

Country Name	The Project for Introduction of Clean Energy by Solar Electricity Generation System
The Democratic Republic of Timor-Leste	

I. Project Outline

Background	The electrification rate of Timor-Leste was 36.6% on national average and power failure frequently occurred in Dili. The power source mainly relied on diesel oil and its fuel supply was all covered by import. Besides, the rise in international crude oil prices caused power shortages in Timor-Leste. Therefore, the government of Timor-Leste recognized getting out of dependence on primary energy sources was an urgent need and made a policy shift to introduce renewable energy sources including solar power.					
Objectives of the Project	To increase power generation capacity, diversify energy resources, and raise awareness of the use of renewable energy sources among the people of Timor-Leste by providing equipment of photovoltaic power generation as well as technical assistance for capacity building of technical personnel in Dili and its suburbs, and thereby contributing to demonstration of Japan's initiative for collaborative efforts by both developed and developing countries against climate change.					
Contents of the Project	<ol style="list-style-type: none"> Project Site: National University of Timor-Lorosa'e, Hera campus (Dili District), 5 Basic Schools (BSs) (Atauro, Biqueli, Darulete, Leorema and Loes) Japanese side <ol style="list-style-type: none"> Grid-Connected type 250kW system (installed in Faculty of Engineering, Science and Technology (FEST) of UNTL Hera campus) and 12.6kW system (installed in Faculty of Agriculture (FA) of UNTL Hera campus): Solar power generation modules*, Frame of the solar power generation modules, Joint box, Power conditioner, Transformer, Cable, and so on. Stand-alone with battery type 7.5kW system (installed in UNTL Hera campus) and 2.5kW system (installed in 5 BSs): Solar power generation modules*, Frame of the solar power generation modules. Joint box, DC/AC inverter, Charge/discharge control Panel, battery, External storage battery panel, Panel board, Cables, etc. *Solar power generation modules include 26 solar panels for UNTL faculty of engineering and 2 solar panels for each BS (as spare parts) arranged through additional procurement. Technical assistance (soft component): Training on basic knowledge, operation and maintenance of grid-connected and stand-alone photovoltaic power generation systems including emergency response. Timor-Leste side: To secure the land in the project sites, equipment transportation and installation, proper operation and maintenance and others 					
Project Period	E/N Date	March 15, 2010	Completion Date (ex-ante)	August, 2011	Completion Date (actual)	November 29, 2018 (Completion of soft component)
	G/A Date	July 8, 2010				
Project Cost	E/N Grant Limit / G/A Grant Limit: 500 million yen, Actual Grant Amount: 500 million yen					
Executing Agency	General Directorate of Policy, Planning, Printing and Inclusion, Ministry of Education, Youth and Sports Faculty of Engineering, Science and Technology, Universidade Nacional Timor Lorosa'e					
Contracted Agencies	Main Contractor(s): (Original) Toyota Tsusho Corporation, (Additional) TEC International Co, Ltd Main Consultant(s): (Original) Aitec (Additional) Yamashita Sekkei Inc. Agent: Japan International Cooperation System					

II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

- The target year was initially the year 2014, three years after the expected project completion year at the time of ex-ante evaluation. However, the project was completed in the month November of the year 2018. Therefore, the target year was changed to the year 2021 and the ex-post evaluation verifies the level of achievement of project objectives based on data from the years 2018 and 2021. In addition, with a design change that the total generation capacity of a grid-connected solar panel had changed from 200kW (plan) to 262.6kW (actual), in the outputs of the project the target value of planned quantitative indicators such as power generation volume at transmission end and annual CO2 reduction were modified by using the calculating method adopted in the Preparatory Survey Report.
- At the beginning of the technical transfer component, the target organizations were both Faculty of Engineering, Science and Technology (FEST) of the National University of Timor-Lorosa'e (UNTL) and Electricidade de Timor-Leste (EDTL) which would be planned to form the Photovoltaics Working Group (PVWG) for Operation and Maintenance (O&M). However, EDTL did not become a member of PVWG.

I Relevance/Coherence

[Relevance]

<Consistency with the Development Policy of Timor-Leste at the Time of Ex-Ante Evaluation >

The project was consistent with the development policy of Timor-Leste at the time of ex-ante evaluation. The government of Timor-Leste decided to participate in "the Cool Earth Partnership" and announced to aim to establish both reductions of greenhouse gas emissions and economic growth by implementing adaptation and mitigation measures against climate change. In the chapter "Power" in "State of the National Report", the strategy for rural electrification was approved by the government of Timor-Leste.

<Consistency with the Development Needs of Timor-Leste at the Time of Ex-Ante Evaluation >

The project was consistent with the development needs of Timor-Leste at the time of ex-ante evaluation. Timor-Leste needed to diversify its energy sources to move away from diesel generation which is dependent on imported fuel, by introducing renewable energy

sources including solar power.

<Appropriateness of Project Design/Approach>

The project design/approach was appropriate. No problem attributed to the project design/approach was confirmed.

<Evaluation Result>

In light of the above, the relevance of the project is ③¹.

[Coherence]

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

The project was consistent with Japan's ODA policy to Timor-Leste at the time of ex-ante evaluation. The government of Japan set improving economic and social infrastructure maintenance and its maintenance capabilities as one of priority areas for assistance to Timor-Lest², and has also provided assistance to developing countries that are grappling with climate change and vulnerable to the adverse impacts of climate change. In 2008, 'the Grant Aid for Environment Programs' was established to support adaptation and mitigation in developing countries. The Ministry of Foreign Affairs of Japan conducted a survey on developing countries' needs for support for environmental programs utilizing solar power generation, etc. As a result of this survey, the government of Timor-Leste requested for the project.

<Collaboration/Coordination with other JICA's interventions>

Any collaboration/coordination between the project and other JICA's intervention was not clearly planned at the time of ex-ante evaluation.

<Cooperation with other institutions/ Coordination with international framework>

Any cooperation/coordination with other partners was not clearly planned at the time of ex-ante evaluation.

<Evaluation Result>

In light of the above, the coherence of the project is ②.

[Evaluation Result of Relevance/Coherence]

In the light above, the relevance/coherence of the project is ③.

2 Effectiveness/Impact

<Effectiveness>

The project objectives were partially achieved. The power generation volume at transmission end (Indicator 1), annual CO2 reduction (Indicator 2), and electricity cost reduction (Indicator3) have not reached the target value. Since the monitoring device was only installed in FEST of UNTL and was not installed in the Faculty of Agriculture (FA) of UNTL, the actual values, which have been able to be confirmed from the commissioning, have not reached the targets. Although the precise timing is unknown, 2 out of 3 power conditioners installed in FEST stopped due to inverter failure and 89 Photovoltaic (PV) modules were damaged by stone throwing. In addition, at the time of ex-post evaluation since the electrical room ventilation fans were removed, the heat is trapped inside the electrical room and the electrical equipment is at risk due to a large amount of dust. Besides, 3 PV modules installed in FA of UNTL were damaged by stone throwing. The power conditioner was out of order due to flooding caused by heavy rain. Spare parts were also damaged due to flooding. Follow-up cooperation for the project is under planning, which is expected to improve the operation of the project.

Regarding the qualitative effects, public awareness has increased, because the students and lecturers of the faculty were all aware of the use of renewable energy. Not only the faculty members, the students of private and public senior high schools also visited the project site and some of the faculty members explained the function of solar power generation. Agencies such as the Korea International Cooperation Agency (KOICA) and UNDP also visited the project sites to get some information regarding solar power generation since those agencies were also planning to implement a similar project in several remote areas of this country. In addition, the PV systems installed in the BSs have raised public awareness, because the residents understood the use of PV systems, municipality administrator and other school members visited and asked for an application method, KOICA and local NGOs also visited for data collection of their projects, and in some communities the residents visited the schools to charge their mobile phones.

<Impact>

There are some positive impacts of the project confirmed at the time of ex-post evaluation. For instance, the project contributed to the total amount of electricity generated by solar energy as targeted in the Strategic Development Plan 2011-2023, which aims to promote economic growth in rural areas through the provision of renewable energy. According to UNTL, the project has also attracted the attention of donors and other agencies planning to install solar power systems. For example, UNDP in partnership with KOICA visited the project sites before they launched the "Accelerating Clean Energy Access to Reduce Inequality (ACCESS) project", which provided access to sustainable electricity to the most vulnerable communities in remote villages such as Outalo, Bobonaro and Manatuto.

No negative impact on the natural environment was observed and no land acquisition and resettlement of people was implemented under the project.

<Evaluation Result>

In light of the above, the effectiveness/impact of the project is ②.

Quantitative Effects

Indicators	Baseline	Target	Actual	Actual	Actual	Actual	Actual	Actual	Actual
	2010	2021				2019	2020	2021	
	Baseline	3 Years after	2015	2016	2017	1 Year	2 Years	3 Years	2022
	Year	Completion				after	after	after	Ex-post
						Completi	Completi	Completi	
						on	on	n	

¹ ④ : very high, ③ : high, ② : moderately low, ① : low

² ODA country data book 2010

1. Power generation volume at transmission end (MWh/year)	-	417.3	337.6 (80.9%)	300.9 (72.1%)	245.5 (58.8%)	141.9 (34.0%)	134.4 (32.2%)	50.9 (12.1%)	N/A
2. Annual CO2 reduction (t/year)	-	231.6	189.1	168.5	137.5	79.5	75.3	28.0	N/A
3. Electricity cost reduction (Ten thousand JPY/Year)	-	450.7	364.6	325.0	265.1	153.2	145.1	54.0	N/A

<Source> Monitoring device of PV system

- Actual figures are shown from 2015, as the installation of the PV systems except the UNTL Faculty of Agriculture was completed in 2014; an additional PV system was installed at the UNTL Faculty of Agriculture in 2018 using the remainder of the grant aid budget.
- Annual CO2 reductions are calculated with the following formula: Capacity of a solar power panel (kW) x Solar radiation (kWh/m2 * day) x System efficiency = Annual power generation (kWh/year) x Emission factor (kg-CO2/kWh) x 365 days
- Annual saving of electric charges is calculated with the following formula: Annual power generation (kWh/year) x Unit electricity rate (yen/kWh)

3 Efficiency

Although the project cost was within the plan/as planned (the ratio against the plan:100%) and the project period considerably exceeded the plan (the ratio against the plan:291%) due to changes of the project sites and specification of facilities.

Outputs were produced as planned.

In the light above, the efficiency of the project is ②.

4 Sustainability

< Institutional/Organizational Aspect>

FEST of UNTL established PVWG composed of 1 coordinator, 1 technician and 1 researcher during the project. However, the activities of PVWG were insufficient because the group members were employed as permanent lecturers at the department. At the time of ex-post evaluation, FEST hired 1 coordinator, 2 technicians and 1 researcher who were able to conduct O&M on a daily basis.

As for BSs, a few technical staff or teachers were assigned to operate and maintain the PV facilities. According to each school, the number of staff allocation has been sufficient. However, except for Atauro BS, other BSs their O&M mechanism did not work, because those school PV facilities were broken between 2016 and 2018. In addition, though some of BSs reported to the MEYS after the facilities were broken, they did not get any positive responses from the MEYS. However, in 2022 the JICA Timor-Leste Office confirmed that MEYS has been keen to join and coordinate with JICA on how to continue the project in order to be fully utilized and effective for the BSs.

<Technical Aspect>

The PVWG of UNTL and the BSs received instruction on O&M in English from the consultant or supplier during the project. As a result, some teachers and technical staff who use English were able to conduct O&M, however others who do not use English were unable to learn technical skills of PV facilities nor understand the manual prepared by the project due to a lack of language ability. At the time of ex-post evaluation, the PV facility of Atauro BS was properly maintained by the technical staff because the staff was able to properly learn O&M from the consultant with the support of an English-speaking teacher, however the PV facilities of other BSs were already failures because the staff did not have sufficient technical skills and knowledge and regular maintenance was not conducted.

<Financial Aspect>

At the time of ex-post evaluation, FEST of UNTL did not have the necessary budget for the proper O&M. Although FEST had requested the head office of UNTL to allocate budget, the head office had not been allocated because of administration issues including FEST's late request and head office's mismanagement. However, the head office agreed with allocating approximately 2,000 US dollars per year to the maintenance budget and signed the Minutes of Discussions on the JICA's follow-up cooperation study. Based on the Minutes of Discussions, FEST of UNTL is expected to include the necessary budget amount for O&M to the Budget Plan Proposal and submit it to the head office in order to obtain approval. The head office also committed to secure the budget for the maintenance after the following up cooperation. As for the BSs, the budget allocation for O&M was not needed since the installed facilities require simple maintenance such as removing dust on the PV panels and turning on/off the system only. However, MEYS committed to allocating a budget to the BSs for damage or loss to the PV system that needs to be repaired or replaced.

<Environmental and Social Aspect>

Since the project site in UNTL was the hunting ground for local residents, the solar panels were damaged by throwing stones. There was no opportunity to discuss this issue between UNLT and local communities. However, UNTL plans to hold an open campus to raise awareness of renewable energy among residents and explain the importance of PV facilities and gain their understanding.

<Current Status of Operation and Maintenance>

As for PV system of UNTL, many modules were cracked due to the stone throwing by local residents and the monitoring system also did not work. Although the modules were replaced with the spare parts, the monitoring system has not worked yet after flood occurred in April 2021. FEST planned to submit the proposal for budget allocation in order to repair the facilities. In addition, UNTL strengthens patrols around the facilities. As for BSs, although Atauro BS did not have any problems on their facility and conducted properly O&M, other schools' facilities have some problems including DA/DC inverters failure and thermally damaged cables in PV modules.

<Evaluation Result>

In light of the above, some problems have been observed in terms of institutional/organizational, technical, and current status of operation and maintenance aspects of the implementing agency. Therefore, the sustainability of the effectiveness through the project is ②.

5 Summary of the Evaluation

The project partially achieved the project objectives. As for sustainability, some problems have been observed in terms of the

institutional/organizational, technical, and current status of operation and maintenance aspects of the implementing agencies. As for efficiency, the project period considerably exceeded the plan.

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

IV. Recommendations & Lessons Learned

Recommendations to Executing Agency:

- It is expected that FEST of UNTL will have discussions with EDTL on the management of the solar power. Although the solar power system is connected to the EDTL's transmission line, EDTL does not monitor how much solar power is generated and fed into the transmission line, which could overload the transmission system in some cases. In addition, since the solar power system of FEST of UNTL feeds electricity into the EDTL's power line without a power purchase agreement, FEST of UNTL does not receive any direct economic benefit from the generation of electricity. It is therefore recommended that FEST of UNTL and EDTL enter into agreement on these issues.
- In order to enhance sustainability of the project effects in terms of technical aspect, it is necessary for executing agency and the BSs to make a mechanism to share the knowledge learned by the project to other staff and the BSs.

Lessons Learned for JICA:

- In the case that a project contains the component which beneficiaries would be responsible for daily operation and maintenance, JICA should confirm the beneficiary's language ability on operation and maintenance and consider proper technical assistance before the implementation of the project. In the project, although maintenance manuals were delivered to each BS and the training was conducted by the supplier, it was seemed that most BSs did not properly learn how to operate and maintain the PV systems nor could understand the manual due to the lack of their language ability.
- During the planning stage of a project, it is necessary for JICA to consider the necessity of any supports from technical entities for the Operation and Maintenance in the case that high technic or specialties are required. In this case, JICA needs to confirm the roles of an implementing agency and technical agencies and make it clear too. In this project, the project should have involved EDTL which has its own electrical engineers. If EDTL would be involved in the project, the FEST of UNTL or BSs could receive EDTL's technical support.
- Since the project sites of UNTL was the place where residents hunted before the installation of facilities, they continued to hunt by throwing stone which damaged the PV facilities after the installation. During the planning stage of the project, it is necessary for JICA to encourage executing agency to have consultation with local stakeholders in order to make the residents understand the project.



Grid-connected solar panel at UNTL-FEST



Stand-alone PV system at Atauro Basic School
(The roof part of this facility is a PV panel)