Internal Ex-Post Evaluation for Grant Aid Project

conducted by Pakistan Office: December 2015

Country Name	**The Project for Introduction of Clean Energy by Solar Electricity Generation System**
Islamic Republic of Pakistan	

I. Project Outline

Background	Pakistan was highly dependent on fossil fuels, mainly oil and gas, to meet its power requirements. Solar energy which had a large potential in the country remained unharnessed and was restricted to small scale standalone photovoltaic (PV) systems. The power deficit in year 2007/08 was around 4,000 MW according to state of industry report 2009. There was not a single grid-connected solar system in the country at that time. In January 2008, Japan established the Cool Earth Partnership aimed at achieving both greenhouse gas (GHG) emission reduction and economic growth for developing countries. Pakistan was singled out as one of the countries to benefit from this initiative, and JICA developed the outline design and modalities for the first ever solar PV based grid-connected system for Pakistan.				
Objectives of the Project	To increase power generation capacity, diversify power sources, and raise awareness for renewable energy by providing PV system and related equipment to Planning Commission (PC) and Pakistan Engineering Council (PEC) in Islamabad and by providing technical assistance, and thereby contributing to publicity of Japan's initiative for promoting measures for climate change both by developed and developing countries.				
Outputs of the Project	1. Project Site: Islamabad (Parking space of the PC and parking space opposite PEC building) 2. Japanese side (1) Provision of grant necessary for procurement and installation of PV system *(PV module, PV structure, Connecting box, Junction box, Power conditioner, Switching Panel, Distribution board, Indoor cubicle, Display board, Data collecting system and others), (2) Technical Assistance (soft component of Grant Aid) * The capacity of PV system was originally designed to be 220 kW (110kW at PC and PEC sites respectively). During the project implementation, the capacity was expanded to 356.16kW by using the remaining balance of the grant aid fund after deduction of the contract value which was as a result of lower than the predetermined price. 3. Pakistan side: Installation of fence at PV installation site of PEC, Land preparation of PEC site, and Replacing of trees				
Ex-Ante Evaluation	2009-2010	E/N Date	11 February, 2010	Completion Date	22 March, 2012
Project Cost	E/N Grant Limit: : 480 million yen, Actual Grant Amount: 466 million yen				
Implementing Agency	Pakistan Engineering Council (PEC)				
Contracted Agencies	.Nippon Koei Co., Ltd, Mitsubishi Corporation, Japan International Cooperation System (The procurement of the project is done by the Japan International Cooperation System under the Agent Agreement with Planning Commission)				

II. Result of the Evaluation

1 Relevance

Consistency with Pakistan's development policy at the time of ex-ante evaluation and ex-post evaluation

This project has been highly consistent with Pakistan's development policy as promotion and development of renewable energy resources and technologies as an important policy measure to boost energy supplies and mitigate climate change is set in policy documents such as national environmental policy formulated in 2005 (at the time of ex-ante evaluation), National Climate Change Policy 2012, National Power Policy 2013 (both at the time of ex-post evaluation) and other documents.

Consistency with Pakistan's development needs at the time of ex-ante evaluation and ex-post evaluation

The project has been also highly relevant with Pakistan's development needs for renewable energy as Pakistan has been heavily reliant on thermal power (64% of total installed capacity in 2013) and the power sector is the single largest source of GHG emission in Pakistan (51% of the total 310 million tons of CO2 equivalent in 2008), and therefore, has needed alternative energy source.

Consistency with Japan's ODA policy at the time of ex-ante evaluation

The project was also consistent with Japan's ODA policy at the time of ex-ante evaluation as prioritized areas for support include economic infrastructure development for activating market economy and supporting the poverty reduction.

Evaluation result

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

2 Effectiveness/Impact

Effectiveness

The project has mostly achieved its objectives, "to increase power generation capacity and diversify power sources, and raise awareness for renewable energy". Indicators of quantitative effects, such as net power generation, reduction in CO2 emission, and reduction in electricity cost have nearly achieved the targets set at the time of ex-ante evaluation based on the originally designed capacity of 220kW, however those figures are relatively low based on the increased capacity of 356.16kW. This would be influenced due to increased level of load shedding carried out during 2012-2014 which restricted the benefit of solar generation[1], and due to the shutdown of solar facility at PC for three consecutive months in 2014 (May-July)[2].

[1] During load shedding the power supply through the solar system also remains switched off so that there is no reverse power flow to the grid. This is to ensure safety of Islamabad Electric Supply Company Ltd. (IESCO) staff. The power generation of the system is affected accordingly.

[2] The incident happened due to phase rotation error on the part of IESCO and resulted in system break down for three consecutive months. The system,

Implementation of the PV system under the project was able to reduce CO2 emission which could have been produced under thermal power as envisaged in the ex-ante evaluation, although the values calculated based on the actual power generation amount have been fluctuating as the value is directly linked to the power generation amount. The electricity cost has been saved, but the same applies for this indicator.

PC and PEC have effectively demonstrated the project to raise awareness for renewable energy. PC published the project detail in its monthly newsletter, displayed project highlights on it's website, displayed information on information boards, took students of various engineering universities around the site and arranged site visits for various government organizations like Pakistan Railways who had shown keen interest in solar power generation. PEC has facilitated the visit of professionals, engineers and students to the PEC and PC project sites. These included representatives of IESCO, Department of Energy, Government of Punjab, Board of Investment, Pakistan Council for Renewable Technologies, etc. and students from various engineering universities and representative of private industries. Participation in seminars and exhibitions as well as electronic and print media were also used as means to create awareness on the renewable energy.

As a result of implementation of soft component of the project, operation and maintenance (O&M) capacity of PEC has been strengthened and PEC has operated the grid-connected PV system without any trouble so far. The soft component has envisaged that a power purchase agreement (PPA) is signed for PC, PEC and IESCO for the trading of the reverse power (surplus power). However, net metering rule and regulations have not been notified, and the PPA prepared by PEC and forwarded by IESCO is pending with National Electric Power Regulatory Authority (NEPRA) for two years due to reasons not expressly made known to the concerned organizations so far. After the soft component implementation, the meteorological data and power generation data have been measured and analyzed, however, the analysis is on a very limited scale due to the limited manpower.

Impact

As for impacts, this project, as the first case of grid-connected PV system in Pakistan, the project acted as a catalyst to introduce relevant rules and regulations for power trade for renewable energy. PEC proudly claims several other projects, particularly solar power projects in the Punjab province and a grid based solar power park, to have been initiated as a ripple effect of this project. PEC also claims to have shared the experiences and knowledge of this project with several stakeholders who were convinced and showed keen interest to initiate similar projects. According to PC and PEC, although previously it was considered too expensive and not a suitable alternative for cheaper sources of electricity generation, the project, which involves very low O&M costs, has resulted in large scale awareness for solar resource to be considered as a viable means of grid-connected electricity generation. As to Japan's initiative for promoting measures for climate change, JICA participated in a workshop held by Research Institute of Innovative Technology for the Earth on Policy dialogue in Islamabad in November 2013 as a key speaker. Japan's contribution in promoting climate change measures through renewable resources and conservation is widely acknowledged among the stakeholders in Pakistan, albeit, specific case studies have not been vigorously publicized in this regard. An unexpected positive impact was observed as the project was cited as a model for ensuring safety of construction workers because of Japanese company's high standard construction management, especially in safety management.

No negative impacts on natural environment were observed and no land acquisition occurred under this project.

Evaluation result

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

Quantitative Effects

Indicator	Before the project (2010)	Target figure at target year (2014)	Actual result (2012)	Actual result (2013)	Actual result (2014)
Indicator 1: Net power generation (MWh/year)	0	315 (*1)	204	380	304
Indicator 2: Reduction in CO2 Emission (t/year)	0	153 (*2)	99	185	148
Indicator 3: Reduction in Electricity cost (million Pakistani rupee: PKR)	0	1.77 (*3)	1.15	2.13	1.71

Note : (*1) Target figure is calculated based on the originally designed capacity of 220 kW. The assumed target figure of the 356.16kW capacity is 510 MW/year. (*2) 315 MWh/year x 0.486 t-CO2/MWh (Default value in Pakistan). The assumed target value based on the actual installed capacity is 245 t/year. (*3) The yearly power consumption of PC and PEC was 980 MWh from November 2008 to October 2009. Net power generation to be generated by the PV system was estimated to be around 32% of yearly power consumption of PC and PEC. The estimated electricity cost reduced by the PV system is calculated by using the unit cost of 5.62 PKR (315kWh x 5.62 PKR=1.77 million PKR). The assumed target based on the actually installed capacity is 2.87 million PKR

Source : JICA internal documents, questionnaires/interviews of PC and PEC

3 Efficiency

Although the project cost was within the plan (ratio against the plan: 100%), project period significantly exceeded the plan (ratio against the plan: 168%) 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

O&M of equipment and facilities provided by the project at the installed sites have been carried out by the Administration & Personnel department and Continuing Professional Development department of PEC, the implementing agency, and Energy Wing of PC respectively.

The institutional structure at PEC is sustained what it was considered desirable at the time of ex-ante evaluation. One official at PEC is mainly responsible to monitor O&M of the PV system, in addition to his other duties. He is supported by one technician/operator deputed at the control room for continuously keeping an eye on the system. On the par to PC, one official, a Deputy Chief at Energy Wing is responsible for the overall monitoring and operation of the PV solar facility at PC. The Energy Wing is located at about 5 km from PC and there is no support available to the official for a systematic and regular check at the solar PV electricity generation facility at PC. No daily

after fault detection and removal by IESCO, has been functioning satisfactorily since then.

operator is designated at PC site since project completion.

As the system have generally been free from O&M troubles, no mechanism is specifically put in place to share the information for O&M except that PC may seek advice from PEC if and when necessary.

Technical Aspect

The soft component of the project established the requisite technical level in PC and PEC to continue operation of the solar facilities without any problems. Two officials, one each at PC and PEC, who were trained under the soft component of the project are still available to the two organizations. The training materials and manuals prepared and handed over under the soft component are considered adequate from the viewpoint of O&M of the system, according to PC and PEC. There is, however, no strategy so far to internally transfer the soft component or to create an alternate capability for system maintenance in case the current officials move out of the institutions on a short notice.

Financial Aspect

PEC has the requisite financial resources so that the effects achieved by the project continue after the ex-post evaluation. The solar site at PC, however, requires at least one dedicated person to ensure regular O&M at the site. Due to the delay in the development of the PC-IV by PEC which is the basic document for seeking resource allocation for O&M of the equipment and facility for continuation of activities after the project completion, PC has not been able to mobilize resources.

Current Status of O&M

The equipment and facilities was found to be in reasonably good condition at the time of ex-post evaluation. While PEC carries out general inspection of all components of the system on daily basis as well as annual periodic inspection, there is no inspection schedule of the system on daily basis at PC because of inappropriate staff allocation. One official of Energy Wing carries out inspection from time to time when the time may permit him.

Evaluation result

In light of the above, the sustainability of effects of this project effect is fair, as there are some problems in institutional, technical and financial aspects as appropriate staff allocation is constrained, however, the current status of the facilities and equipment are in good condition.

5 Summary of the Evaluation

The project has mostly achieved its objectives, "to increase power generation capacity and diversify power sources, and raise awareness for renewable energy" as net power generation, reduction in CO2 emission, and reduction in electricity cost have nearly achieved the targets. The project effects have been also demonstrated effectively and the soft component under the project has strengthened O&M capacity of the related organizations. Positive impacts were also identified, as the project acted as a catalyst to introduce relevant rules and regulations for renewable energy as well as new projects of grid-connected PV system in the country. As for sustainability, the operating agencies have some problems in the institutional, technical and financial aspects, as appropriate staff allocation is constrained. However, the current status of the facilities and equipment are in good condition. As for efficiency, the project period exceeded the plan while the cost was within the plan.

In light of the above, this project is evaluated to be satisfactory.

III. Recommendations & Lessons Learned

Recommendations to implementing agency:

1. It is strongly recommended that the Government of Pakistan (GOP)/NEPRA takes immediate action to notify the Net Metering Rules and Regulations. It will give way to adoption of a complete framework and allow the benefit of reverse power flow from the grid-connected solar power generation to pass on to the consumer/generator/investor. It will create much better ripple effects to cause many more similar projects to be initiated in the near future. A deadline for notification of the rules must be set up as delay connotes negative signals to the promotion of renewable sources of energy in the country. NEPRA should also finalize the PPA as expeditiously as possible. JICA may assist in expediting the stalled approvals by reminding the GOP to the need of addressing the issues as urgently as possible. The PEC and PC, being the direct beneficiaries of the project, should follow-up at the highest level to seek requisite processing/approvals (at the level of Chairman, Secretary and the Minister) and should not leave it to mid-level officials to write mundane reminders to the relevant agencies to do the needful.
2. It is further recommended that PC and PEC review the resource requirement for a more focused and meaningful management of the solar facilities and for rigorous data analysis. Deadlines for developing PC-IV and its approval should be set. Budgetary requirements should meantime be worked out and met through the current O&M budgetary provisions through re-appropriations or other permissible means. It is also recommended that refresher short term training with respect to fault localization and operation and maintenance of the facilities and data analysis should be arranged for the concerned staff. At the same time, process for in house soft component transfer to make alternate arrangement for O&M at the solar facilities should be put in place so that any change of position or office by one person should not affect the routine operation of the system.

Lessons learned for JICA:

The ex-post evaluation found the scope of the data analysis has been limited relative to the expectation under the soft component due to the limited manpower and found that PC needs to assign someone for regular O&M to reap best effects of the solar system which needs to be addressed. For future projects, JICA may put maximum emphasis on capacity building of the relevant institution in a way that post implementation issues do not arise. Even though soft component is implemented, effects of soft component do not continue without ensuring proper institutional arrangement.

(Display Panel Installed at the PEC Site)

(View of the Solar Panels at PEC)