

Country Name	The Project for Introduction of Clean Energy by Solar Electricity Generation System
Federated States of Micronesia	

I. Project Outline

Background	The Federated States of Micronesia (FSM) had relied almost 100% on diesel generation for its electricity supply and depended exclusively on imports for its main energy resource of petroleum, and thus, the country was susceptible to rising crude oil prices. Moreover, accompanying the increasing amount of crude oil consumption, CO ₂ emission also largely increased. Becoming increasingly aware of climate change and feeling the impact of rising crude oil prices, the Government of FSM was faced with an urgent need to review its dependency on diesel power generation and to diversify its power generation resources. Assistance for FSM to introduce renewable energy technology including solar electricity generation was expected, as renewable energy could enable stable supply of electricity, while reducing greenhouse gases emissions.				
Objectives of the Project	To enhance power generation capacity, diversify energy sources and increase awareness among people on utilization of renewable energy by procuring equipment for solar electricity generation and training technical experts in Pohnpei, where the country's capital is located, thereby contributing to demonstration of initiatives of Japan to promote efforts among both developed and developing countries for climate control.				
Contents of the Project	<ol style="list-style-type: none"> Project site: Federal Government Complex (Capital) and College of Micronesia National Campus (COM-FSM) in Palikir, Pohnpei State Implementations of the Japanese side: <ol style="list-style-type: none"> Procurement and installation of photovoltaic (PV) system (PV module, mounting structure for PV module, power conditioner, transformer, data management and monitoring system, storage battery, replacement parts, maintenance tools etc.) Technical Assistance (soft component of Grant Aid: training on basic knowledge, inspection and maintenance including troubleshooting of grid-connected PV system) Implementations of FSM side: Securing of the equipment installation site, ground levelling and removal of obstructions on the equipment installation site, installation of fences and gates, electrical, water supply and drainage works etc. 				
Ex-Ante Evaluation	2009	E/N Date	December 8, 2009	Completion Date	April 17, 2013
		G/A Date	February 1, 2010		
Project Cost	E/N Grant Limit / G/A Grant Limit: 530 million yen, Actual Grant Amount: 530 million yen				
Implementing Agency	Pohnpei Utilities Corporation (PUC)				
Contracted Agencies	Yachiyo Engineering Co., Ltd., ICONS Inc., Shikoku Electric Power Co., Inc. (JV), Sojitz Corporation, Wakachiku Construction Co., Ltd., Crown Agents Japan Limited (Procurement Agent)				

II. Result of the Evaluation

1 Relevance
<p><Consistency with the Development Policy of FSM at the time of ex-ante and ex-post evaluation></p> <p>This project has been highly consistent with FSM's development policy, as increasing power supply capacity of renewable energy and reducing greenhouse gases emissions are set in policy documents such as Infrastructure Development Plan (IDP) (2004-2023), The Strategic Development Plan (SDP) (2004-2023), FSM National Energy Policy (2012), Pohnpei State Energy Action Plan (2013) and FSM's Intended Nationally Determined Contribution (2015) at the time of both ex-ante and ex-post evaluations.</p> <p><Consistency with the Development Needs of FSM at the time of ex-ante and ex-post evaluation></p> <p>At the time of ex-ante evaluation, while PUC possessed a diesel power plant and a hydropower plant, only the diesel power plant was in operating condition, and of the seven diesel generators at this plant, two were broken down, which resulted in unstable electricity supply with frequent blackouts. At the time of ex-post evaluation, only 3.9% of total energy production is covered by renewable energy sources (as of 2015), which needs to be increased to 30% by 2020 as targeted in the FSM National Energy Policy. Therefore, the project has been highly consistent with FSM's development needs.</p> <p><Consistency with Japan's ODA Policy at the time of ex-ante evaluation></p> <p>The Cool Earth Partnership, a new fund mechanism for climate change worth US10 billion dollars (1.25 trillion yen) in total, was announced by the then Japanese Prime Minister Fukuda at the Davos summit in January 2008. In the Pacific region, Palau, FSM, and the Marshall Islands etc. joined the Cool Earth Partnership. Further, at the 5th Pacific Islands Leaders Meeting held in May 2009 at Tomamu, Hokkaido, Japan announced assistance in the amount of 50 billion yen to Pacific Islands and the one of the areas for assistance included environment and climate change. Therefore, the project was also consistent with Japan's ODA policy.</p> <p><Evaluation Result></p> <p>In light of the above, the relevance of the project is high.</p>
2 Effectiveness/Impact
<p><Effectiveness></p> <p>The project has mostly achieved its objectives, "to enhance power generation capacity, diversify energy sources and increase awareness among people on utilization of renewable energy". Actual figures of net power generation (Indicator 1), reduced CO₂ emission (Indicator 2)</p>

and reduced diesel fuel consumption (Indicator 3) have exceeded the target figures since project completion. . The PV system installed under the project has successfully generated the targeted amount of electric power and contributed to diversification of energy sources¹. Regarding awareness among people on utilization of renewable energy, the Department of Resources and Development (R&D) has sometimes guided students of elementary schools to see the PV system at Capital (once or twice a year, based on requests from schools), which is considered to increase awareness among children. Thus, some PR activities have been conducted on a limited scale.

<Impact>

As for the expected impact, “contributing to demonstration of initiatives of Japan to promote efforts among both developed and developing countries for climate control”, firstly, JICA Micronesia Office presented overviews of JICA’s cooperation in the energy sector introducing this project at meetings such as the Steering Committee of the North Pacific ACP² Renewable Energy and Energy Efficiency Project (North-REP), which is a multi-country program funded by the European Union (EU), in February 2015 and FSM Energy Steering Committee Meeting in March 2015. Secondly, after the project completion, an additional PV system (200kW) has been installed in each state in FSM in December 2014 through the Pacific Environment Community (PEC) Fund, which is a commitment by the government of Japan to support Pacific Islands Forum³ countries to tackle environmental issues including implementation of renewable energy projects, and the knowledge and experience of PUC gained through the soft component of the JICA project are utilized for operation and maintenance (O&M) of facilities installed under the PEC funded project. And as introduction of PV system has been promoted, the effect to showcase PV system of the project has appeared in Micronesia. In fact, efforts of Japan in climate change is distinctive in terms of including the soft component as part of a project to ensure appropriate O&M of PV facilities/equipment as seen under the project. Based on the above findings, it can be said that this project has contributed to demonstration of initiatives of Japan to promote efforts for climate control.

Regarding other impacts, no negative impact on natural environment has been observed and no land acquisition and resettlement has occurred under the project.

<Evaluation Result>

In light of the above, the effect of the project has been observed mostly as planned. Therefore the effectiveness/impact of the project are high.

Quantitative Effects

Indicators	Capacity to be installed	Target 2016 ⁽¹⁾ 3 years After Completion	Actual 2013 Completion year	Actual 2014 1 Year After Completion	Actual 2015 2 Years After Completion
Indicator 1: Net power generation (MWh/year)	160kW (Planned)	168	-	-	-
	180 kW (Actual)	189 ⁽²⁾	218 ⁽³⁾	204	195
Indicator 2: Reduction of CO ₂ Emission (t-CO ₂ /year)	160kW (Planned)	121	-	-	-
	180 kW (Actual)	136 ⁽⁴⁾	157	147	141
Indicator 3: Reduction of diesel fuel consumption (litter/year)	160kW (Planned)	46,000	-	-	-
	180 kW (Actual)	51,000 ⁽⁵⁾	60,000	56,000	53,000

Source: Ex-Ante Evaluation Sheet, JICA internal documents, and Solar System Operation Result

Note: (1) In ex-ante evaluation sheet, the target year for evaluation is stated to be 2014, which is three years after project completion (the project was planned to be completed in November 2011). However, the installation of PV system under the project was completed in February 2013. Thus, in ex-post evaluation, the target year should be changed to 2016 (three years after the installation of PV system). (2) The capacity of the PV system was increased from 160kW to 180kW utilizing remaining project cost. The target figure for 180kW was calculated by $168 \times 180/160 = 189$. (3) The figure is the total from February 2013 (installation completion) to January 2014. The generation within 2013 (till December 2013) was 199 MWh. (4) The target figure for 180kW was calculated by $121 \times 180/160 = 136$. (5) The target figure for 180kW was calculated by $46,000 \times 180/160 = 51,750$, which was rounded down to 51,000.

3 Efficiency

Although the project cost was as planned (ratio against the plan: 100%), the project period exceeded the plan (ratio against the plan: 126%⁴) because it took more time from procurement agent agreement to contractor agreement than planned. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional Aspect>

PUC takes charge of all the electricity businesses in Pohnpei State. It is composed of three departments: Department of Administration and Customer Services, Department of Water and Sewer, and Department of Power Generation and Distribution, under which there are two divisions: Division for Power Generation and Division for Power Distribution. PUC is owned 100% by Pohnpei State Government

¹ The actual fuel consumption was reduced by 2,671,447 liters in Pohnpei State as a whole between 2012 and 2015. According to PUC, however, major reasons are the installation of high efficiency new diesel generators and restart of hydropower. Also according to PUC, the actual values of the PV system to reduction of fuel/CO₂ emission are smaller than calculated, as the capacity of the PV system installed under the project is not large enough to replace an existing diesel generator, and in case output of diesel generators decreased according to output of the PV system, the efficiency of diesel generation is decreased.

² ACP stands for African, Caribbean and Pacific Group of States. The Steering Committee is represented by the Secretary and officials of the Department of Resource and Development as well as General Manager of Utilities Corporation of each state.

³ The Pacific Islands Forum is a regional economic cooperation organization of 16 independent and self-governing states.

⁴ Because the start of the project period is defined as the procurement agent agreement in the plan, this percentage is calculated along with it. Besides, it took nearly ten months from the G/A to the procurement agent agreement.

according to “State Law 2L-179-91” laid down in 1991. However, it is run independently from the government, as a semi-governmental organization (public company).

The total number of staff members of PUC is 170 (12 females and 158 males) as of October 2016, of which three staff members belonging to the Renewable Energy section (one manager and two staff, all males) are responsible for Operation and Maintenance (O&M) of the PV system installed under the project. Routine inspection and maintenance of the PV system are conducted by two staff members once in two weeks, and according to PUC, the number of staff members is sufficient to conduct O&M properly, as most of the facilities and equipment procured under the project are maintained in a good condition. It is considered to be sufficient as these three staff members are dedicated for O&M of the concerned PV system and the two persons can handle day-to-day O&M.

<Technical Aspect>

All of the three staff members in charge of O&M of the PV system are technicians. While trainings to internally transfer the techniques acquired under the soft component of the project are not conducted within PUC, the manager of the Renewable Energy section has conducted OJT for his two staff to teach them what he learned in the soft component utilizing the O&M manual. Training materials and manuals prepared under the soft component are shared and utilized by these three staff members only. Nonetheless, according to PUC, their technical skills are sufficient to conduct O&M properly, as most of the facilities and equipment procured under the project are maintained in a good condition.

<Financial Aspect>

In the preparatory study, annual O&M cost of the PV system installed under the project was estimated to be approximately USD 4,200 including personnel expenses of PUC staff USD 4,000 and fuel cost USD 200. Data on actual financial data including profit and loss statement of PUC and O&M cost of the PV system was not provided due to no breakdown of the number on the financial report. However, according to PUC, while the financial status of PUC is in deficit, personnel cost has been sufficiently paid and O&M budget for the PV system has been secured since handover. The General Manager of PUC explained that as the O&M cost of the PV system is negligibly small within PUC’s entire budget, PUC is able to continuously secure the budget appropriately.

<Current Status of Operation and Maintenance>

As mentioned above, inspection and maintenance of the PV system are conducted once in two weeks in accordance with the route map of inspection tour. All the inspection results of all equipment are recorded in the inspection tour record. During inspection, the inside of collection boxes and junction boxes is also checked following the recommendation made at the defect inspection conducted in 2014. As of February 2016, the computer for visualization at the President office in the Federal Government Complex and the computer for measurement at COM-FSM have problems in CPU, because of which the display boards (to display the amount of energy production by the PV system) are not functioning. The problems of CPU have not been solved since they occurred (2013 at the President office and 2014 at COM-FSM), despite PUC’s efforts of repair such as contacting the manufacturer and replacing parts. Therefore, PUC decided to replace both computers, and ordered them as of October 2016. All the other equipment are in a good condition. All of the spare parts and consumables procured under the project are kept in the storage.

<Evaluation Result>

In light of the above, some problems have been observed in terms of the financial aspect of the implementing agency and the current status of operation and maintenance, as it is difficult to confirm that sufficient budget is secured for O&M due to unavailability of financial data, and some equipment have problems. Therefore, the sustainability of the project effect is fair.

5 Summary of the Evaluation

Through the project, the project objectives have been mostly achieved: actual figures of all the performance indicators have exceeded target figures. Positive impact was identified, as this project was introduced at several meetings and the knowledge and experience of PUC gained through the soft component are utilized in the successive solar electricity generation project. As for sustainability, there are some problems in the financial aspect of PUC and the current status of operation and maintenance, as financial data is unavailable and some equipment have problems. As for efficiency, the project period significantly exceeded the plan.

Considering all of the above points, this project is evaluated to be satisfactory.

III. Recommendations & Lessons Learned

Recommendations to implementing agency:

In order to supply electricity more efficiently combining diesel and solar power generation, the capacity of PUC staff should be further enhanced utilizing various JICA cooperation schemes such as Technical Cooperation Project “the Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries” (2016-2021) and JICA training programs (e.g. “Training for Planners to Promote Renewable Energy in Micro Grid” (2014)).

Lessons learned for JICA:

As mentioned above, awareness raising activities on utilization of renewable energy have been conducted on a rather limited scale. The fact that two display boards have not been functioned due to defects of the CPUs also seems to have affected the awareness raising activities. Thus, when implementing a similar project in the future, a soft component of a project (training) should include (1) actions that should be taken if display boards have problems, and (2) simulations on a study tour especially targeted at diplomatic missions, elementary school students and college students etc. with recommendation for the implementing agency to organize study tours after project completion.



The PV system on the roof of the president office in the Federal Government Complex



The PV system on car parking roof of COM-FSM (Palikir campus)