

Country Name	The Project for Introduction of Clean Energy by Solar Electricity Generation System
Palestinian Authority	

I. Project Outline

Background	Palestine had depended most of its electricity supplies on imports from Israel and Jordan, and the rate of electricity supplies by the Palestinian Authority at the time of ex-ante evaluation was 10% to 15% only, despite the increasing electricity demands accompanying with the high population growth rate in cities and refugee camps ¹ . Therefore, assistance for Palestine to introduce renewable energy technology including solar electricity generation was expected, as renewable energy could enable stable supply of electricity within Palestine, while reducing greenhouse gases (GHG) emissions. Japan had actively provided assistance to developing countries making efforts to contribute to climate control, and announced a new fund mechanism for climate change worth US10 billion dollars for five years in 2008. As a component of the new fund mechanism, a new scheme of grant aid called “Program Grant Aid for Environment and Climate Change (GAEC)” was also introduced in 2008 to support adaptation and mitigation strategies of developing countries, and a policy was set to promote utilization of clean energy including renewable energy and to positively utilize Japanese advanced technologies.				
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 a suburb of Jericho city, 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"> 1. Project site: Agro-Industrial Park planned to be constructed in a suburb of Jericho city 2. Implementations of the Japanese side: (1) Procurement and installation of Photovoltaic (PV) system (300kWp) and related equipment, (2) Technical Assistance (soft component of Grant Aid): training on basic knowledge on grid-connected PV system and on maintenance and emergency response, etc. 3. Implementations of Palestinian side: Laying high tension incoming cable to substation 				
Ex-Ante Evaluation	2009	E/N Date	December 21, 2009	Completion Date	September 22, 2012
		G/A Date	December 21, 2009		
Project Cost	E/N Grant Limit / G/A Grant Limit: 597 million yen, Actual Grant Amount: 597 million yen				
Implementing Agency	Palestinian Energy and Natural Resources Authority (PENRA)				
Contracted Agencies	Oriental Consultants Co., Ltd., Toyota Tsusho Corporation, Hitachi Plant Technologies Ltd., TSUCHIYA Corporation, Tubaila Target United for Engineering & Construction, ESCOM Energy Services Company, Japan International Cooperation System (JICS) (Procurement Agent)				

II. Result of the Evaluation

1 Relevance
<p><Consistency with the Development Policy of Palestine at the time of ex-ante and ex-post evaluation></p> <p>This project has been consistent with Palestine’s development policy, as ‘increasing the ratio of renewable energy among energy demand’ and ‘reduction of dependency on imported energy’, etc. are set in policy documents such as “National Plan for Development of Renewable Energy & Efficiency 2007-2012”, “National Development Plan” (2012-2015²), and “Palestinian Solar Initiative” (2012) .</p> <p><Consistency with the Development Needs of Palestine at the time of ex-ante and ex-post evaluation></p> <p>At the time of ex-ante evaluation, Palestine had depended most of its electricity supplies on imports from Israel and Jordan. In 2012, 91% of electricity supplies were still covered by imports (mainly electricity purchase from Israel). While Palestine aims at securing 130MW of electricity by renewable energy by 2020, only 5 to 6 MW of electricity was secured as of 2014, and most of the electricity supplies is still dependent on imports from Israel. Therefore, needs for renewable energy (particularly solar power generation) that is possible to generate within Palestine are still high at the time of ex-post evaluation.</p> <p><Consistency with Japan’s ODA Policy at the time of ex-ante evaluation></p> <p>The Japanese government announced “the Cool Earth Partnership” as one of efforts for developing countries making efforts to contribute to climate control by balancing their economic growth with reduction of GHG emissions at the Davos summit in January 2008, and Palestine joined the Cool Earth Partnership. As a component of this effort, Japan newly introduced GAEC in 2008 in order to support developing countries struggling to contribute for the climate control due to lack of abilities and funds for balancing their economic growth with reduction of GHG emissions. 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 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 of the PV system procured and installed under the project (Indicator 1) and reduced CO₂ emission (Indicator 2) in 2014 exceeded target figures (102% of target), and actual figures in 2015 (target year of the project) almost achieved target figures (97% of target). The power generation slightly below the target in 2015 might</p>

¹ At the time of the ex-post evaluation, the main electricity suppliers are Israel and Egypt.

² National Development Plan after 2016 was under preparation at the time of ex-post evaluation.

reflect fluctuations in generating efficiency mainly due to insolation and dusts, thus showing the effectiveness of the introduction of the PV system. Moreover, operation and maintenance (O&M) of project facilities are properly conducted by PENRA and Jerusalem District Electricity Company (JDECO) at the time of ex-post evaluation owing to the soft component of the project, and thus it can be said that there have been effects of the soft component. Furthermore, various groups such as students, companies and overseas diplomatic corps conduct site visits to the project facilities approximately once a month on average, and PR activities for promotion of utilization of renewable energy are conducted. For university students, in particular, PENRA organizes environmental summer camps including study tour to the project facilities besides accepting individual visits.

<Impact>
This project was the first introduction of a grid-connected PV system in Palestine. PENRA provides the Ministry of Environmental Affairs of the Palestinian Authority with information on this project, and the Ministry introduced this project in international conferences on climate change (in Jordan, United Arab Emirates (Dubai) and Tunisia, etc.). Moreover, a PV system of 500kW has been installed for 120 households in Tubas since project completion, and another PV system of 500kW is planned to be installed in the same area. According to PENRA and JDECO, this project served as an impetus for installing such grid-connected PV system in Palestine. 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 been 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 is high.

Quantitative Effects

Indicators	Baseline 2009 Planned Year	Target 2015 3 Years After Completion	Actual 2012 Completion Year	Actual 2013 1 Year After Completion	Actual 2014 2 Years After Completion	Actual 2015 3 Years After Completion
Indicator 1: Net power generation (kWh/year)	0	422,000	168,876 ⁽¹⁾	351,414 ⁽²⁾	431,802	409,932
Indicator 2: Reduction of CO ₂ Emission (t/year) ⁽³⁾	0	290.6	116.3	242.0	297.4	282.3

Source: Ex-Ante Evaluation Sheet, questionnaire survey and interview with PENRA and JDECO

Note: (1) The facilities installed under the project started operation in July 2012, and the figures above are those of August to December 2012. The amount of net power generation from August 2012 to July 2013 was 487,548.5kWh, which exceeded the target. (2) The reason for substantially falling below the target in 2013 was due to breakdown of some equipment procured under the project. JDECO repaired the equipment at its own expense in the same year and power generation capacity of the facility was recovered. (3) The amount of lifecycle CO₂ emission in oil thermal power generation (power generation end): 742.1g-CO₂/kWh. The amount of lifecycle CO₂ emission in solar power generation (power generation end): 53.4g-CO₂/kWh. Reduction of CO₂ emission by solar power generation: (742.1-53.4) x 422,000/1,000,000=290.6t-CO₂

3 Efficiency

Although the project cost was as planned (ratio against the plan: 100%), project period exceeded the plan (ratio against the plan: 127%)³, because the procurement/installation period was prolonged mainly due to the change of country of manufacture of the network transformer. It was confirmed that output of this project was produced as planned. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional Aspect>

At the time of ex-ante evaluation, O&M of the project facilities was planned to be conducted by PENRA, among which O&M of special high-voltage substation equipment only was planned to be outsourced to JDECO, which was in charge of management of power distribution networks. Thus, PENRA was planning to employ two electrical engineers and a security guard (night-time). At the time of ex-post evaluation, an engineer belonging to JDECO conducts O&M of the project facilities and a staff of PENRA supervises the O&M. While there has been a change in O&M system, daily and periodical inspections are properly conducted and target figures of net power generation of the project facilities have been achieved, and thus there seems to be no problem regarding O&M system. In January 2017, O&M of the project facilities was transferred to a developer in charge of operation of Jericho Agro-Industrial Park (JAIP Corporation). JAIP Corporation has already concluded an agreement on outsourcing of O&M of the project facilities with a private company that has considerable experience of O&M of PV systems (CREATIVE Corporation), and proper O&M is planned to be conducted. However, if O&M by these companies is not properly conducted, O&M is supposed to be conducted by PENRA and JDECO again. PENRA has continuously been the owner of the facilities. Since JAIP Corporation assumes O&M responsibility as of January 2017, the amount equivalent to the cost of electricity generated with the project facilities is deducted from the electricity bill to be paid by the Corporation.

<Technical Aspect>

The number of staff who received the soft component (technical training on maintenance) is five in PENRA and two in JDECO. In PENRA, one of these five staff supervises O&M of the project facilities by JDECO, while in JDECO, an engineer who is different from the above two staff who attended the training conducts O&M based on the O&M manual and the maintenance plan prepared under the project. It is judged that there is no problem in the technical aspect, as O&M is conducted properly⁴. When JAIP Corporation becomes in charge of O&M of the project facilities, it is considered that there will be no problem in the technical aspect, as CREATIVE Corporation has considerable experience of O&M of PV systems.

³ The actual project period was calculated in the same way as the planned period, i.e., with the signing on the consultant contract as the starting point. Besides, it took nearly 10 months from the conclusion of the G/A to the consulting contract.

⁴ According to JDECO, engineers who attended the training of the soft component have been transferred to other sections. However, the JDECO staff in charge of O&M of the project facilities at the time of the ex-post evaluation is also in charge of O&M of other PV systems in Jericho, and the project facilities are maintained without problems.

<Financial Aspect>

At the time of ex-ante evaluation, O&M cost of the project facilities was estimated to be 128,340 Shekel annually including personnel expenses, electricity cost for operation of equipment such as the data management and monitoring system and the large-sized display monitor, water charges and consumables expenses. The actual O&M cost (paid by JDECO) is 83,200 Shekel in 2013, 146,200 Shekel in 2014 and 83,200 Shekel⁵ in 2015, resulting in less amount than the amount estimated during ex-ante evaluation except for 2014. The reason for O&M cost having increased in 2014 was that some equipment of the project facilities were broken down and repaired. O&M including repairing of broken-down equipment is carried out appropriately with the necessary O&M budget secured from the revenue from electricity generation. A certain amount of O&M budget has been spent as necessary every year. The financial condition of JDECO is considered as relatively stable in medium and long terms.

<Current Status of Operation and Maintenance>

At the time of ex-post evaluation, daily and periodical inspections of the project facilities are conducted based on the maintenance plan. The facilities and equipment installed under the project are in mostly good conditions⁶. Consumables and spare parts are properly procured and managed.

<Evaluation Result>

In light of the above, no problem has been observed in terms of the institutional technical and financial aspects of the implementing agency and the current status of O&M. Therefore, the sustainability of the project effect is high.

5 Summary of the Evaluation

Through the project, regarding enhancement of power generation capacity and diversification of energy sources as the project objectives, the amount of power generation has increased and emission of CO₂ has been reduced, and thus project effects have been observed as planned. Regarding increasing awareness among people on utilization of renewable energy, PR activities on the PV system have been conducted. Moreover, initiatives of Japan to promote efforts for climate control have been demonstrated through introduction of this project in international conferences etc. As for sustainability, no problem has been observed in terms of the institutional, technical and financial aspects and the current status of O&M. As for efficiency, the project period exceeded the plan.

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

III. Recommendations & Lessons Learned

Recommendations to implementing agency (PENRA):

As of July 2016, the O&M system, in which JDECO conducts O&M of the project facilities and PENRA supervises JDECO, has been established and target figures of net power generation have been achieved. Following the transfer of the responsibility over O&M of the project facilities to the developer of Jericho Agro-Industrial Park in January 2017, the actual O&M work is outsourced to CREATIVE Corporation that has experiences of O&M of PV systems. In that way, it is expected that target figures of net power generation will be continuously achieved. However, if technical problems occur, PENRA needs to provide technical support.

Lessons learned for JICA:

As a result of providing assistance in response to the needs for a grid-connected PV system in Palestine as a precedent for other subsequent PV generation projects, this project became a model of grid-connected PV systems, which have gradually been diffused in the country after project completion. In this way, this project is a successful example of importance of providing timely assistance to development needs in recipient countries.

⁵ The JICA exchange rate for December 2015: 1 Shekel = 31.613 yen.

⁶ (1) Some equipment of data management and monitoring system was broken down at the time of site survey in May 2016. The equipment was already repaired as of January 2017. (2) During the defects inspection (2013), it was found that water supply pipes have not been installed into the project facilities, and recommended to PENRA to promptly install the pipes, as sufficient amount of water is necessary for cleaning of PV modules etc. However, at the time of ex-post evaluation, it is still under coordination between Jericho city and the supervisory agency of Jericho Agro-Industrial Park, and the pipes have not yet been installed. Thus, cleaning is conducted using water delivered with water supply tanks. Nonetheless, no problem has occurred to date with cleaning with water from tanks.



Solar Panel



Monitoring Room