bound.

Index 2 (φ_{2i}):

The second index quantifies how much DPV generation does a feeder admit, in comparison with the peak demand of the feeder. For example, a value of $\varphi_{2i} \geq 1$, means that the DPV deployment in that feeder ***i*** could supply the total demand of the feeder. It is defined as:

$$\boldsymbol{\varphi_{2i}^{N}} = \frac{P_{PV(i)}^{max}}{P_{Demand(i),tot}^{max}} \qquad [2]$$

Where:

- $P_{Demand(i),tot}^{max}$ is the peak demand of the feeder (MW) at 12:00.

Index 3 (φ_{3i}):
The third index is defined as:

$$\varphi_{3i}^{N} = \frac{P_{PV(i)}^{max}}{P_{Demand(i),tot}^{min}} \quad [3]$$

Where:

- $P_{Demand(i),tot}^{min}$ is the lowest demand of the feeder (MW) at 12:00.

Since the low demand scenario is more critical due to reversal of power flow in transformers when integrating DPV, this index is very relevant as it quantifies how much DPV generation a feeder can admit, in comparison with the lowest demand of the feeder.

It is worth underlining that the worst low demand scenario is the zero-demand scenario that would result on $\varphi_3 = \infty$, implying that the total DPV generation will flow in the reverse direction onto the utility-scale grid.

Both peak and low demand are obtained at 12:00, since at that time the irradiance is assumed to be extremely high in the island (Figure 5a).=

Figure 5a: Illustrative curves of higher and lower demand observed in a year and of DPV generation over 24 hours of the day.

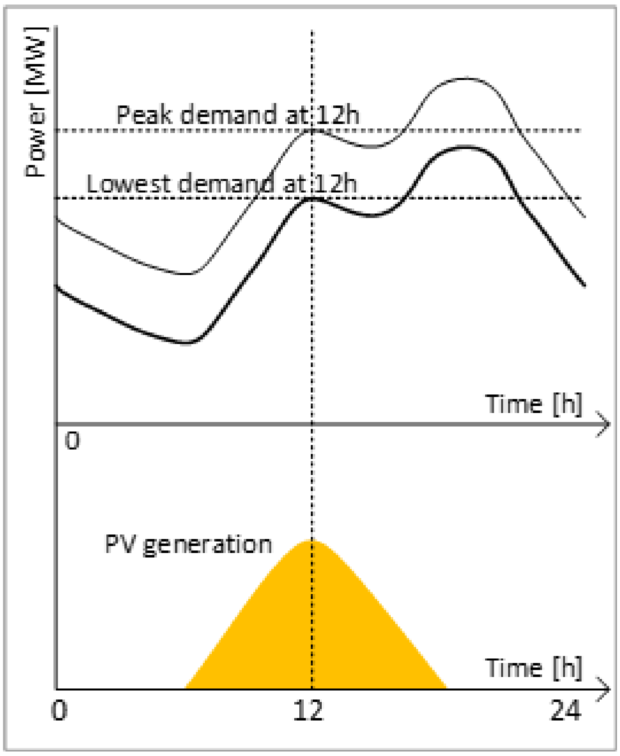
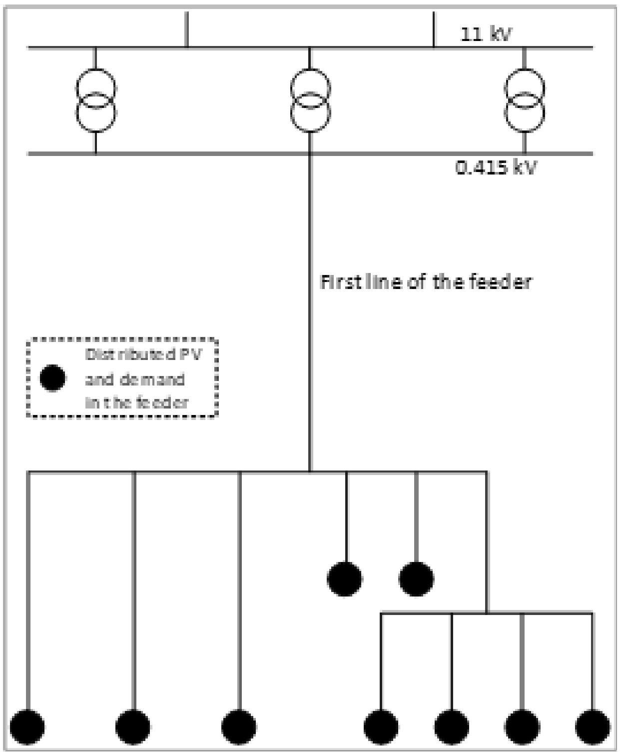


Figure 5b: Representative topology of the connection of the first and subsequent feeders to the power sub-station.



III.1.2. Definition of holistic rules

The following four rules are proposed based on the three indices determined above:

Rule 1:
Index (φ_1) is the most reliable since it contains information about the grid characteristics and topology of the feeder. To assure realistic, reliable, simple and conservative rules for DPV deployment, the following heuristic rule is proposed:

- DPV penetration level in a feeder, $\boldsymbol{P_{PV}^{max}}$, will be considered feasible if it verifies:

$$\boldsymbol{\varphi_{1i}^{N}} \leq \mathrm{Min}(\varphi_{11}\,;\ \varphi_{12}\,;\ldots;\ \varphi_{1N}) \quad [4]$$

Rule 2:
Although the index φ_{1i}^{N} is already conservative, even more conservative rules can be proposed, using indices related to the demand of the feeder (φ_2 *or* φ_3). The following heuristic rule which includes limitation due to transformer rating and the peak demand of the feeder is proposed:

- DPV penetration level in a feeder, $\boldsymbol{P_{PV}^{max}}$, will be considered feasible if it verifies:
rule 1 plus $\boldsymbol{\varphi_{2i}^{N} \leq 1}$

Rule 3:
If no information of the electrical parameters of the feeders are available, the index φ_{1i}^{N} cannot be applied. Rule 3 considers $\boldsymbol{\varphi_{2i}^{N}}$.

- DPV penetration level in a feeder, $\boldsymbol{P_{PV}^{max}}$, is considered feasible if it verifies: $\boldsymbol{\varphi_{2i}^{N} \leq 1}$.

Rule 4:
Rules 1, 2 and 3 assume that voltage drop compensation method for on-load tap changer (OLTC) in the transformer of the substation are considered since PV deployment can produce reversal of power flow. If compensation methods of OLTCs are not considered, then more conservative rules for PV deployment can be proposed, using index φ_{3i}^{N}:

- DPV penetration level in a feeder, $\boldsymbol{P_{PV}^{max}}$, will be considered feasible and will not produce reverse flows in the transformer of the substation if it verifies: $\boldsymbol{\varphi_3 \leq 1}$.

The latter rule means that the maximum PV penetration level in a feeder must be lower than the lowest yearly demand of the feeder at 12:00. Although the application of rule 4 avoids power flow reversals, it significantly reduces the maximum PV penetration level that can be deployed on a feeder (for instance, for the case of Viti Levu, there is a reduction of 48% of maximum PV penetration level from applying rile 3 to rule 4).

III.2 Analysis of the transmission and distribution power system

The assessment of the impact of PV on technical system operation is carried out by means of **steady-state** and **dynamic** simulations. A simplified single line diagram (SLD) at 132 kV of the power system of the island of Viti Levu is shown in Figure 3.

The SLD provides an intuitive view of the electrical grid but it has not been plotted according to geographical location of substations. The transmission lines (132 kV) interconnect the substations close to the hydropower plants. The transformers on these substations feed the 33 kV grid whose detailed SLD is not depicted. The loads (feeders) are connected to 11 kV voltage level of the transformers.

A. Steady-state simulations

- *N-1 contingency analysis:* consists of verifying the thermal and voltage limits lines and transformers following a disconnection of a grid asset.

B. Dynamic simulations

- *Transient stability study:* consists of simulating faults at different buses. The transient stability margins are quantified by means of the critical clearing time (CCT).
- *Frequency stability study:* consists of simulating a trip of the major operating generator unit. Frequency stability are quantified by means of:
  1. Minimum frequency, in Hertz (Hz) (f_{min}); and 2. Shed power, MW (p_{shed}).
- *Voltage stability study:* consists of a long-term simulation of a contingency closer to a problematic zone in terms of voltage stability.

The analysis is performed using representative critical snapshots, carefully selected:

- *Contingency analysis:* the high-demand scenarios are used as they are the most critical, causing overloading of the lines and voltage drop in the system.
- *Transient stability analysis:* in general, low-demand scenarios are the most critical since fewer number of synchronous generators are operating in the power system. Nevertheless, heavily loaded scenarios are also of interest, since they increase angular separation in pre-fault operating point.
- *Frequency stability analysis:* low-demand scenarios are the most critical since fewer number of synchronous generators are operating in the power system. As an example of the results obtained, Figure 6, presents a plot of frequency after tripping of a bigger operating generator the primary control acts to stabilize the frequency, using the PSSE® dynamic model of the power system.
- *Voltage stability analysis:* heavily loaded scenarios are used as they can cause voltage drop at the buses to values closer to their lower limits.

III.2.1 Dynamic model

The dynamic model of the power system of the island of Viti Levu, aiming at analysing steady state and dynamic simulations, was developed using power system simulator for engineering (PSSE®). Dispatch profile of generation expected to cause severe challenges due to high share of

PV penetration and situations where the power system has lower synchronous generation were considered for the simulations. The inherent variability of the solar PV and operability of load shedding was also included in the study.

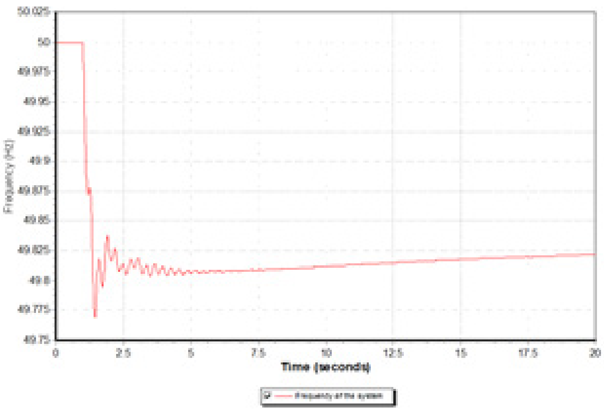
Dynamic studies of the power system including three-phase fault and trip of a major generation unit at utility-scale level were simulated.

Sequential load flow studies were carried out. They aimed at assessing the voltage regulation aspects and the impact of short-circuit currents and to identify constraints related to protection settings. Representative feeders, categorized as industrial, commercial and residential were analysed for the study to assess the impact of DPV.

The following assumptions were made throughout the study:

- PV installations at or below 11 kV were considered distributed generation.
- PV installations at 33 kV or above, were considered centralized (utility-scale) generation.
- the capacity for utility-scale installations is equal or below 5 MW.
- The 11 kV feeders were modelled and simulated as aggregated loads.

Figure 6: Frequency stability analysis.



IV. Relevant Conclusions

One of the challenges that IRENA faces when providing technical support to its Member Countries, particularly the islands, is the accurateness and availability of data and timely response from the countries to provide information, mainly due to limited resources of the utilities. This challenge also verified when analysing larger power systems as it may imply a considerable time to collect and process data.

The methodology used to define hosting capacity for the island of Viti Levu can be applied in the studies of different islands. While the definition of indices can be generalized, the application of the rules 1 depends on the availability of the information of all feeders, rule 2 and rule 3 needs to be assessed and agreed by the utility as it defines the extent to which conservative approach needs to be considered and rule 4 depends on voltage drop compensation method for on-load tap changer (OLTC) of the existing transformers.

The maximum hosting capacity at feeders' levels that were defined without assessing the utility-scale power system, based on peak demand at 12h00 as of data collected referent to 2017 were:

- with rule 3: 100% of value of peak demand at 12h00.
- with rule 4: 52% of peak demand at 12h00.

After performing the grid assessment at utility level, comprising of steady-state and dynamic simulations, it was concluded that for the initial phase, while a pre-defined fixed PV amount corresponding to 16% of the peak demand at 12h00 deployed at utility scale, the maximum DPV value can vary between 6.2% and 25% of the peak demand at 12h00, depending on the technical requirements to be considered by the utility such as fault ride through (FRT) based on grid code options.

The above means that, if for instance the grid code of Australia is implemented, the maximum hosting capacity of PV deployment in the Viti Levu power system is 41% of the peak demand verified at 12h00 in 2017.

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Update on Quality Technical Training Initiatives for the Pacific

Geoff Stapleton & Sandip Kumar
Global Sustainable Energy Solutions

Overview
Key issues with respect to the solar energy industry and training in the Pacific include:

- Over the last 5 to 8 years donors have spent in excess of US$1billion on solar projects in the Pacific region however there has been negligible amounts spent on training and capacity building that meets the current needs of industry.
- 6 million Euros has been spent on the EU PacTVET project for Climate Change and Sustainable Energy training development, but the material developed has not met the current industry training needs.
- Over the years many reports have been written on "training needs" including back in 2005 the Pacific Renewable Energy Training Initiative (PRETI) (a document developed to encourage donors to spend $4m on developing training capacity) was jointly prepared by Mr Geoff Stapleton and Dr Herb Wade, but nothing eventuated.
- Training courses that have been conducted have tended to be ad hoc and meanwhile NOT all the private companies installing systems in the Pacific can source training for their technicians.

To support the above, the general feedback at the conclusion of every sustainable energy industry meeting, conference and workshop has been, that the sustainable energy industry and power utilities need more training.

The industry has grown to the point that GSES firmly believe that Renewable Energy training must become "mainstream" – that it is conducted by in-country training institutes involved with other "trade" training.

Quality Training
Training providers in the Pacific are often approached by countries, regions and donors on concerns as to how to establish quality training program for renewable energy (RE) in the Pacific. However, not many people really know what a quality training for technicians is. To help overcome this GSES was the lead author of a joint publication of the IEA PVPS (International Energy Agency's Photovoltaic Power Systems Programme) Task 9 and the International Solar Energy Society (ISES) titled: "*Guideline to Introducing Quality Renewable Energy Technician Training Programs*"

The guide provides an overview of:

- quality training frameworks;
- the processes involved in developing competency-based Quality - Training programs; and
- the capacity building requirements for the technical and vocational education sector

The overall objective of the guide is to enable stakeholders to identify the best way to introduce renewable energy courses into an existing quality training framework or, if one does not exist, to establish a process whereby the training being provided is following quality procedures.

Quality technician training comprises two main components:

- Quality management standard
- Competency standards, also known as units of competency, Job Task analysis, etc.

To complement the development of quality technical training on renewable energy in the Pacific, Sustainable Energy Industries Association of the Pacific Islands (SEIAPI) has been working with the Pacific Power Association (PPA) in developing technical guidelines, training competency standards and establishing an accreditation/certification program for companies, designers, installers and inspectors.

PPA/SEIAPI Certification and Accreditation Program
To support the development of a quality based sustainable energy industry, SEIAPI and PPA has developed a certification/accreditation scheme for individuals and organizations (business entities). Initially, the PPA/SEIAPI Technician Certification and Accreditation Program was launched by

SEIAPI in May 2012. Later in April 2014, the Scheme was relaunched as the PPA/SEIAPI Certification/Accreditation Program whereby Individuals are able to be certified as:

i) designers;
ii) installation (maintenance) technicians; and
iii) inspectors (of system installations).

The organisation (or business entity) is able to be accredited as the supplier of products, systems and services. However, to be accredited in providing products/services in a specified technology, the organisation needs to have certified designers and installers on their staff or under sub-contract. If there are any Individuals who operate as sole traders within the industry, for example they might sell and install RE equipment or be an energy efficiency auditor, then they must apply to be both a certified individual and an accredited organization.

The program has two levels of certification/accreditation: provisional and full. An individual will need to successfully complete a training course which has been recognised (and or specified) by PPA/SEIAPI. As the certification/accreditation program is an industry-based program, SEIAPI/PPA would verify that the individual is actually incorporating into their work what they have learnt in such a training course. Therefore, both levels of membership, i.e. (i) the individuals and (ii) the organisations, will initially receive 'provisional' certification/accreditation after successfully completing the training. Full Certification would be provided after they submit evidence that they have applied the training received in their work.

Currently, technologies under which certification exists include:

- PV Grid connect systems
- Stand Alone PV Power systems
  - Level 1- Solar Home Systems
  - Level 2- Stand-alone systems with/without Inverters
  - Level 3 Hybrid Power systems

A list of valid provisionally/fully certified installers are available from:
http://www.seiapi.com/certification-and-accreditation/

Caption: Credible Solar Installation Works: A proof of certified installers

Development of regional competency standards

In 2011, SEIAPI worked with the University of the South Pacific (USP) to host an inaugural meeting, which led to the formation of the Renewable Energy & Energy Efficiency Training Competency Standards Advisory Committee and associated technical committees. The USP then acted as chair of the advisory committee and SEIAPI took the role of managing the technical committees.

In order to obtain provisional certification, individuals must attend training courses which use the competency standards (also known as unit standards or Job Task Analysis) developed and approved by the Renewable Energy & Energy Efficiency Training Competency Standards Advisory Committee as the basis for their curriculums.

In May 2012, SEIAPI released the following training competency standards:

- Designer of Grid Connect PV Systems
- Installer of Grid Connect PV systems

Later in September 2013, SEIAPI released the following trainer competency standards:

- Designer of Solar Based Off-Grid Power Systems
- Installer of Solar Based Off-Grid Power Systems
- Installer and Maintainer of Solar Based Off-Grid Power Systems

On the other hand, the 6 Million EU-PacTVET project started late 2014 focussed on training for climate change and sustainable energy and led to the development of what is known as Certificate I, II, III and IV for Sustainable Energy. This, however, was good for young people gaining basic knowledge but not what the industry required to meet current demand for technicains to design and install systems.

In 2018, as part of the SEIDP (Sustainable Energy Industry Development Project), SEIAPI/PPA updated old competency standards which are more accurately known as unit standards under Pacific Register of Qualifications and Standards (PRQS). This work involved the demarcation of PV systems through levels. A Technical Advisory Committee was formed including Solar Engineers, Trainers and Solar Consultants from various countries in the Pacific. A number of unit standards were developed which were then approved by the Technical Advisory Committee. Upon submissions to EQAP and a thorough vetting the approved unit standards have been accredited under PRQS. The following unit standards have been accredited:

- Designer of Grid Connected PV Systems
- Installer of Grid Connected PV Systems
- Designer of Off Grid PV Power Systems – DC Load SHS
- Designer of Off Grid PV Power Systems – Stand-alone Solar Systems
- Designer of Off Grid PV Power Systems – Hybrid Power Systems
- Installer of Off Grid PV Power Systems – DC Load SHS
- Installer of Off Grid PV Power Systems – Stand-alone Solar Systems
- Installer of Off Grid PV Power Systems – Hybrid Power Systems
- Maintainer of Off Grid PV Power Systems – DC Load SHS
- Maintainer of Off Grid PV Power Systems – Stand-alone Solar Systems
- Maintainer of Off Grid PV Power Systems – Hybrid Power Systems
- Operator and Maintainer of Grid Connected PV Systems

Caption: Presentation of certificates of 12 accredited unit standards by EQAP to SEIAPI/GSES Rep (Sandip Kumar) at SPC Nabua office, Suva, Fiji [2].

As a continuation of SEIDP in 2019/2020, seven other competency standards are to be developed and to be submitted to EQAP for accreditation. Some have been developed while others are in progress, however, there will be a consolidated submission for the following:

- Selection and Installation of Solar Water Pumping Systems
- Selection and Installation of Solar Water Heaters
- Energy Efficiency – Residential and Small Commercial Applications
- Designer of Grid connected PV system with Batteries
- Installer of Grid connected PV system with Batteries
- Designer of Micro-hydro Power Systems
- Installer of Micro-hydro Power Systems

Overall, these competency standards are available as skill-sets to any training institution in the Pacific that wishes to develop certificate, diploma or degree level programs on renewable energy technologies and energy efficiency. These competency standards outline the complete design, installation and/or maintenance procedures for RE/EE technologies and if properly implemented within a course backed with recommended training set-ups, it will greatly meet the needs of the industry in terms of preparing quality/trained workforce.

PRIF: Regional Training Program scoping study

In 2019, Pacific Region Infrastructure Facility (PRIF) administered a regional training program scoping study. The scoping study intended to investigate and confirm training needs in the energy sector which can be best addressed by a regional approach. This technical assistance was provided by ITP Renewables from May to August 2019. The study mainly focussed on the following outcomes:

- Frameworks for design. 11 principles, including:
    - Addressing previous coordination and scheduling issues
    - Sustainability, toward cost recovery and away from ad hoc or project basis
    - Involve the private sector (access to courses and role in planning)
    - Distributed (in-country) training where possible for example, Lautoka Energy Fiji Limited (EFL) when centralised
- Recommend a feasible model
    - Governed and run from existing institutions

(PPA, EFL, and skill based independent board design)
- Identify the required support and mechanisms to deliver (next steps)

During the time of writing, the recommendations and outcomes of this report were to be finalised. The outcomes, however will further steer the 'wheels of change' to accelerate training provision in the region.

GIZ Pacific Training Resources Project
Another major milestone in 2019 was the funding support by GIZ to facilitate the purchase of training resource material that were developed by GSES to aid training institutions in the Pacific. Again, PPA was chosen to administer the license regionally. GIZ has purchased for PPA a license to use GSES training resource material for the four courses, namely:

- Design and Install Grid connect PV Systems
- Design and Install Off Grid PV Systems
- Design and Install Hybrid Systems
- Design and Install Grid Connect PV with Batteries

The training resource material for each course includes:

- Face to Face Course Agendas
- PowerPoints for lectures
- In class exercises and answers
- Practical Session Descriptors
- Assessment Material
- Trainer's Guide

Each course has an accompanying recommended list of equipment, materials, equipment lay-out structure for training, etc.

Caption: Typical PV training set-up

Furthermore, using these training resources, GIZ is supporting development of a training centre at Solomon Islands National University mainly through:

— Purchasing training hardware
— Training of trainers (ToT)

In the coming years, there is a high possibility of expanding this support to other countries in the Pacific. SEIAPI is adamant to be engaged with this initiative to make accessible more training avenues for their members. All members shall be catered however, countries such as Fiji, Vanuatu, PNG, Tonga, Cook Islands and Samoa will be prioritised as private solar systems increase over time.

Licencee of Training manual
It is planned that SEIAPI will be the licensee for the following GSES manuals:

- Design and Installation of Grid Connect
- Design and installation of Stand-Alone Power Systems
- Design and Installation of Grid Connect PV with batteries

These manuals will be available to PPA/SEIAPI members at attractive prices. The local printing possibilities will be explored to ensure affordability of such resources to the Pacific energy fraternity.

Conclusion
SEIAPI is embarking upon strengthening the current PPA/SEIAPI certification and accreditation scheme, however, it faces funding challenges to bring consistency in its operations. SEIAPI is adamant, that in the near future, it will overcome these challenges to improve the quality of products and services, empower more training and enhance capacity building initiatives in the sustainable energy industry along with fostering partnerships with regional organisations, donors and agencies for the betterment of the RE industry as a whole. The PPA/SEIDP Project has supported the development of technical standards and competency standards to further build upon this foundation, a quality, productive, recognised and a sustainable industry.

'Eua and Vava'u to Benefit from New Solar Energy Project

Infratec

The Government of Tonga has signed with NZ renewable energy company Infratec and JV partner NETcon to design and deliver additional solar generation and battery storage systems on ‘Eua and Vava'u as part of the Tonga Renewable Energy Project.

Design and procurement work will begin immediately and the project is expected to be completed by mid 2021 assuming no longer term Covid-19 restrictions — bringing more reliable, affordable and sustainable energy to the two islands.

The New Zealand based companies will deliver on-grid solar power plants and battery storage systems on the islands— significantly increasing access to renewable energy on the islands and reducing reliance on current diesel generation

Infratec Chief Executive Greg Visser said the project would have significant benefits for local people and businesses and the economy.

“This is important infrastructure for ‘Eua, Vava'u and for the Kingdom of Tonga. We will be designing and delivering the infrastructure to more than double the solar power currently on the islands. For ‘Eua, this translates to 28% of their energy needs, and 7% for the larger island of Vava'u”.

“On a technical level, these systems include the battery needed to deliver solar day and night, and for the first time run the islands off-diesel for periods of time.”

It will help Tonga achieve its renewable energy goals and reduce the dependency on fuel imports — ultimately reducing the cost of doing business, creating new business opportunities, and freeing up household income for other needs.

“We will also be delivering the project in a way that brings as much benefit as possible to local people and communities — including employing local community liaison staff, providing employment and training for local people, and delivering an HIV/Aids prevention programme on each of the islands.”

The project is administered by Tonga Power Limited and the Asian Development Bank and funded by the Green Climate Fund, Asian Development Bank, Australian Department of Foreign Affairs and Trade and Tongan Government.

“We'd like to acknowledge all of our partners — great projects like this are borne out of great leadership, and the Tongan Government is the leader in the Pacific in showcasing how renewable energy can bring lasting benefits to its people.

“We are very much looking forward to working with the Government and the people of Tonga, and in particular the people of ‘Eua and Vava'u.”

The project will get underway immediately, for completion mid 2021 without extensive Covid related delays. With Covid-19 restrictions in place, local partners will commence the initial site works (such as site clearing and survey), while Infratec engineers kick off the design working remotely in New Zealand.

Infratec and NETcon are also designing and delivering solar power/battery storage power plants and distribution systems on five outer islands (O'ua, Tungua, Kotu, Mo'unga'one and Niuafo'ou), through the Tonga Renewable Energy Plan.

Note to editors:
Infratec is a subsidiary of South Canterbury lines company Alpine Energy, with a mission to deliver innovative renewable energy solutions to create positive impacts for communities, businesses and the planet. It has installed sustainable renewable energy systems around the world from Afghanistan to Tuvalu and New Zealand.

Managing The Inevitable: Downtime

Marshalls Energy Company (MEC), Marshall Islands

Expecting the Unexpected

Planning for expected and unexpected power outages is a crucial part of any energy utility operation's contingency plan. Outage management for the rapid recovery of electrical service consists of careful monitoring and identification of line faults, speedy mobilization and deployment of crews and equipment, and timely coordination between the teams on the ground and a control center. Marshalls Energy Company (MEC) in the Republic of the Marshall Islands (RMI) has assessed its current and future needs in mitigating potential outages by identifying areas to build capacity and critical items to procure and implement. Aging and dilapidated infrastructure and increasingly frequent outages need attention in order to secure the reliability of the existing grid and to reduce downtime for customers. This is especially critical for the islands of Majuro and Ebeye where two thirds of the population reside and are the centers for government and commerce.

Cause and Effect

Where some parts of the world struggle with cold temperatures that can freeze cable and equipment, the Pacific Islands are battered with tropical, seasonal, and extreme weather events like tropical storms and cyclones. Strong winds knock down trees and cause flying debris to damage and interrupt overhead lines. Heavy rains, storm surges and rising sea levels due to climate change exacerbate existing damage on underground cables, joint connections, and transformers and switches that have already undergone wear and tear from saltwater corrosion and water damage. Sudden fluctuations in supply and lightning can also short out a system.

The financial impact of downtime varies based on industry, length of outage, time of day, and the number of people. Based on billing reports and available outage data, MEC's average revenue loss per hour when there's a power outage is $5,532. The losses to private organizations and other government agencies are unknown but can be substantial.

The cost of downtime is not limited to dollars. The loss of power can severely impact essential services provided by government offices, medical facilities, businesses, and first responders. Everyday operations and overall quality of life is impacted every time the power goes out.

Decreasing Downtime

The grids in RMI consist of overhead and underground distribution networks and, where faults in aerial lines are easier to identify and locate, finding underground faults pose another challenge. To minimize potential downtime events, MEC recently acquired a cable locator and a fault locater truck (also known as a "thumper truck") to help identify the location of cable faults in the underground distribution system more quickly. The linemen would connect the thumper to the underground cable and send pulses of electricity into the line. By calculating the time for the electricity to travel to the fault and back, linemen are able to determine the location of the fault and identify where to begin digging.

However, due to the existing configurations of the underground cable, the thumper equipment has not produced the desired results of significantly reduced fault location times. As an alternative solution, MEC is investing in sectionalized cabinets to enclose the joints above ground, effectively removing the future need for distribution crews to excavate for potentially burnt or damaged cables.

Installation of surge arrestors prevents risk of damage to the alternators due to voltage surges. There are several possible sources of surges that may have damaged the MEC alternators, including direct lightning strikes, lightning surges entering the station along a phase wire, a switching surge entering the station on the incoming line, or a switching surge generated within the station. To eliminate these risks, it is necessary to install surge arresters directly connected to the generator terminals.

The preventative maintenance plan for the generation side includes major repairs to E5, which was damaged due to fire and a major overhaul of E7, which was not producing the expected generation output and capacity. Additional items includes regular maintenance for smaller engines, scheduled visual line and transformer inspections and maintenance, and manhole inspections. A newly purchased bucket truck will add capacity in the heavy equipment fleet by allowing more staff to address multiple faults simultaneously.

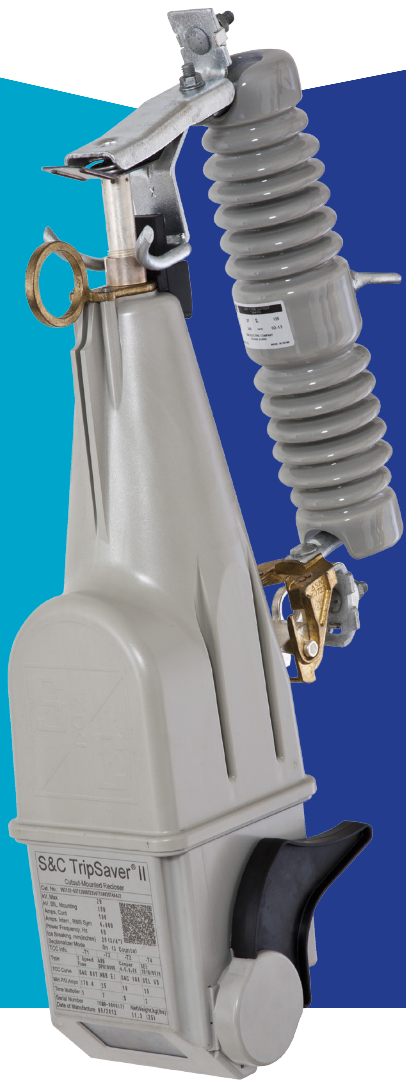
Future plans for distribution include upgrading cable sizing and equipment to stainless steel, adjusting transformer sizes, and the introduction of additional smart metering on transformers to increase monitoring capacity.

During an outage, the whole MEC team from distribution and generation to the CEO is involved. Careful coordination and a streamlined reporting structures are imperative as the risk to trip the whole feeder and sometimes the island, ranges from medium to high. A capacity-building plan includes adding skilled linemen and a distribution advisor.

Climate Resiliency

The greater energy roadmap for RMI includes an ambitious commitment to 100 percent renewable energy by 2050. Energy security requires equal parts integration of these future renewable goals and fixing and maintaining existing infrastructure to better the service to the island communities of RMI.

Two Results. **One Solution.**



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Tonga Renewable Energy Project (TREP)

Tonga Power Limited (TPL), Tonga

NUKU'ALOFA, TONGA (02nd June 2020) — The Tonga Renewable Energy project (TREP) is currently underway with its contributions to the Tonga Energy Roadmap 2010-2020, with a budget of 53.2 million consisting of 44.6m USD from donor funding and 8.6m USD from Tonga Power Limited and the government of Tonga. The Tonga Renewable Project builds on achievements and lessons learnt through earlier investments in the renewable energy sector and provides the necessary scale, to transition Tonga to a low carbon future, climate resilience and affordable energy.

Project Benefits & Project Scope

It is estimated that TREP will reduce CO2 emissions by 13,616 tonnes per year and 340,395 tonnes over the projects 25-year lifespan. The project will provide enabling technical solutions (e.g battery energy storage system (BESS) etc) and capacity building for promoting more private sector investments on renewables, which will in turn help Tonga meet its 50% Renewable Energy target.

The project consists of Tonga's first ever grid stability and Load Shifting Battery Energy Storage System for Tongatapu. Solar and storage for Tonga's outer islands 'Eua and Vava'u will be installed to increase their renewable energy share aswell as installation of solar battery and minigrids on the outer islands of O'ua, Tungua, Kotu, Mo'unga'one, and Niuafo'ou which will be 100% Renewable.

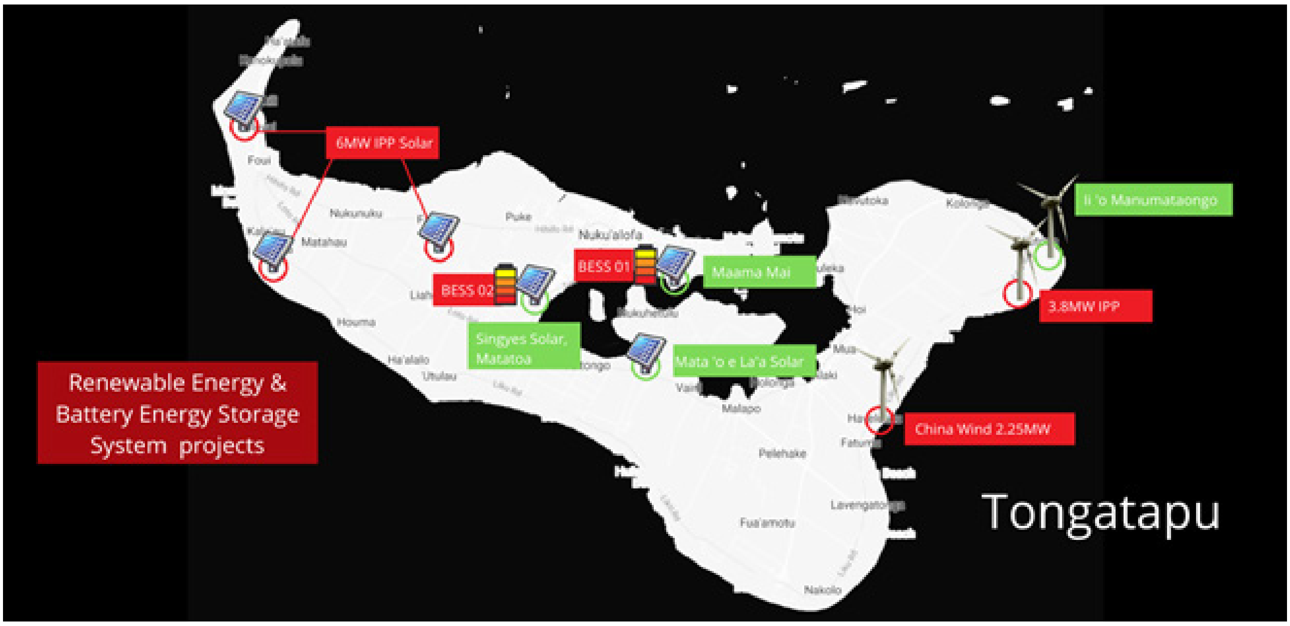
COVID-19 Impacts

Impacts of COVID-19 has affected the progress of TREP with completion dates for projects being delayed due to the restrictions for shipping of certain project materials. Engineering specialists that have been recruited from overseas for some of the projects will wait till borders are open before being able to visit Tonga to overlook technical aspects of some of the projects.

Project Timeframe & Status of Implementation
Although the impact of COVID-19 has had a big effect on the progress towards achieving the 50% Renewable Energy target, Tonga Power's major projects team is working hard towards ensuring that progress is steady. With the restrictions of COVID-19 the project team has utilized local contractors for civil construction of the:

1. TREP-01, Grid Stability BESS: est completion date **November 2020**
2. TREP-02, Load Shifting BESS: est completion date **December 2020**
3. TREP-03, Solar for 'Eua & Vava'u: est. completion date **Mid 2021**
   Off-grids **end of 2021**.

Upcoming Renewable Projects



With the implementation and completion of TREP, Tonga Power's upcoming projects will be able to be integrated with ease into the grid due to the enabling technical solutions such as the BESS for load shifting and grid stability. These upcoming major projects include:

- **6MWIPP Solar:** PPA signed with Sunergize NZ, this project is currently on its implementation phase and is spread out through 3 different locations in Western Tongatapu with 2 sites estimated to be completed by the end of this year and 3rd site to be completed early 2021.
- **China Wind 2.2MW:** Donor Funded by Government of China, this project is currently in progress and aims to be completed 2021.
- **Wind IPP 3.8MW:** Finalizing PPA negotiations also aimed to be completed in 2021.

Check out our website www.tongapower.to for updates on our progress towards 50% Renewable Energy.

Hydro Development (Tafitoala/Fausaga, Fuluasou & Vailoa Palauli)

Electric Power Corporation (EPC), Samoa

TAFITOALKA/FAUSAGA HYDRO POWER PLANT

Source intake

Hydro power station completed and Gen-set installed and commissioned

Project Title: Tafitoala & Fausaga New Hydro Plant

Implementing Agencies: MOF/EPC in association with ADB

Project Background: New hydro plant capacity is 600KW; 100% complete and presently being commissioned to be in service in November 2018. Plant uses water from two rivers. Annual Production is approx 2 million kWh (or 1.36% of Upolu's Total Annual Energy Demand); saving 433,000 liters of diesel or $1.36 million and reduction of 1.25 tons of CO2 greenhouse gas emission pa. Primary Contractor is Pernix MAP JV and subcontractors are Bluebird Construction, Vortex Group, MTL Designer and Maskell Production Ltd; total contract cost is $9,990,827 SAT (equivalent). Construction of communication system for integration with SCADA/Micro Grid Controller system is contracted to Gabot Holding.

For project Govt. (MNRE/ EPC) took and proclaimed lands from 25 families in Tafitoala and Fausaga and compensation have been paid by EPC to all except 5 families; 3 in a land dispute, and payment of compensation for other 2 families in process now. Project Management by EPC's Project Manager & PMU assisted by Implementing consultant Stantec MWH NZ Ltd.

Project Implementation Status: Complete and successfully commissioned and put into operation on 16th November 2018.

Funding: Donor Partner (s) – Project is part of "Renewable Energy Development and Power Sector Rehabilitation Project" funded by a total grant of US$27.76 million (or $70.79 million Tala) from Asian Development Funding, Multi donor Clean Energy Fund, Disaster Response Facility under ADF, European Union, NZ Government, Samoa Government and EPC

FALEATA VAILOA (PALAULI) NEW HYDRO PLANT

Implementing Agencies: MOF/EPC in association with ADB

Project Background: New hydro plant capacity is 200KW; 100% complete and presently being commissioned to be in service in November 2018. Plant uses water from the same Faleata River where SWA's drinking water intake is located. Water is first used to generate electricity in new hydro plant before it discharges to Samoa Water Treatment in Vailoa for drinking portable water supply. Annual Production is approx 0.5 million kWh pa (or 3.6% of Savaii's Total Annual Energy Demand); saving 125,000 liters of diesel or $0.4 million and reduction of 0.3125 tons of CO2 greenhouse gas emissiom pa.

Primary Contractor is Pernix MAP JV and local subcontractor is Bluebird Construction; total contract cost $5,302,294 SAT. For project Govt. (MNRE/EPC) took and proclaimed lands from 15 families in Vailoa and compensation have been paid by EPC to all except 1 family (EFKS Church) who want land to be leased.

Project Management by EPC, PMU assisted by Implementing consultant Stantec MWH NZ Ltd.

Project Implementation Status: Complete and presently being commissioned and expect to be in service later this month; November 2018.

Funding: Donor Partner(s) – Project is part of "Renewable Energy Development and Power Sector Rehabilitation Project" funded by a total grant of US$27.76 million from Asian Development Funding, Multi donor Clean Energy Fund, Disaster Response Facility under ADF, European Union, NZ Government, Samoa Government and EPC.

Vailoa Palauli PM during groundbreaking

Works in progress - Hydro power station

Works in progress for power station

Catchment area - Vailoa Palauli

Contractors at work at the catchment area

FULUSOU HYDRO POWER PLANT

Implementing Agencies: MOF/ EPC in association with ADB

Project Background: New hydro plant capacity is 680KW; 80% complete and under construction and scheduled to be completed in February 2019. Plant uses water from the Fulusaou River through an old dam that was built in the 1950s. Part of contract is refurbishment of dam to meet "NZ Standards Of Large Dams" (NZSOLD). Annual Production is approx 2.58 million kWh pa (or 1.8% of Upolu's Total Annual Energy Demand); saving 645,000 liters of diesel or $2.031 million pa and reduction of 1.6 tons of CO2 greenhouse gas emission pa. Primary Contractor is Pacific Engineering Projects Ltd and local subcontractor is Transwork Ltd; total contact cost is $15,924,805 SAT. Govt. owns legal easement for whole project except one family that part of Govt. legal easement is exchanged with family at no cost. Penstock runs underground through Faleata Golf Course. Project Management by EPC PMU assisted by Implementing consultant Stantec MWH NZ Ltd.

Project Implementation Status: Project is 80% complete and construction and installation of generator in progress; schedule completion date extended to February 2019.

Funding: Donor Partner(s) –Project is part of "Renewable Energy Development and Power Sector Rehabilitation Project" funded by a total grant of US$27.76 million from Asian Development Funding, Multi donor Clean Energy Fund, Disaster Response Facility under ADF, European Union, NZ Government, Samoa Government and EPC.

Fuluasou - Power Station (inset) power station inside

Intake structure

Penstock 1

Penstock 1

PPA/World Bank/Korea Green Growth Trust Fund Virtual Knowledge Exchange on EVs and BESS

Andrew Daka
Executive Director - Pacific Power Association

Suva Fiji, 17 June2020

The Pacific Power Association in collaboration with the World Bank and the Korean Green Growth Trust Fund facilitated a Virtual Knowledge Exchange with representatives from the utilities of the Pacific Power, energy officials from various Pacific Islands Countries and Territories Governments. The event was a two day Virtual event conducted on line Knowledge Exchange (KE) on E-mobility and Energy Storage System (ESS).

The event was conducted as knowledge exchange between the representative from the Korean Electric Vehicle(EV) and Battery Energy Storage (BESS)industry and the Pacific delegates to learn more about the EV and

This event was funded by WB Korea Green Growth Trust Fund (KGGTF) and is in line with the Bank's Regional Sustainable Energy Industry Development Project.

The aim of the event was to

i) To understand the specific situation, assess actual application, and needs for the deployment of E-mobility and ESS in Pacific Island Countries and Territories (PICs) and
ii) To understand Korea's EV and ESS policy framework and share experiences and knowledge on deployment of EV and ESS. Korea's experiences in promoting EV and ESS are of high interest and relevance to PICs with its EV program in Jeju Island and deployment of solar/wind plus ESS system in remote islands. We hope you will find this exchange helpful to developing PIC-wide regional E-mobility policy and program. Korean institutions will share their experiences and knowledge on deployment of EV and ESS.

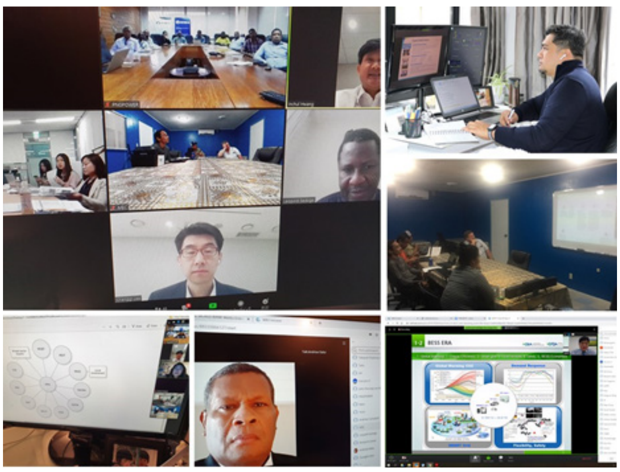
For the Pacific Islands, the introduction of electric vehicles would address two of our major challenges; one being the issue of energy storage and the other transportation.

RE development in the Pacific - Project sizes
Over the last 3- 5 years we have seen a drastic change in RE development in the region. There has been a significant shift in the project sizes with utilities getting more confidence and experience in developing, operating and managing projects. The majority of the utilities are developing multi MW projects.

Storage - essential component of Projects
Majority of Renewable Energy project now in the Pacific, especially PV, have an storage component for purposes of grid performance in terms of stability and/or increasing the contribution of RE to the energy mix.

Electric Vehicles - New Opportunities
There is presently little work in EV at in the Utilities. The only notable work at present is in Cook Islands with TAU. Other utilities like PPUC (Palau) have a couple of donated vehicles but limited charging facilities

The introduction of EV would bring about a whole new set of possibilities and opportunities. It could significantly increase the energy storage capacity on the network.



Charging stations would provide new customer base for the utilities to recover any drop in demand that might have been brought about by customers being more energy efficient or those that have RE installations.

To successfully rollout any EV initiative, there would need to be work in drafting relevant Policy to unsure the technical and financial viability of EVs. This is very important and I hope that the work that SPC is currently undertaking will provide us more information on what the regions intend to do in terms of EV policies.

The rollout of any EV initiatives would greatly assist the Pacific Island countries in progressing towards their NDCs; in terms of reduced fuel consumption especially when using RE generation for the charging stations.

The use of EV is ideal for most PICTs as the majority of the islands are reasonably flat and driving distances are relatively short.

On that note I thank again our colleagues from the Korean institutions for being able to share their knowledge and experience and the Korean Green Growth Trust Fund for funding the Knowledge Exchange.

More than 90 participants attended the event over the 2 days.

Welcome!

New Allied Member

One new Company has joined PPA as an Allied Member since our last PPA Magazine. The new member is:

BEIJING EASWEST ENERGY CO. LTD: Beijing EastWest Energy Co. Ltd is based in Lautoka, Fiji. Their primary activity is renewable energy project turnkey services especially solar and wind. Their secondary activity is supply power equipment.

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