Internal Ex-Post Evaluation for Grant Aid Project

conducted by Laos Office: February 2019

Country Name	The Project for Introduction of Clean Energy by Solar Electricity Generation System
Lao People's Democratic Republic	

I. Project Outline

Background	Lao PDR had challenged the reduction of greenhouse gas emission and prepared "Climate Change Strategy" in December 2009. The Government of Lao PDR set forth that electrification attains 90% by the year 2020 by means of grid connection and generation by renewable energy, such as solar power, wind power, and micro hydropower.			
Objectives of the Project	To increase power generation capacity, diversify power sources, and raise awareness of people of Lao PDR for utilization of renewable energy by procurement of photovoltaic (PV) system and related equipment in the Wattay International Airport in Vientiane Capital as well as technical assistance for capacity building of technical personnel, and thereby contributing to demonstration of Japan's initiatives for promoting collaborative efforts by both developed and developing countries against climate change			
Contents of the Project	1. Project Site: Wattay International Airport and Electricite Du Laos (EDL) premises/Vientiane Capital 2. Japanese side (1) 236kW PV generation system (PV modules, watt hour meter, junction box, circuit breaker, collecting box, transformer, cables, data management and monitoring system, display board and others) and PV system spare parts and maintenance tools (2) Additional purchase of 178 kW PV generation system at EDL premises (installation of grid-connected PV system) (The output was added by using the residual amount of the E/N limit amount) (3) Technical assistance (soft component): Training on basic knowledge, technical characteristics, preventive inspection, operation and maintenance (O&M) of PV system including emergency response 3. Lao side: Land preparation, other expenses related to procurement of equipment and contracted agent which were not covered by grant aid and others			
Project Period	E/N Date	March 4, 2010	Completion Date	March 3, 2013 (Original purchase) June 10, 2014 (Additional purchase)
	G/A Date	March 9, 2010		
Project Cost	E/N Grant Limit / G/A Grant Limit: : 480 million yen			Actual Grant Amount: 467 million yen
Executing Agency	- Lao Airport Authority (LAA) under Ministry of Public Works and Transport, Department of Civil Aviation (DCA) under Ministry of Public Works and Transport - Electricite Du Laos (EDL)			
Contracted Agencies	Main Contractor(s): NEWJEC Inc Main Consultant(s): ITOCHU Corporation Agent: Japan International Cooperation System			

II. Result of the Evaluation

1 Relevance:

<Consistency with the Development Policy of Lao PDR at the Time of Ex-Ante and Ex-Post Evaluation>

The project has been consistent with the development policy of Lao PDR such as the "Power Development Plan 2007" and the existing "Renewable Energy Development Strategy" which was established in 2011 and still effective. Lao PDR has been aiming at increasing the share of renewable energies of the total energy consumption.

<Consistency with the Development Needs of Lao PDR at the Time of Ex-Ante and Ex-Post Evaluation >

The project has been consistent with the development needs of Lao PDR for the renewable energy. Due to the geographical situation (the mountainous area accounted for about 80%), low population density, and financial constraints, it has been difficult to promote electrification in the national grid. As Lao PDR dependents on hydropower, there has been a problem that the amount of electricity generation decreases in dry season. Thus solar power can be an alternative energy sources during the dry season.

<Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation>

The project was consistent with Japan's ODA Policy at the time of ex-ante evaluation. Development of socio-economic infrastructure including power sector is one of the prioritized areas for assistance under the "Country Assistance Program for Lao PDR" (2006). Also, the Government of Japan introduced a scheme of "Program Grant Aid for Environment and Climate Change" in 2008 aiming at support for developing countries with lack of implementation capacity and funds for balancing between reduction of CO2 emission and economic growth in order to effectively promote global efforts against climate change

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact:

<Effectiveness>

The project has achieved its objectives. Quantitative effects such as "Net power generation" (indicator 1), "Reduction of CO2 Emission" (indicator 2), and "Reduced electricity cost" (indicator 3) have been obtained, meeting the targets set at the time of Ex-Ante Evaluation.

Although the actual power generation achieved the target from 2013 to 2015, the volume slightly dropped in 2016 and 2017, because the ongoing construction work of domestic terminal and expansion of international terminal of the Wattay International Airport sometime requires for shutting down the Photo Voltage (PV) system installed by the project. Nonetheless, the ratio against the target in 2016 and 2017 are approximately 90% of the target figure. Similarly, both power generation volume at EDL office of 2016 and 2017 were less than 2015.The main reason is the thunderstorm in rainy season that caused the shutdown of EDL grid power system affected to the PV System.

As to the capacity enhancement by the project, during 2013-2016, there were seven trained Lao Airport Authority (LAA) staff members responsible for operation and maintenance work of the PV system. After two years, only one remains, as some resigned and some were transferred to other assignment. However, the present technical staffs usually uses O&M manual and follow up Preventive Maintenance Report Sheet for routine and periodic inspection work of PV system, and there has been no problem on condition of PV system and its O&M activities. Five staff members of EDL who were trained under the project have continuously been engaged in O&M by utilizing the manual.

It was expected that by installing the PV system at Wattay International Airport, many people would have a chance to raise their awareness for renewable energy. The PV system has been demonstrated as the project envisaged, as the number of passengers using International Terminal of Wattay International Airport increased a lot from 658,000 persons in 2012 to 1,898,112 persons in 2017.

<Impact>

While this project was expected to show Japan's initiative on climate change measures, it was unable to confirm if the project was introduced as a model case at symposiums and other occasions by the time of ex-post evaluation. Nevertheless, the model of this project was recognized as a showcase project by stakeholders who play a role for power generation facilities development in Lao PDR, as many PV generation systems have been implemented/will be implemented. For example, a survey team from a joint venture company of Laos and German companies who run the PV business in Laos visited the site.

No negative impact on natural environment was observed. No land acquisition and resettlement occurred under this project.

<Evaluation Result>

Given the above mentioned facts, the effectiveness/impact of the project is high.

Quantitative Effects

(1) Original PV System (236kW)

	Baseline 2012 Baseline Year	Target 2016 3 Years after Completion	Actual 2013 1 Years after Completion	Actual 2014 2 Years after Completion	Actual 2015 3 Years after Completion	Actual 2016 4 Years after Completion	Actual 2017 5 Years after Completion
Indictor 1: Power generation volume at transmission end MW/year)	0	288.2	299	294	295	269	262
Indicator 2: Reduction of CO2 emission (ton/year) *1	0	198	206	203	203	185	180
Indicator 3: Reduced electricity cost (million JPY/year) *2	0	2.6	3.28	3.22	3.23	2.94	2.87

Source: PV system Office of LAA

*1 The expected CO2 emission reduction is estimated provided that diesel engine generators in Laos produce the same power energy with those of PV system by using the unit CO2 emission rate for burning fuel and for plant operation released by “Central Research Institute of Electric Power Industry”.

*2 Multiplying the average power tariff of 835 Kip/kWh which LAA pays EDL and expected power generation by the PV system.

(2) Additional PV System (178kW)

	Baseline 2012 Baseline Year	Target*	Actual 2015 1 Year after Completion	Actual 2016 2 Years after Completion	Actual 2017 3 Years after Completion
Indicator 1: Power generation volume at transmission end (MWh/year)*	0	n.a.	214	208	201
Indicator 2: Estimated reduction of CO2 emission (ton/year)	0	n.a.	147	143	139
Indicator 3: Reduced electricity cost (million JPY/year)	0	n.a.	2.25	2.18	2.11

Source：PV system Office of EDL Office.

*No targets were set.

3 Efficiency:

Although the project cost was within the plan (the ratio against the plan: 97%), project period significantly exceeded the plan (ratio against the plan: 165%) partly because of expansion of the capacity of PV system. The outputs of the project were produced as planned (with expansion of the capacity). Therefore, efficiency of this project is fair.

4 Sustainability:

<Institutional Aspect>

The Power Supply Center (PSC) of LAA and the PV System Office, the Administration Department of EDL has been responsible for O&M of the 236 kW PV system and the 178 kW PV system respectively. No problem has been observed in the institutional setup. As to

LAA, nine staff members have been assigned to PSC, including the Head Office, the Deputy Head Office and an administrative staff respectively. Three technicians have been assigned to the terminal building and another three members have been assigned to the PV System Office. According to the PV System Office, three staff members have been sufficient for taking care of routine inspection and maintenance work of PV System. Sometime, if the maintenance work is required more than three persons, the additional supporting staff could be temporally shifted from other divisions under LAA for couple of days of working.

As to EDL, the PV System Office is one of six operation offices under the Administration Department which has about 65 officers/staff. There were seven technical staff members work for the PV System Office, five technical staff members who had been trained at the time of project implementation have continued work for the PV System Office including two more staff recruited in 2016. The number of staffs has been sufficient for carrying out O&M according to the operating condition of the PV system that has been operated for four years.

<Technical Aspect>

As mentioned in "Effectiveness" above, the present technical staffs of LAA usually use O&M manual and follow up Preventive Maintenance Report Sheet for routine and periodic inspection work of the PV system, and there has been no problem on condition of the PV system and its O&M activities. However, the effective use of these tools has been somewhat limited, as LAA has only one staff member who was trained during project implementation and has not been trained since project completion. The technical staff had limited capacity to handle the technical problems that happened with the PV system. There was no training system in place, and they were mostly trained as OJT and instructed by trained staff for daily work, weekly and monthly inspection of PV system by filling in the Preventive Maintenance Report Sheet.

As to EDL, five technical staff members who were trained during the project has continuously worked for the PV System Office, and the provided manual has been properly used that could be ensured the high efficiency of O&M work. Even though no training course has been conducted since project completion, they have been able to handle effective O&M work. In addition, the PV System Office also received technical advices and support from the EDL Training Center which has various electrical engineers and trainers who can share and provide knowledge and experiences to PV technical staff.

<Financial Aspect>

The budget has not been fully secured by LAA for O&M works of the PV system that is why the proposed items of spare parts of electrical devices had never been procured for 3-4 years. Fortunately, for the time being, the serious damage has not occurred yet as the PV system assumed still being in good condition since it has just been operated for 4-5 years. As mentioned above, the technical staff had limited capacity to handle the technical problems that happened with the PV system. Therefore, the secured budget of LAA is needed for outsourcing technical services in order to ensure smooth operation and to maintain efficiency of the PV system for its long useful life.

The PV System Office of EDL has continuously received annual budget of 30 million kips for O&M of the PV system after the project completion. According to the situation of operating and technical condition of the PV System, the provided annual budget of 30 million kips has been sufficient. However, EDL has not made procurement plan for spare part of electrical devices so far. Because, the PV system is well operated at this moment. In the near future, the planed budget of O&M might be increased higher than 30 million kip to cover procurement amount of spare part.

Table 1. PV O&M Cost of LAA

(Unit: million kips)

Cost Items	2014	2015	2016	2017
Personnel	-	6	6	6
O&M	0	0	0	0

Table 2. PV O&M Cost of EDL

(Unit: million kips)

Cost Items	2015	2016	2017	2018
Personal	11.9	11.9	11.9	11.9
O&M	30	30	30	30

<Current Status of Operation and Maintenance>

As to 236 kW PV system at Wattay International Airport, the inspection and regular maintenance activities have mainly carried out by three staff members of PV System Office. The facilities of the PV system at Wattay International Airport have been generally in good condition. The small problems were observed with the Power Conditioner and Display device. The observed technical problems were as follows: (1) One of air conditioner was not functioned automatically to start and stop the compressor. This problem has been noted in for two years. (2) The displayed number of Power Active (kWp) on the Display Device was not activated. But its recorded data could be printed out from Monitoring Device Center. The problem has been noted for three years. Technical staff did not know how to solve the problems, and PV system Unit did not have budget for services fees if asking for outsources technical service for checking and fixing the mentioned problems. Some kind of electric devices were supposed to be procured as spare parts for replacement if necessary; however, the request of required equipment/electrical devices had never been approved by LAA for procurement for three years.

As to 178 KW system at EDL premise, all provided equipment items of PV system have been still in good condition and also the proper maintenance work has been effectively carried out. The procured spare parts (PV modules, power conditioners), consumables and maintenance tools procured by the project have been properly maintained and kept in the stored room. The procured spare parts, tool and equipment have not been used for replacement yet due to no broken and damage occurred yet in the PV system. However, EDL has to think and start to prepare procurement plan and additional annual budget to cover procurement amount in the future.

<Evaluation Result>

Some problems have been observed in terms of the technical and financial aspects of LAA. Therefore, the sustainability of the project effect is fair.

5 Summary of the Evaluation:

The project has achieved its objectives, "To increase power generation capacity, diversify power sources, and raise awareness of people of Laos for utilization of renewable energy", as the targets of indicators were met. The model was recognized by stakeholders and the many PV generation system have been implemented after the project was completed. As for sustainability, some problems have been observed in

terms of the technical and financial aspect; however, there has been no problem on the institutional aspect. As for efficiency, although the project period exceeded the plan, the project cost was within the plan.

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

III. Recommendations & Lessons Learned.

Recommendations to Executing Agency:
LAA is required to take immediate action to secure budget for O&M of PV system. The knowledge and skill of in-charged technical staff also need to be maintained and improved in order to maintain the reliability and sustainability of PV power generation. Therefore, the plan for conducting training course should be considered.

(PV system at EDL building)

(Top view of PV system)