

Workshop Summary Report

**Efficient Renewable Energy Integration in
the Pacific Islands region**

Koror, Republic of Palau

8 – 12 April 2013

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1. Introduction

IRENA held a series of workshops on harmonised technical guidelines and grid stability assessments, from 8 to 12 April 2013 in the Republic of Palau, aimed at promoting efficient renewable energy integration in the Pacific Islands. The workshops provided policy makers, grid operators and utility experts with trainings on technical guidelines for solar photovoltaic (PV) systems and the use of modelling tools to assess the grid stability in situations where the power grid has a higher share of integrated renewable energy. Close to forty participants from eight island states in the North Pacific participated. The workshops were organised in collaboration with the Pacific Power Association (PPA), the Sustainable Energy Industry Association of the Pacific Islands (SEIAPI), Palau Public Utilities Corporation (PPUC), and the Secretariat of the Pacific Community and the North Pacific, African, Caribbean and Pacific Renewable Energy and Energy Efficiency Project (SPC North-REP).

This report summarises the discussions and outcomes from the workshops and provides details on the next steps related to activities targeting an efficient integration of renewable energy in the Pacific Islands region.

2. Workshop on Harmonised Technical Guidelines for PV Systems in the Pacific Islands

2.1 Background

The Pacific region relies heavily on costly imported petroleum fuels to meet their energy demands essential for national economic and social development. Fuel import in 2009 was approximately 1.3 bn litres, 16% of which was used for power generation. A number of Pacific Island countries have recognised the importance of diversifying the energy mix to include renewable energy (RE) sources. Thus a number of Pacific Island countries have set ambitious RE targets with the objective of reducing their dependence on costly imported fuel. Regional examples of this type of effort include Tokelau, which has transitioned from a petroleum dependence to 100% RE, and the Cook Islands, Niue and Tuvalu, all of which are on their way to achieve a similar target.

Solar and wind resource integration are both gradually increasing in the Pacific region. The number of solar PV systems (off-/on-grid) installed throughout the region has increased significantly since 1980's and cost per unit has fallen alongside technology improvements, leading to increased investment at national and regional levels. This changing landscape has not been fully matched with appropriate level of support such as policy and regulatory framework, human capacity and skills, nor the infrastructural development that fosters private participation and socio-economic growth.

IRENA has adopted a number of initiatives to support the Pacific Islands in their transition to a renewable and clean energy economy. The Global Renewable Energy Islands Network (GREIN) launched in Auckland, in March 2013 serves as the global platform that supports IRENA's work on grid integration and RE standards for islands.

2.2 Content of the workshop

The workshop on harmonised technical guidelines for PV systems has been designed by IRENA, in collaboration with the PPA and SEIAPI, to provide practical knowledge and hands-on experience regarding the design, installation and maintenance of solar PV systems. The workshops also provided participants with an opportunity to share their experience and knowledge in the area of renewable energy integration into power grids.

The focus was primarily on the implementation of simple and practical approaches commonly adopted as industry best practice with regard to the design, installation, repair and maintenance of off-/on-grid solar PV systems. The workshop material used the technical guidelines for PV systems in the Pacific Islands region, developed by SEIPA and PPA.

This material contains relevant information concerning the practical approaches that are essential for designing a solar PV system and includes:

- Setting design criteria in terms of system size that meet the clients' requirement;
- Defining the purpose and ensuring compliance with relevant industry and government related standards to safeguard lives and minimise damages to infrastructure;
- Performing visits to the site; and
- Requesting quotations during procurement process.

The safe and efficient installation of PV systems into complex grid connected systems are reliant on the availability of manuals and documentation. This is also the case in supporting the subsequent maintenance and repair of the system. Poor installations can often result in system safety and performance being compromised. On the other hand, regular training and upgrading of local skills and capacity, can contribute to the sustainability of the system’s performance.

2.3 Discussions and outcome of the workshop

Participants learnt during the workshop that issues of safety, sustainability and system performance are equally important to the design, installation and maintenance of off-/on-grid systems, as shown in Figure 1, and ultimately result in client satisfaction and a healthy industry.

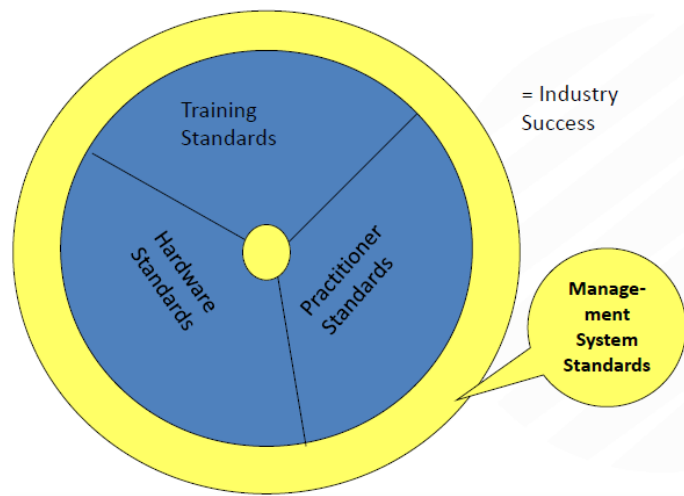


Figure 1: Standards required for a complete renewable energy system¹

Off-grid installations in particular, are often supported by battery storage that is costly to purchase and maintain. Furthermore, off-grid systems are commonly installed across very remote islands and rural areas where the physical environment is highly corrosive. The poor local transportation linkage and communication including the lack of local capacity are key barriers for maintaining the off-grid systems.

Participants were informed about a range of practical techniques for monitoring (*e.g.* weather patterns, and power usage), managing (*e.g.* daily consumption, usages of devices and behaviour), and maintaining (*e.g.* cleaning batteries and panels) the PV systems to achieve a system sustainable performance.

2.3.1 Participants’ discussion

The workshop also included a group’s discussion session. During this session participants identified a number of issues and options affecting the implementation of RE standards (solar off-/on-grid) across the region. These issues are listed below.

¹Source: Stapleton, G. (2012) PowerPoint presentation “Harmonisation of standards for renewable energy systems”, Bonn, Germany.

Group	On-Grid Solar	Off-Grid Solar
1	<ul style="list-style-type: none"> Compliance to standards is largely voluntary rather than mandatory. Regulations regarding the conditions for connecting to the grid are lacking. 	<ul style="list-style-type: none"> Standard guideline for stand-alone systems and equipment for Palau is lacking. Adoption of SEIAPI guidelines plus additional workshop conducted by IRENA will provide opportunity to raise awareness and wider adoption of the guidelines in the region.
2	<ul style="list-style-type: none"> Materials and equipment received by islands contrived through donor funded projects do not meet a common standard due to variation in equipment technical specifications. Donors do not provide strong support for the implementation of common standards. Collaboration/cooperation between donors may result in accelerated adoption of the technical standards. 	<ul style="list-style-type: none"> Billing models are not sustainable and subsidies may continue to be provided to users. Alternatively, a fixed rate or a prepaid system can be implemented.
3	<ul style="list-style-type: none"> The technical capacity to implement, including knowledge about the guidelines is lacking. Training would provide installers, technicians, etc. to be formally certified. 	<ul style="list-style-type: none"> There is lack of installation training and those who are trained are not formally certified. Additional training programmes for all technicians would be important and it would help facilitate the implementation of a technician certification programme.
4	<ul style="list-style-type: none"> Industry standards adopted by utilities in the Northern region of the Pacific are different from those adopted by utilities in the South. Cooperation between agencies and regions through project implementation may provide opportunity for employment at the local community. 	<ul style="list-style-type: none"> There are no uniform standards across the Pacific. The lack of building codes in many islands and adoption of relevant building codes is necessary to ensuring safety standards are met.
5	<ul style="list-style-type: none"> Too many products with different specifications in the market. Testing facilities and approval of products for the Pacific Islands may filter out poor quality products. 	<ul style="list-style-type: none"> Lack of guidelines published in the local languages. It is important to conduct training in the local language.

2.4 Next Steps

- Most utilities within the Northern Pacific have adopted the SEI-API/PPA technical guidelines. Utilities that have not adopted the guidelines are encouraged to endorse the framework to ensure a harmonised approach is sustained.
- Governments are encouraged to adopt the guidelines as a regulatory tool for the industry and the market.
- Donors and development partners that are active in the region need to continue providing support – perhaps provide funding to support national and regional training on standards.
- Training institutions in the region need to develop and deliver training modules on renewable energy and standards.
- Development of train the trainer programmes to address sustainability of the guidelines must be strengthened.
- IRENA will convene a workshop on RE standards for policy makers, utilities and private participants in the southern region of the Pacific.

3. Workshop on Assessment of the Grid Stability for Renewable Energy Integration in the Pacific Islands

3.1 Background

One of the first steps in planning the integration of high shares of variable and intermittent renewable energy into existing island grid systems is an appropriate assessment of the stability of the electricity grid. Grid stability can be defined as *“the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact.”*² It becomes a critical issue especially for small island grids. The utilities and policy makers in the Pacific region are therefore required to better understand the threshold to which their grids can sustain the penetration of such variable renewable energy without affecting the power quality.

3.2 Content of the workshop

In this context, the workshop on grid stability assessment of renewable energy integration in the Pacific Islands, aimed at enabling a better understanding of the grid stability issues to participants. The achievement of this goal was supported by the provision of training on the methodology to perform a sound grid stability assessment using computational dynamic modelling.

IRENA’s grid stability assessment is based on the operation and interpretation of results from a dynamic modelling of the grid, which simulates the transient effects of frequency and voltage in the system under varying load conditions by renewables, which would help identify the levels of renewables integration to grids. Depending on the levels of renewable penetration, the system would require different strategies and a range of technology solutions exist to ensure grid stability.

3.2.1 Strategies depending on the different levels of renewable energy integration

Figure 2 presents the different strategies required to enable the integration of renewable energy into electricity grids, without compromising the grid’s stability, for different thresholds of penetration.

² Source: IEEE/CIGRE Joint Task Force on Stability Terms and Definitions, “Definition and classification of Power System Stability”, IEEE Transactions on Power Systems, 2004

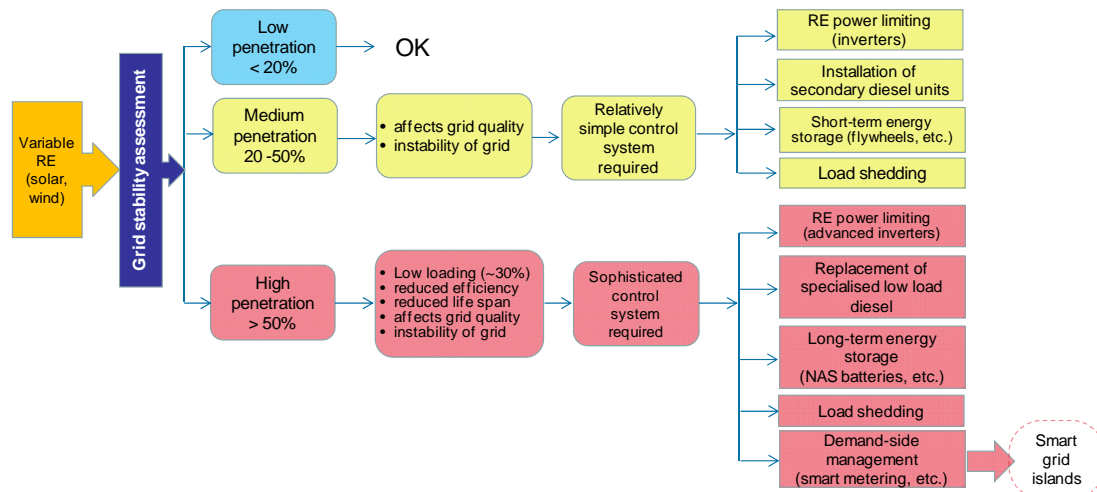


Figure 2: Renewable energy integration strategies depending on penetration level

In collaboration with PPA, IRENA is carrying out a pilot project that aims to develop a standard methodology for grid stability assessment, using dynamic modelling software to support planning high shares of renewable integration. The first pilot study is being conducted using Palau grids, where the national utility urgently requires to assess the grid stability due to an expected grid integration of a number of PV installations. In the course of the study, PPA was given a training course on dynamic modelling using this software.

During the workshop, preliminary results were presented indicating that the Palau could increase its PV penetration to 30% of current maximum demand without any special control requirement in grid operations, in virtue of the high availability of spinning reserve from existing diesel units. Also in the workshop, a hands-on training with computerised modelling software was provided to help island technicians understand how to assess power grid stability and power quality with higher shares of renewable integration.

3.3 Discussions and outcome of the workshop

At the end of the workshop, group discussions were carried out in order to discuss the IRENA’s methodology to the grid stability assessment for islands and obtain feedbacks including further challenges and needs from the participants. Key discussion points included the following.

- There was a general agreement that the IRENA methodology for grid stability assessment for islands, as presented in Figure 3, and the modelling software tool used for the assessment, *i.e.* PowerFactory, are useful and applicable to islands.
- A critical first step for an island in this methodology is to make a commitment to carry out the assessment and be able to provide man-power and other resources necessary for the analysis.
- It was highlighted, however, that many of the islands in the Pacific will require technical support throughout the assessment. In particular, the collection of required data for the assessment is a challenge as there is no structured data collection system in the region. A standard template for the required data can be very useful to start the exercise.
- PPA can play a key role in assisting such grid stability assessments including data collection in the region where many of the islands are expecting more integration of renewable energy.

- To raise the capacity for energy planning and grid system operation with renewables, continuous support for capacity development is necessary in the region. IRENA can play a role in coordinating such programmes in the region in collaboration with key partners including PPA, SEI-API, SPC North-REP.
- While the pilot study is focused on the technical aspects of RE integration, additional studies may be required to determine the economically optimal recommendations for technology solutions based on the assessment.
- In order to raise confidence in the developed model in the pilot study, a field test validation was suggested as the next step.
- Also, for the following case studies in the region, IRENA may wish to look into islands with a different grid size category from Palau, which is of a medium size.
- Many of the islands generally have limited budget to purchase licenses for the modelling software. This also needs to be considered in taking the next steps of the grid stability study.
- Policy frameworks such as net metering and regulations, which enable the expansion of renewable energy deployment, are also important and should be taken into consideration in parallel.

Steps	Experts and Science Community	IRENA	Regional entity/utility (e.g. PPA)	Islands (e.g. Palau)	Technical provider (e.g. DIGSILENT)
Data collection				Data collection	
Build a model in the PowerFactory			Build the model or support (based on the capacity of an island)	Build the model (based on the capacity of an island)	Software Support
Dynamic model simulation/results		Support	Run the model or support (based on the capacity of an island)	Run the model (based on the capacity of an island)	Software Support
Validation of the model/results	Support	Support	Support	Validate the model/results	Software Support
Recommendations on strategies and technology solutions		Support	Assessment	Assessment	
Quality assurance of recommendation	Confirmation	Support			

Figure 3: IRENA grid stability assessment methodology

3.4 Next Steps

- IRENA will continue to actively show the potential for higher shares of renewables on island power grids and in developing this capacity for energy planning in the region.
- Together with the GREIN network, IRENA will carry out four more grid stability case studies in islands in 2013, of which two will be in the Pacific region in collaboration with PPA.
- A methodology for grid stability assessment for a high share of renewables integration in island grids will be developed by end 2013.
- Moreover, PPA will continue to support IRENA in sharing the methodology and knowledge for the grid stability assessment within and beyond the Pacific region.