



**Japan-IRENA Joint Workshop:  
Accelerating Renewable Energy Deployment in the Pacific region  
- Meeting the challenges -**

**26 May 2012, Okinawa, Japan**

## **Summary**

### **Introduction**

The energy challenges faced by the Pacific island countries are clear: decreasing the dependency on fossil fuel and diversifying the energy mix. In most countries, the majority of their electricity is generated from imported fossil fuel, mostly from diesel. With volatile fossil fuel prices, long and costly supply routes, and relatively small energy markets, the typical power supply costs are in the range of USD 0.3-0.6 per kWh, even higher for some remote islands due to high transport costs. About three quarters of the imported oil products are used for the transportation sector, while about a quarter is used for electricity generation. A transition to renewable energy and increased energy efficiency can result in a more sustainable and secure energy future in the Pacific region. Many of the Pacific island countries have formulated ambitious targets for renewable energy, some aiming for 100% electricity from renewables. Today, renewables contribute only around 10% to the average energy mix.

IRENA has been engaged in the Pacific region since 2011 as part of the *IRENA Islands Initiative*, established to assist islands in transitioning to an increased share of renewable energy, and to learn from their unique experience as lighthouse projects. This year IRENA is expanding its work into other Small Island Developing States (SIDS). To date, IRENA is working with various stakeholders in the Pacific region. A workshop with experts from the region was held in Sydney in October 2011 which resulted in the development of an IRENA work programme for the region. The Pacific Leaders gathered in Abu Dhabi, UAE, in January 2012 and endorsed the implementation of the proposed IRENA activities for the region. Particular activities agreed to include: mapping the renewable energy readiness of the Pacific Island countries; creating a repository of knowledge of relevant technologies; assessing grid stability issues; and integrating these activities into a coherent roadmap for the Pacific Islands.

The Government of Japan is currently in the process of reviewing its energy policy from scratch after the Great East Japan Earthquake to include accelerated development and deployment of renewable energies to the maximum degree possible. While the drivers of the transition are different, the challenges of accelerating renewable energy deployment are similar as in the case of Pacific island countries. Japan has also been active for many years in supporting the Pacific island countries to address their socio-economic and climate change issues including the deployment of renewable energy. Sharing Japan's own experience and expertise in renewable energy technologies can further enhance the efforts in identifying the possible technology solutions in the region.



In this context, a workshop was organized jointly by the Government of Japan and IRENA to discuss the specific technology solutions to address the challenges of accelerating renewable energy deployment in the Pacific region, focusing on the issues of grid stability and renewable energy use in the transportation sector. The workshop was held in Okinawa taking the opportunity of the 6<sup>th</sup> Pacific Island Leaders Meeting (PALM6), where the leaders of the Pacific island countries agreed the importance of renewable energy and energy efficiency for achieving sustainable development as well as reducing greenhouse gas emissions in the region and welcomed this workshop.

During the workshop, various technology solutions from different islands around the world were shared and discussed to enable the integration of large share of renewable energy. There was a general understanding that existing technology solutions can address the challenges, but the true challenge is to transform the knowledge and expertise into actions through implementation of the solutions in the region. Participants also recognised that further cooperation among various stakeholders is critical. Stakeholders include governments, regional organisations, private sectors and utilities. The partnership with Japan and IRENA contributes to these efforts.

### 1. Grid stability for integration of high shares of renewable energy

- One of the key challenges is integrating high shares of variable renewable energy sources, mainly solar and wind, into island grid systems. There is a need for identifying the technical criteria for grid stability, including the operation of the system when integrating a high share of renewables, the ways to ensure a reliable power supply during the power sector transition and the better understanding what role electricity storage can play.
- The majority of island networks are old with average diesel generators more than 20 years and the power supply is relatively inefficient with high system losses. The Pacific Power Association (PPA) has recently conducted an energy loss study for 20 island utilities which observed an average of 12.8% of utility system losses. With the increased variable renewables integration, stability problems are being experienced already in Niue and Cook Islands.
- IRENA has initiated a grid stability assessment for the Pacific island grids to seek how much the island grids can absorb variable renewable energy without affecting the power quality. A database has been developed of all diesel generators in the region including their technical characteristics. Assessment of diesel generators on islands showed that the engines can be operated at around 30% partial load but in some cases, especially for the older generators, this may require a retrofit of the controller. It is also necessary to assess the impact of variable renewable energy on the frequency and voltage in island grids. IRENA thus started to look into software packages which allow dynamic modeling of the power grids to simulate the variation. Various software packages are available but so far with limited validation for small island grid operation.
- Okinawa has been active in promoting renewable energy introduction along with various measures including energy saving houses, ocean energy, and EV buses to achieve a smart energy island as a whole. Miyako island of Okinawa is promoting a micro grid project integrating 4,200 kW wind and 4,000 kW solar PV with 4,100 kW of batteries. The batteries ensure grid stability, helping to limit frequency fluctuations and accommodate varying PV output.



- Hawaii is also a leading group of islands aiming for high shares of renewables in their power supply. To better integrate wind and PV and improve grid reliability, their projects have extended to the concept of smart grids which will incorporate advanced information and communication technologies to control the power system.
- A case study in Rokkashomura-Futamura wind power station in Aomori Japan was introduced. It operates in an island mode, consisting of 51 MW wind power and 34 MW batteries. It was the only part of the Northern Tohoku electricity system that continued to operate in the aftermath of the Great East Japan Earthquake in March 2011.
- The case of King Island in Tasmania, Australia, has shown that renewable energy can reduce the cost of island energy supply substantially by curbing the consumption of diesel fuel. Over the past 10 years, the island was successful in reducing its diesel use by 45%, which represents a financial saving of over 2 million dollars a year. This has been achieved through a series of development steps using energy storage, dynamic resistive frequency controller, a flywheel based UPS (Uninterruptible Power Supply) and further demand side management to achieve zero diesel operation.
- “Off the shelf” technologies are available today which can possibly deliver up to 30% diesel savings. However higher shares will require infrastructural and operational changes.
- Grid stability control is more challenging in island systems than in large grids. Modern inverters for PV systems can help in frequency and reactive power control. Smart grids with remote control of feed-in can also help.
- State of the art batteries (e.g., sodium-sulphur (NaS), lithium-ion, vanadium redox flow) can store electricity, one strategy to accommodate variable renewable energy generation. In combination with intelligent inverter technologies, batteries can maintain grid stability even with 100% renewable energy generation and diesel generators turned off. Those modern batteries such as NAS, vanadium redox flow and lithium-ion batteries do not require high maintenance and even though they seem to be expensive, they can contribute to an energy system with high share of renewables at lower electricity generation costs which are competitive with existing diesel engine systems. The experiences with the batteries in the Pacific island countries are still limited. Nevertheless, with the implementation of batteries, it is possible to achieve 100% renewable energy systems that are technically and economically feasible in the Pacific region.
- Demand management can also help to integrate variable renewables. Excess electricity can be used for desalination, Electric Vehicles, water pumping and cooling/freezing.
- The importance of modeling analysis tools to assess different scenarios of combinations of various components was emphasized when planning the integration of renewable energy to island grids. Such tools will allow the maximum share of renewable energy in the grid and help to develop solutions for grid stability.
- There is no only one tool for assessing island grid stability and to determine the penetration level of renewables. There are many available tools but they need to be customized for the sizes and characteristics of the island grids. The analyst/tool user is as important as the tool itself.



## 2. Use of renewable energy in the transportation sector

- In the Pacific island countries, approximately 75% of the fossil fuel is used for transportation sector, while 25% goes to the electricity generation. It therefore makes sense that any effort to reduce the reliance on fossil fuel must target the transport sector. However among many regional energy projects over the past 30 years, only about 10% of all funding has been spent on the transportation sector. More attention is warranted in this field.
- There are three modes of transportation: land, sea, and air. The energy share for the transportation modes depends on the island area and quality of infrastructure, population, principal economic activities, and number of the outer islands. Detailed statistics are not available and needs to be addressed as a priority.
- A renewable energy option in the land transport is biofuel from coconut oil which has been promoted with varying degree of success in some islands including Fiji, the Republic of Marshall Islands, Papua New Guinea, Solomon Islands and Vanuatu.
- For air transport, various airlines operating in the region have tested the use of biofuels. For sea transport, there are some options based on wind, solar power, and even hydrogen but all need further developments. A wind propulsion system for ships was presented which uses kites to propel and pull ships to reduce their energy consumption. Depending on the strength and direction of wind and the type of ship, it can reduce the daily fuel consumption between 1 to 3 tons (e.g. 3 tons on a vessel that consumes 30 tons equals 10% savings). The system is already installed on different types of vessels and being used in daily operation. In addition, just by an optimized piloting scheme of cargo ships, supported by software, about 9% of fuel savings can be achieved.
- In Iejima island of Okinawa, an innovative approach has been taken to raise sugar and fiber sugarcane yield through interspecific hybridisation of different sugarcane species. Okinawa has also started to introduce bioethanol blending to gasoline, targeting 3% ethanol in the gasoline pool by the fiscal year 2015.
- Some challenges to introduce biofuels in the Pacific region discussed include the lack of land area and natural biomass resources to produce biofuel, the possible conflict between fuel and food supply, lack of regulatory instruments to support the biofuels, and coordination between the government and private sector.

### Further opportunities for accelerated renewable energy deployment in the Pacific region

- Many of the islands worldwide are in transition to increased introduction of renewable energy to reduce their high dependency on fossil fuel and diversifying the energy sources. The workshop raised the understanding of technical challenges and possible solutions from the knowledge and experiences around the world.
- In addition to the technical challenges in accelerating renewable energy deployment in the Pacific region, it was pointed out that there are no clear energy policies in a number of countries and current policies are not effective and/or properly enforced. Adopting proper legislations, technical standards and financial incentives can create the enabling environment to support the acceleration of the renewable energy penetration. For example, policy instruments such as net-metering have been successful in the increased deployment of renewable energy in some of the



Pacific island countries including Cook Islands and Palau.

- Moreover, in order to move from knowledge to actions to increase renewable energy deployment, most important issues are the power sector planning and prioritization of investments as well as ensuring proper sector governance, regulation, and legislative frameworks are in place to promote private sector participation, competitions and investments.
- For instance, although there is increasing interests in Independent Power Producers (IPPs), it is still an early stage and the governments need to put in place proper policies and regulations to govern those interests and reinforce the deployment of the standardised Power Purchase Agreement (PPA). Samoa has set up a regulator for the energy sector which intends to balance the interest between the power utility and the IPPs.
- Technical capacity development for sustainable operation and maintenance of renewable energy technologies was also raised as one of the key challenges for the region.
- Currently, 75% of the Pacific Power Association member utilities are Government owned. It was pointed out that more private sector engagement in investment, equipment supply and technical exploitations is needed.
- Almost all the renewable energy developments are funded by the donors and developers; hence there are no economies of scale and very little commercial investments.
- It is important that renewable energy projects implemented by development partners and donors are aligned with the national plans and energy roadmaps of the Pacific island countries so that they become sustainable.
- It was also suggested that more effective integration and coordination of project financing and technical cooperation activities by various bilateral partners, regional and international organizations can increase efficiency and effectiveness. Developing a good business model is the key to a success.
- Further cooperation and work are required in the Pacific region, building up on the experiences and knowledge available worldwide. IRENA can facilitate the cooperation among countries. IRENA will look forward to close cooperation with governments, private sectors, and regional institutions to make a transition in the power and transportation sectors happen. IRENA has already started its collaboration with the Pacific Power Association in grid stability assessment. An IRENA regional coordinator will be hosted by the Secretariat of the Pacific Community in Fiji.
- Transition of islands to renewables can act as a light house for other regions. IRENA with the support of its member countries including the Government of Japan will continue the engagement with the Pacific region to implement solutions to the challenges in accelerating renewable energy deployment.

-----