India

FY2016 Ex-Post Evaluation of Japanese ODA Loan Project

"New and Renewable Energy Development Project"

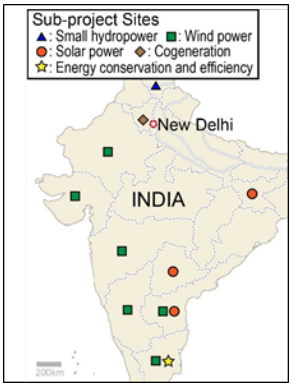
External Evaluator: Mitsue Mishima, OPMAC Corporation

0. Summary

The project aimed to provide medium- and long-term funding for new and renewable energy power generation and energy efficiency promotion projects in India, confronting a shortage of electric power generation capacity, by means of a two-step loan through the Indian Renewable Energy Development Agency Limited (IREDA), thereby contributing to the securing of electric power supply, diversifying its source, and alleviating the environmental burden. This project is supposed to respond to the growth of energy demand resulting from rapid economic growth and to improve the environment, is consistent with both the policy and development needs of India and the development assistance policy of Japan and thus is highly relevant. The project cost and period were within the plan and efficiency of the project is high. Wind power and solar power projects funded through IREDA are on the whole being operated as planned. This is recognized as substitution for thermal power generation which is the main source of electricity in India, reducing coal and other fuel consumption, resulting in reduction of CO_2 emission, and thus having impact on environment improvement. Further, employment creation impact at the sub-project sites is observed, and therefore effectiveness and impact of the project are high. With regard to sustainability of the project, although IREDA has to increase its staff, to strengthen their capabilities and to strengthen the monitoring system of loan projects responding to the rapid increase of loans, as of the time of this ex-post evaluation, no major problems have been observed in the institutional, technical, financial aspects and current status of the project operation and maintenance system. Thus, the project sustainability is high.

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

1. Project Description



Project Locations

Wind power generation financed by the project

1.1 Background

During the five years starting with the fiscal year 2005, energy consumption in India grew in tandem with rapid economic growth, with annual GDP growth averaging over 8%. Thus, to sustain stable supply of energy became an urgent issue of great importance for supporting such rapid economic growth. However, India had a skewed structure of energy supply, by relying on coal-fired power generation for 53% of the nation's power supply (as of 2009), which combined with the high and rising level of dependence on imported energy resource, created unease with regard to the stable supply of power. Seeking to diversify the structure of energy supply, the Indian government has worked at development of new and renewable energy (using wind power, solar power, cogeneration, etc.) but these types of energy source accounted for only 9.0% of national power generation (as of 2009), leaving much development potential to be exploited. Regarding conservation of energy, the *Energy Conservation Act of 2001* designated the 15 industrial sectors that accounted for the greatest shares of energy consumption, and mandated the obligation of energy audits, subsequent to which the sectors were required to work at achieving specific targets of energy efficiency.

In 1987 the Indian government established IREDA with the objective of financing and promoting the projects in the new and renewable energy field and the conservation of energy. Consonant with this the Ministry of New and Renewable Energy (MNRE) was established in 2006. MNRE has created a subsidy scheme so that independent power producers (IPPs) can enter the power sector market. Concerning energy conservation, the Bureau for Energy Efficiency (BEE) was set up under the Ministry of Power (MoP), and has been the single responsible organization for improving energy efficiency in all sectors of the economy, and has supported the implementation of energy conservation projects of various business entities. Within this context, market expectations for IREDA, the official government financial institution dedicated to activity in the fields of new and renewable energy, and of energy efficiency, have been high and therefore the project has supported for implementing various policies in the same area of the Indian government.

1.2 Project Outline

The objective of the project is to secure stable and diversified source of power supply against the recent increasing energy demand in India, by providing the two-step loans through IREDA for new and renewable energy development and energy efficiency and conservation projects in the country, thereby contributing to environmental improvement, sustainable economic development and mitigation of global climate change.

Loan Approved Amount/ Disbursed Amount	30,000 million yen / 30,000 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	June 2011 / June 2011
Terms and Conditions	Interest Rate: 0.55% Repayment Period: 30 years (Grace Period) (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	Indian Renewable Energy Development Agency Ltd. (IREDA) / the same as at the left (Guarantor: The President of India)
Project Completion	December 2014
Main Contractor (Over 1 billion Yen)	None
Main Consultant (Over 100 million Yen)	None
Feasibility Studies, etc.	"Special Assistance for Project Implementation: New and Renewable Energy Development Project (Phase 2)" (December 2014)
Related Projects	"New and Renewable Energy Development Project (Phase 2)" (September 2014)

2. Outline of the Evaluation Study[1]

2.1 External Evaluator

Mitsue Mishima, OPMAC Cooperation

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: December 2016 – February 2018

Duration of the Field Study: February 12 – March 15, 2017, May 13 – May 26, 2017

2.3 Constraints during the Evaluation Study

Out of eighteen target projects which were financed by IREDA under this ODA loan (hereinafter referred to as "sub-projects"), two projects are as yet unfinished and operational conditions cannot be evaluated and hence their effectiveness and impact are not covered by this report. Further, as of the time of the ex-post evaluation, repayment had been completed for eight sub-projects prior to the scheduled repayment date, of which operation data could not be obtained for one and hence that project is not included for the target of analyzing the effectiveness of the project.

[1] Regarding the data and information collection support for the evaluation study, it was contracted with and implemented by the National Institute of Labour Economics Research and Development (NILERD).

3. Results of the Evaluation (Overall Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of India

The Eleventh Five Year Plan (April 2007 to March 2012) that was effective as of the time of the project appraisal, 93,577MW of new power development projects were planned in order to meet the rise in demand attendant upon rapid economic growth, of which, the target for new and renewable energy was 15,000MW. The plan also included the target of a 20% improvement of efficiency of energy use, compared to the energy use in fiscal year 2007 to 2008, by fiscal year 2016 to 2017.

Further, as part of countermeasures for environment improvement such as mitigating emission of CO_2 under the *National Action Plan on Climate Change*, announced in 2008, the *National Solar Mission and the National Mission for Enhanced Energy Efficiency* were launched and have been actively working to achieve progress in investing for solar energy and energy efficiency projects. As for solar energy, in 2010 the *Jawaharlal Nehru National Solar Mission* was formulated and a policy with special regard to photovoltaic and solar thermal power generation was promoted. In addition, the *Strategic Plan for New and Renewable Energy Sector (2011-2017)* of MNRE has the objectives of promoting renewable energy generation for on-grid distribution mainly by solar power and wind power generation, biomass power generation and cogeneration by bagasse[4], and hydropower generation; and of promoting renewable energy power generation unconnected to the power system (off-grid) for the rural area, with quantified targets for each.

Examining the on-going plans and policies at the time of this ex-post evaluation, the subsequent *Twelfth Five Year Plan (April 2012 to March 2017)* includes the target of 30,000MW for new and renewable energy and also continued to assign importance to the policy of improving the efficiency of energy consumption in the industrial sector, including the thermal power plants, with the target of 20% reduction by fiscal 2016-2017. Then, in the *Three-year Action Plan (April 2017 to March 2020)*, the Indian government gave attention to increasing renewable power generation facilities and expanding the distribution network, as well as, with regard to conservation of energy, promoting investment in energy saving facilities in all sectors, based on cost-benefit analysis.

Regarding wind power generation, *Generation Based Incentives (GBI) policy for power generation*, introduced in 2009, is a scheme[5] to provide subsidies based on the amount of power supplied to the grid. Policy that began under the *Eleventh Five Year Plan* continues

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[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[3] ③: High, ②: Fair, ①: Low

[4] Bagasse is the fibrous material remaining after processing sugar cane and is used as boiler fuel.

[5] According to the actual power generation, subsidies are paid since 2012 at 0.50 rupees/kWh, and up to 10,000,000 rupees/MW over the period of 10 years.

under the *Twelfth Five Year Plan*. IREDA is the implementing agency for GBI. In addition to these policy initiatives, the government has adopted various incentives such as tax exemption for imported equipment, and income tax relief for 10 years starting from the time of project operation.

From the above, the project is consistent with the various development policies of the Indian government from the time of appraisal to ex-post evaluation.

3.1.2 Consistency with the Development Needs of India

According to MoP statistics in fiscal year 2011-2012 available at the time of the ODA loan project appraisal, due to rapid economic growth, there was an 8.5% shortfall in power generation capacity relative to the power demand, making it necessary to adopt countermeasures for new power development including renewable energy and promotion of energy efficiency. In the background of this project, as stated above, was a skewed reliance on coal-fired generation, and in view of reducing the environmental burden by reducing use of fossil fuels, and considerations of diversification of energy sources, and securing stable power supply, it was necessary to increase renewable energy power generation capacity which accounted for only about 9% of the total.

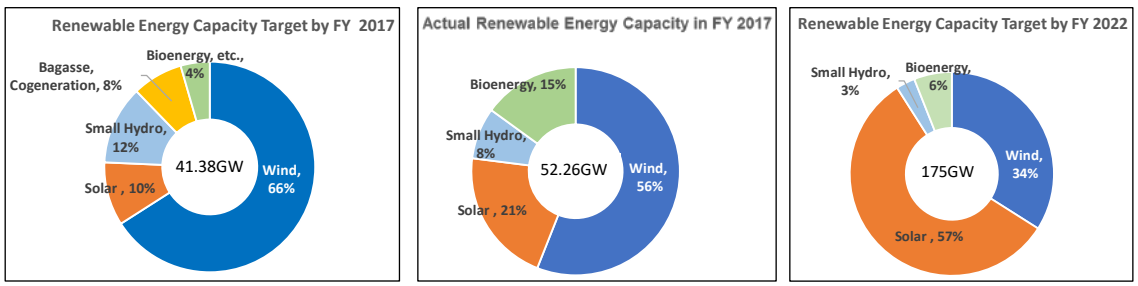
Turning to developments after that time, India's GDP growth rate for three-year period 2014 to 2016 was in the 7% range and electricity consumption per capita increased by about 6% on the annual average. Although MoP statistics show that the shortfall of power generation installed capacity to the power demand was reduced from 8.5% in fiscal year 2011-12 to 0.7%, in fiscal year 2016-17, there is a small insufficiency at the time of this ex-post evaluation study. In view of the continuation of demand and supply gap, a need still exists for increasing generation capacity and improving energy efficiency. *The Twelfth Five Year Plan* which is in force during the project implementation, calls for reduction of the share of coal in national power generation from 56% in 2012 to 42% in 2030, and for the share of renewable energy to be raised from 12% in 2012 to 33% in 2030. Nevertheless, according to MoP statistics as of February 2017 at the time of the ex-post evaluation, the source of power generation in India depends on coal-fired, accounting for 58.9% of generation on an installed capacity base. Total power generation installed capacity of renewable energy is 50GW, or 15.9% of the total. This means an increase of about 4% from the level of 2012, and it is still required to continue efforts for implementing renewable power generation projects in the future.

Regarding the planning of increases in renewable energy generation facilities over the long term, according to MNRE, it is estimated that India has the potential of renewable power generation of 900GW (750GW from solar, 102GW from wind, 25GW from bioenergy, and 20GW from small scale hydropower installations). MNRE aims at the development of 175GW on-grid power generation facilities using various renewable energy by 2022 (100GW from

solar, 60GW from wind, 10GW from bioenergy, and 5GW from small-scale hydropower facilities). In the *Twelfth Five Year Plan*, of the projected 30,000MW of new power from renewable sources connected to the grid by fiscal 2017-2018, 15,000MW are planned to come from wind power, 10,000MW from solar energy, and 5,000MW from other sources. Further, off-grid renewable energy from independent power supply, is planned to be 3,400MW, comprising 2,000MW from cogeneration using bagasse and 1,000MW from solar energy. Comparing the plan and actual total installation capacity of renewable energy as shown by Figure 1, whereas the target value at 2017 was 41.38GW, the actual value was 57.26GW that exceeds the target value. Therefore, it can be stated that progress has been made in increasing the renewable power generation facilities during the *Twelfth Five Year Plan*, and that the target value of 175GW by 2022 is set at a very high level, about three times higher from current figure, signifies that the need to develop renewable energy remains high.

As for energy conservation, at the time of the project appraisal, according to the *National Mission for Enhanced Energy Efficiency*, the energy conservation target is given as 23 million petroleum-equivalent tons per annual, equal to 19,598MW of power generation capacity. The government has stated in the *Eleventh Five Year Plan* that BEE and various MoP schemes achieved avoidance of the development of the power generation capacity equivalent to 11,000MW. In the *Twelfth Five Year Plan*, at the time of this ex-post evaluation, the projection for possible total energy reduction by the industrial sector is 13.18 million petroleum-equivalent tons. Of this amount, the projection for thermal power stations is 5.23 million tons, indicating that need to further conserve energy remains high.

As indicated above, need to develop renewable energy and conserve energy has remained high from the time of the project appraisal to ex-post evaluation, and the nature of this project is consistent with those needs.



Source: Ministry of New and Renewable Energy

Figure 1: Indian Government Plan to Increase Renewable Energy Power Generation Facilities (2017 and 2022) and Actual (2017)

3.1.3 Consistency with Japan's ODA Policy

"Improvement of poverty and environment issues" is high-priority goals of the *Country Assistance Policy for India (2006)*, concerning assistance to India. Within this, assistance for renewable energy and for energy conservation are mentioned in the policy related to environment issues. Accordingly, JICA has assigned high importance to "support for sustained economic growth through improvement of the economic infrastructure" and "support for measures related to the environment and climate change". As shown by these viewpoints, a policy to support for the development of new and renewable energy and energy conservation are being addressed and the project is consistent with these policies.

This project has been highly relevant to the development plan and development needs of India, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

The financial scheme of this project, as shown in the figure below, is in the form of a two-step loan, comprised of a loan by JICA to IREDA and IREDA's lending for eligible sub-projects (by sub-loans) according to JICA requirements. Eligible sub-project for financing by JICA were medium-to long-term finance by IREDA, either solely financed or co-financed by IREDA for photovoltaic and solar thermal power generation projects, wind power projects (5MW and more in case of nonrecourse project finance[6]), small-scale hydropower projects, cogeneration (using bagasse) projects (less than 150MW), biomass power projects (less than 150MW) and energy saving and energy efficiency projects.

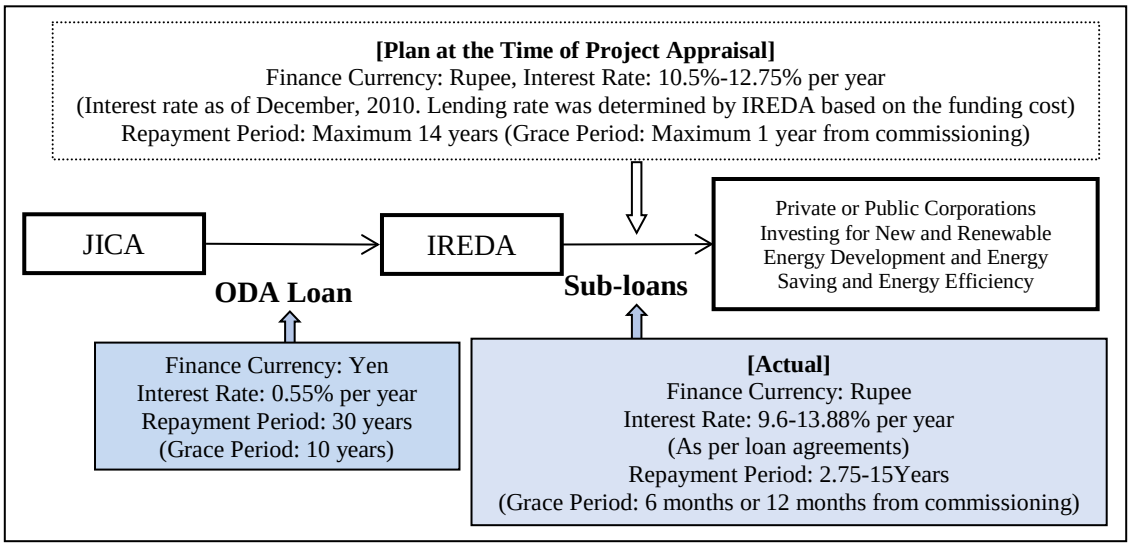


Figure 2: Financing Scheme of the Project

[6] Non-retroactive type financing when repayment is to be solely from earnings (positive cash flow) from specified operations or assets possessed by an individual or corporation (non-exempt property).

Target sub-projects by IREDA which are eligible for this project were totaled 18, as shown in Table 1. Most (12 projects) were for wind power. In the background of this, an increase for wind power in all IREDA's lending is identified as one of the factors, due to implementation of a subsidy scheme to promote for wind power generation during the project periods, as referred in the section of this report on relevance. Other sub-projects comprised two each for photovoltaic power and small-scale hydropower projects, one for cogeneration (bagasse) power generation (power generation and steam utilization upon bagasse combustion for a sugar mill), and one for energy conservation and efficiency (modernization of sugar producing machines and auxiliary equipment of sugar mill cooperatives and public companies[7])

Table 1: Number of Target Sub-projects and Actual Loan Conditions

Project Type	No.	Loan Conditions		Project Site States									
		Interest Rate	Repayment Period (Years)	HP	HR	RJ	GJ	JH	MH	TG	AP	KA	TN
(1) Wind power	12	9.6-13.75%	9-15			✓	✓		✓		✓	✓	✓
(2) Solar power	2	11.4%	10-12.8					✓		✓	✓		
(3) Hydropower	2	12.5%	10-11	✓									
(4) Cogeneration (bagasse)	1	13.88%	10		✓								
(5) Energy Conservation and Energy Efficiency Promotion	1	11.75%	10										✓
Total／Average	**18**	**Average Approx. 12%**	**Average Approx. 11 Years**	Project sites are in a total of 10 states									

Source: IREDA.
Note: State names: HP: Himachal Pradesh; HR: Haryana; GJ: Gujarat; JH: Jharkhand; MH: Maharashtra; TG: Telangana; AP: Andhra Pradesh; KA: Karnataka; TN: Tamil Nadu.

Regarding the terms and conditions of the financing, it was thought at the time of the project appraisal (December 2010) that interest rates would be set at 10.5 to 12.75% per annual, and the repayment period would be up to 14 years. As it turned out there were differences owing to the timing of the financing and variations in credit risk among borrowers, but on the average interest was about 12%, fixed, and the repayment period was about 11 years (including 6-12 months from the project completion as the grace period). According to IREDA, compared to commercial bank cases in the market, there was a merit for borrowers in terms of relatively lower interest rate and a tendency for a shorter appraisal period. Among the business operators who had received IREDA financing and were directly interviewed upon ex-post evaluation surveys, some commented on the loan conditions in positive terms on these points in general.

Up to the time of project completion in 2014 (completion of ODA loan disbursement) there

[7] The project has two components (1) generating power by burning bagasse and (2) renewal of sugar producing machines and other equipment. (1) was financed by the Power Finance Corporation, public financial institution in India, and (2) by IREDA. Target component by the project was (2), which is to pursue energy-conserving effect by renewal of facilities.

was no occurrence of non-performing loans (or non-performing assets, hereinafter "NPA", that were 180 days late after the scheduled repayment due date). At the time of this evaluation study (May 2017) there were eight instances of advance repayment (one small hydropower, seven wind power projects). According to IREDA, the early repayments were caused by borrowers refinancing loans from another institution or the borrowers' selling of project assets to other companies. Thus, the projects themselves were being existing and continued. The trend of loan interest rate at public banks, according to Reserve Bank of India (hereinafter "RBI") information was 10-10.75% in fiscal 2011-2012 but fell to 8.9-9.15% in July 2016 [8], signifying that IREDA rates at present are on the relatively high side. This fact appears to be one of the causes for refinancing.

Concerning technical assistance related to the project, at the time of the project appraisal, a plan was made for strengthening the technical appraisal capacity of IREDA with regard to photovoltaic power generation, improving the comprehensive understanding and analytic capability of IREDA's technical appraisal capacity and performance, and holding a seminar for sharing the knowledge on new and renewable energy with participation by Japanese and Indian companies. However, the bidding for a technical support consulting contract was not successful. In that situation, assistance for technical appraisal capacity on solar power generation was obtained from the Agence Française de Développement (AFD). As a result, there was no Japanese technical assistance as in the plan. However, it is considered that absence of Japanese technical assistance did not affect the outcome of the project.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total amount of ODA loan was disbursed, as planned at the time of project appraisal, 30,000 million yen. While total planned project cost was 33,535 million yen, actual cost 33,349 million yen was lower than the planned.

Table 2 Project Cost (Plan/Actual)

Unit: million yen

Items	Plan (2011)		Actual (2014)	
	Total	Of which ODA loan	Total	Of which ODA loan
Loan for sub-projects	30,000	30,000	30,000	30,000
Interest during construction	470	0	328	0
Commitment charge	65	0	21	0
Administration cost	3,000	0	3,000	0
Total	33,535	30,000	33,349	30,000

Source: JICA and IREDA.

[8] Source: RBI website, https://www.rbi.org.in/scripts/PublicationsView.aspx?id=17207 (as of July 2017), Table 74, Structure of Interest Rates. There is no information provided for the five major public banks here, but ordinarily these rate quotations are for State Bank of India, Punjab National Bank, Bank of Baroda, Canara Bank, and Bank of India.

3.2.2.2 Project Period

The timing of the project completion was defined as the last disbursement by JICA to IREDA. At the time of the project appraisal, the project was expected to last from June 2011 to March 2016 (four years and 10 months, or 58 months) but the actual schedule was from June 2011 to December 2014 (three years and seven months, or 43 months), so the project was completed one year and three months earlier than the plan (74% of the planned period). The reason for early completion was that applications of sub-project loans that can be eligible for ODA loans were submitted earlier than had been expected, and the commitments had reached up to the ceiling of lending framework earlier accordingly. As stated in the output section of this report, the rapid increase in wind power projects that could be eligible for ODA loan was one of the factors particularly influencing this.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

As the sub-projects eligible for the ODA loan were not identified at the time of project appraisal, no calculation of the internal rate of return (IRR) was made and for that reason no calculation was made at the ex-post evaluation. According to appraisal data of IREDA sub-projects, the financial internal rate of return (FIRR) was calculated based on the cost of sub-projects, operations and maintenance and the revenue from electricity sale. As a result, yielded FIRR values ranges from 11 to 22%. Information supplied by IREDA indicates that recalculation in 2015 gives FIRR values of ranging from 14 to 17%. These figures were discussed with IREDA at the time of ex-post evaluation, but it was not possible to confirm basis of calculation.

Both the project cost and project period were within the plan. Therefore, efficiency of the project is high.

3.3 Effectiveness[9] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

Fifteen of the 18 sub-projects had been completed by the time of the ex-post evaluation, and their facilities had started operation. Regarding the one cogeneration project, using bagasse at a sugar mill in Haryana State and the one energy conservation project at sugar mills in Tamil Nadu State (the borrower for this project is Tamil Nadu Power Co., financing for power generation plant and improvement of sugar mill facilities at 12 sugar mill cooperatives and public companies), the construction of both projects has taken much longer than had been planned and had not been completed by the time of ex-post evaluation. It was confirmed in the field survey in May 2017, however, that the turbine for the cogeneration sub-project,

[9] Sub-rating for Effectiveness is to be put with consideration of Impact.

procurement of which had been significantly delayed, had arrived in April 2017. Trial operation is scheduled for September. Regarding the energy conservation sub-project, it was found that completion was planned to take place in December 2017 (see Box, "Result of Site Survey and Stakeholder Interviews at Four Sub-Projects"). At one wind power sub-project, approximately 30% of the planned capacity had not been completed, but the field survey revealed that completed facilities which had been completed were in good operation (see Box).

Effectiveness and impact of the project were judged from status of facilities completed by the time of ex-post evaluation only.

3.3.1.1 Operation Indicators (Installed Capacity and Capacity Factor)

As the sub-projects had not been identified at the time of the project appraisal, no initial target values were set at the time of ODA loan appraisal and target values were set at the time of screening of loan applications of sub-projects. The total target capacity of sub-project plants was 844MW; as of May 2017, actual installed plant capacity was 819.5MW. The difference between target and actual values is due to a reduction in capacity at two wind power sites. As for the capacity factor of the facilities, by type of generation, it was above 80% of the target on average; annual power generation of all sub-projects came to 1,121GWh. All of this represents output from new facilities, and as a contribution to diversification of power sources. The result also is significant in assuring stable power supply and in meeting the demand in view of the continued growth of demand in recent years in India.

Table 3: Operation Indicators (Installed Capacity and Capacity Factor)

Type of power generation	Installed Capacity (MW)[1]		Capacity Factor[2] (%)	
	Target (Status upon completion)	Actual (status at time of ex-post evaluation)	Target (Status upon completion of each sub-project)	Actual[3] (2015-2016)
Wind	791.0	766.5	20.3	18.2
Solar	32	32	18.8	14.7
Small hydro	21	21	57.4	57.4
Total	844MW	819.5MW (May 2017)	—	—

Source: IREDA

Note 1: A notation made at the time of the project appraisal stated "maximum capacity" but this expression is synonymous with "installed capacity", and consequently the present report uses "installed capacity". Target value of total installed capacity is total target values of sub-projects at the time of the loan application reviews by IREDA.

Note 2: Capacity factor = actual annual power generation volume ÷ (installed capacity x annual hours) x 100. Target values are those used by IREDA at the time of sub-project loan application review. Here, capacity factor is average value for total sub-projects of the respective power generation category.

Note 3: Actual values here are based on values for accounting year 2015-2016. For cases when data for that year were not available, data for the nearest year before or after this year were used. One wind power sub-project was repaid in full in April 2015, thus IREDA has not been in touch with the operator and hence data are not available from that sub-project.

3.3.1.2 Effect Indicator (Energy Substitution Effect)

When IREDA undertook its review of the project applications, major power generation source of the grid to which the sub-projects of wind, hydro, and solar power facilities connected was thermal power plants (mostly coal-fired, some heavy oil-fired), and therefore reduction of fossil fuel use was expected as the project effect through implementation of the sub-projects. The trend of electricity demand was rising at about the time the sub-projects began operations, thus it was possible that without the project, thermal power generation by coal or oil consumption would have increased. Therefore, when calculating the projected effect of energy substitution, using the same conditions as used at the time of IREDA's loan reviews, it was found as shown in Table 4 that there was potential for reduction of about 370,000 coal-equivalent tons per year and about 20,000 oil equivalent tons per year as the energy substitution effect.

Table 4: Effect Indicators (Energy Substitution)

Energy substitution	Estimated value
Coal consumption	371,516 coal equivalent tons /year
Oil consumption	23,139 oil equivalent tons/year

Source: Calculated by evaluator based on the answers to questionnaires from IREDA and sub-project implementation companies.

3.3.2 Qualitative Effects (Other Effects)

At the time of the project appraisal it was anticipated that there would be qualitative effects of "energy efficiency; stabilization of electricity supply; improvement of the environment, sustainable economic development, and alleviation of climate change". Regarding efficiency in energy use, as two sub-projects related to this effect have not been completed, no observation can be made at the time of this ex-post evaluation study. Stable supply of electricity was evaluated as quantitative effects. Improvement of the environment and alleviation of climate change are evaluated as the project's impact. Sustaining economic development was evaluated in terms of local socio-economic impact.

(Box) "Result of Site Survey and Stakeholder Interviews at Four Sub-Projects"

The evaluator conducted a site survey and interview to the project-related persons of four sub-projects. The result of the survey was as follows:

(1) Company A: Cogeneration using bagasse (power generation and heat utilization)

- Status of operations
  Company A had 5MW of power generation plant and the project was for addition of 25MW from bagasse. Completion of the project was delayed in two years comparing to the scheduled date. While the major reason for this delay was a shortage of funds for acquisition of the turbine, it was installed in April 2017. According to the IREDA official in charge of this project, commercial operation is planned to be commenced in September 2017, after a trial commission period.


Company A: Outside View of the Power Generation Facilities

- Comment regarding IREDA financing
  The loan application review process and paperwork went smoothly. Very much assistance was provided by the loan officer for the sub-project, including help on engineering matters. There was awareness that the origin of the funds was the Japanese government. The company was satisfied with the loan conditions and its implementation.

- Socio-economic impact
  Hiring an additional 50 persons is expected as a result of the facility expansion. Hiring from among the local population is planned except for engineers and technicians. Basically, employment of local residents for project construction work has been assigned priority. Construction materials, 20% of construction cost, were utilized for purchase of construction materials in the local market. In this sense, the sub-project contributed to the local economic development.

(2) Company B: Wind power project

- Status of operations
  The site of this sub-project is in Maharashtra State and 14MW facility of original plan, 19 MW, is in operation. The remaining 5MW generators has been procured but lack of funds has delayed installation. At present no problems have been observed in operation of the scale of 14MW.

- Comment regarding IREDA financing
  At present the interest rate is about the same as that for loans from private-sector banks.

- Socio-economic impact
  This sub-project contributed to the additional jobs for members of the local community during construction and operations, and it also contributed to the increase in local tax revenue resulting from a rise in land value. No complaints about noise have been made by residents near the facility. There is no concern over the environment.

(3) Company C: Solar power project

- Status of operations
  The company is operating a total of 30MW solar power generation facilities, at four sites in Andhra Pradesh and Telangana states. While it is linked to the grid in its area, the company also sells electricity directly to private companies by the power purchase agreement (including a Japanese company, Toshiba). As for the status of facility operations shortly before the site survey there had been a problem related to the cable, but it had been resolved. There were no major breakdowns or malfunctions and operations to date have been smooth.


Company C: Solar Power Generation Site

- Socio-economic impact
  There was new hiring of technical personnel for operation of the project facilities. The private companies which have contracted for purchase of electricity are charged lower rates than those of the state distribution company and hence are being benefited by the project.

(4) Sugar Mill Modernization Project for Sugar Mill Cooperatives / Public Companies (Energy conservation)

- Status of operations
  At the time of the ex-post evaluation study, at the site of the 12 entities (February 2017) where modernization of sugar mill facilities was planned, four had completed installation and had begun trial operation only recently.

- Socio-economic impact
  Impact could not be verified, as projects had not been completed at the time of the ex-post evaluation. However, through interviews at the Vellore sugar mill cooperative and Tamil Nadu Generation and Distribution Corporation Ltd. (TANGEDCO) it was expected that impact would be reduction of the energy cost of operating the sugar mill plant after replacement of its obsolete equipment, employment retention and increase effects at the sugar mill plant, and recovering of confidence of sugarcane farmers in the cooperative / public company through the end of frequent disorder of sugar mill operation. Providing that operation of the plant is going smoothly and there are no effects of external factors such as deterioration of the economic environment, these expected impacts appear to be realized. It is assumed that the project has social significance as the project benefit farmers including poor families, who provide their sugar cane to those cooperatives and public companies.


Sugar Mill Facility at
Vellore Cooperative Sugar Mills Ltd.

- Experimentation with a new financial scheme
  The borrower of this sub-project was an electric power company as sugar mill cooperatives and public companies were not able to borrow money and invest in modernization of sugar mill plants and power generation plants because of regulatory restraints and incapable of individual borrowing. Reduction in energy consumption through the modernization of the plant is expected and surplus electricity can be supplied to the grid. According to the agreement between the power company and the sugar mill cooperative and public companies, the power company would plan, construct, own, operate and maintain the generation facilities, while the cooperatives and public companies would provide with the power company for the required land, and bagasse as power generation source for free. Contractor of Sugar mill plant construction would be supervised by the cooperative and public companies. Ownership of the project facilities will be transferred from the power company to the cooperatives and public companies, once loan repayment is completed by the power company. According to the IREDA official in charge of this sub-project, this undertaking is significant as it used a new financial scheme whereby the power company invested in the projects of the cooperatives and public companies. This person also mentioned interest in promoting this new model financial scheme for other cases, but at the time of the ex-post evaluation, there was no other state power company which showed an interest in this scheme.

3.4 Impacts

3.4.1 Intended Impacts

(1) Reduction of CO_2

Calculation of the reduction of CO_2 emission resulting from replacement of coal and oil consumption as fuel for power generation by the sub-projects yielded the annual value of approximately 909,000 CO_2-equivalent tons. Thus, it is judged that contribution is made by the project to alleviating the climate change.

(2) Impact on Local Socio-Economic Development

IREDA has indicated that each sub-project has had a socio-economic impact on its local community through creation of employment opportunities. In the case of each sub-project sites visited for this ex-post evaluation study (see Box), jobs were created during construction and subsequent operation, with the exception of the solar power sites. In addition, there was an instance where land values rose in the site area, so there would be an impact of tax increment.

3.4.2 Other Positive and Negative Impacts

3.4.2.1 Impacts on the Natural Environment

IREDA stated that it confirmed that all sub-projects met national requirements regarding the environment (such as clearance by the Forestry Department in the case of a project site in a forest land). Loan officers visited project sites during the loan review, construction, and completion stages, to confirm the conditions and status of the project sites. Reports of the conditions observed indicate that there were no instances of adverse impact on the natural environment and also it was confirmed there was no problem identified by IREDA after commencement of operation.

Further, as the project replace coal and oil as fuel, they work to abate emission of SO_2, NOx, and fine particles and hence are conducive to improvement of the atmosphere.

3.4.2.2 Land Acquisition and Resettlement

According to IREDA there were no instances of local residents being forced to resettle due to the sub-projects. At the time of the ex-post evaluation study, the evaluator confirmed again through discussions with IREDA officials in charge of lending for the sub-projects that there was no sub-project corresponding to Category A of JICA Guidelines for Environmental and Social Considerations. Further, as a result of meetings with the project operators at project sites and confirming the contents of IREDA documents on sub-projects, no residents had to relocate and there were no problems in acquisition of land.

The objective of this project was “to assure the supply of electricity to meet demand and diversify power sources,” and it was achieved by the project. Due to the project implementation, the substitution of fossil-fuel based energy resources and reduction of emission of CO_2 have been recognized as positive impact. Therefore, it is judged that the project contributed to improvement of India’s environment and to alleviation of climate change. There was also employment generation impact by implementation of the project. As aforementioned, this project has largely achieved its objectives.

Therefore, effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

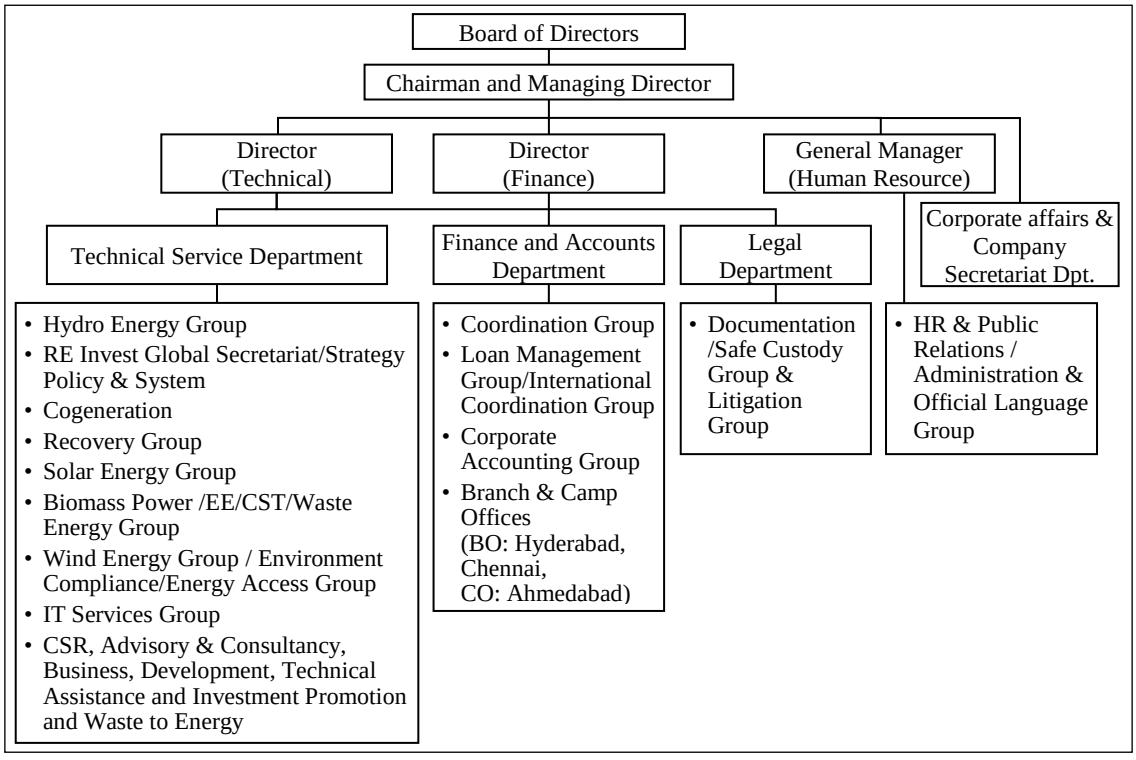
3.5.1 Institutional Aspects of Operation and Maintenance

IREDA, established as a public entity in 1987, is categorized by RBI as a nonbank financial institution. At the time of the ex-post evaluation, as an affiliated organization to MNRE, its’ administration was under the supervision of MNRE. The organization of IREDA is as shown in Figure 3. Under the Board of Directors and Chairman and Managing Director, there are the director in charge of engineering and, the director in charge of finance, and general manager

of human resources, and there are departments for Technical Service, Finance and Accounts, Human Resource, and the Systems Group. Technical Service department consists of groups specialized in hydropower, solar power, wind power, cogeneration, biomass generation, and energy conservation. This department was in charge of the sub-projects from loan appraisal to administration. The total number of employees of IREDA was 152 at the time of the ex-post evaluation. The number of employees had not that increased in recent years in accordance with the increase in number and amounts of the loans, thus at the time of the ex-post evaluation, there were some concerns for possible shortage of staff members. On this point, IREDA has already received approval from MNRE to increase total number of staff to more than 200 by 2020 and IREDA is in the process of employing the new staff every year. As of April 2017, 24 new persons had been employed and were being trained.

Most of the work of collecting repayment from the borrowers of IREDA is done at its head office. Some employees are stationed at Chennai and Hyderabad offices (but only one at Chennai) to assist the head office, such as by checking conditions at project sites, assisting in preparation of necessary documents for the loan, and coordinating with governmental agencies and banks.

At the time of the ex-post evaluation, measures were being implemented to increase staffing in response to the increase in financing and no serious problems were evident concerning the institutional aspects of IREDA and its allocation of responsibilities to each department.



Source: Compiled by evaluator quoting from the major parts in IREDA documents (as of April 2017).

Figure 3: IREDA Organization Chart

3.5.2 Technical Aspects of Operation and Maintenance

Among IREDA's loan officers are university graduates holding bachelor degrees or higher; many of them are MBA holders and specialists in electrical engineering. At the end of every January the Human Resource Department collects training need assessment reports from department managers about the staff, and subsequently each staff member takes training courses which are judged to be necessary for their work. Training programs according to specific job content are provided for senior management, middle management and young staff members on a regular basis so that employees can acquire the skills and knowledge they need.

As for loan appraisal, IREDA applies Credit Rating Model for Renewable Energy Financing that was adopted in September 2013; referring to credit ratings from multiple credit rating agencies, and an eight-level scale is used to assign credit ratings. In this way, detailed analyses on risks are made.

Thus, IREDA is making endeavor to improve its employees' capacity to perform loan appraisal and administration. As a financing institution, IREDA obviously monitors the status of loan repayment after project completion; however, they do not necessarily collect and monitor the project operation data regularly in the same way for all projects. Therefore, in order to confirm the operation data of each sub-project in the ex-post evaluation study, depending on the case, the evaluator had to request the sub-project borrowers to provide the operation data and this took time.

Through the technical assistance provided by JICA related to the New and Renewable Energy Development Project (Phase 2), which is subsequent of this project, IREDA has been developing an information system for project monitoring and evaluation that will enable it to confirm the operation data such as actual power generation of each project. This information system, which covers JICA-financed sub-projects, and then it is planned to cover all IREDA projects. At the time of the ex-post evaluation, construction of the system was still underway but once it is completed IREDA will be able to use its data for monitoring and analysis. Therefore, it is very crucial for IREDA to decide on its policies for operating and maintaining the system, and then to establish the organizational arrangements and capabilities for post monitoring of the projects.

3.5.3 Financial Aspects of Operation and Maintenance

Among the major financial indicators for its past five years, IREDA has reported an increase in earnings after tax, owing primarily to increases in interest revenue in every year. The capital adequacy ratio (CAR)[10],that slipped after reaching 28% in fiscal 2011-2012, and remarkably decreased to 19.9% in fiscal 2015 -2016. Nevertheless, it was above the RBI's 15% standard for nonbank financial institutions. Since fiscal 2013-2014 NPA ratio has tended to rise every

[10] CAR: capital divided by risk weighted assets according to items. The higher the percentage, the healthier the entity.

year. NPA ratio was 2.46% in fiscal 2013-14, 3.84% in fiscal 2014-15, and then 4.09% in fiscal 2015-2016. IREDA and MNRE agree each year on a target NPA and as shown in Table 6 NPA ratio surpassed slightly the target ratio in every year.

Projects that have become NPA are concentrated in the fields of small-scale hydropower, cogeneration, and biomass generation. These are vulnerable to external factors, such as rainfall affecting small hydro plants and unexpected situations concerning procurement of fuel materials in case of cogeneration and biomass power generation, so therefore appropriate and meticulous planning is indispensable for a project in these categories to succeed. IREDA has reported that there was some deficiency in technical review of feasibility studies for small-scale hydropower projects, and is dealing with this situation by assigning specialized technical personnel to such work, and improving the capacity of technical review. Among financial indicators for fiscal 2016-2017 NPA ratio again declined and reached almost to the target level. Net profit after-tax increased, by 20% above the previous year's value. Along with the increase in revenue, capital costs also increased, but at the present time, in general, there are no serious issues threatening financial soundness.

Table 5: Major Financial Indicators of IREDA

Unit: million rupees

Indicators	FY 2012-13	FY 2013-14	FY 2014-15	FY2015-16	FY 2016-17
Revenue	**7,296**	**8,954**	**11,183**	**11,745**	**14,817**
Interest revenue	7,191	8,908	11,179	11,740	14,793
Expenditure	**4,757**	**5,546**	**7,397**	**7,562**	**9,438**
Capital Cost	3,806	4,880	6,463	6,684	7,259
Personnel Cost	183	212	257	226	281
Profitbefore tax	**2,506**	**3,403**	**3,786**	**4,176**	**5,379**
Profit after tax	**2,026**	**2,405**	**2,719**	**2,980**	**3,650**
Provision	**470**	**191**	**312**	**393**	**1,239**
Asset	**71,931**	**90,803**	**102,805**	**131,958**	**187,042**
Capital Adequacy Ratio (%)	**24.8**	**23.8**	**23.1**	**19.9**	**18.3**

Source: IREDA Documents

Table 6: Transition of NPA Ratio of IREDA

Unit: %

Indicator	FY 2013-14	FY 2014-15	FY2015-16	FY 2016-17*
Target	-	3.00	3.25	3.68
Actual	2.46	3.84	4.09	3.70

Source: IREDA
Note: *This figure is before audit.

3.5.4 Current Status of Operation and Maintenance

During the ex-post evaluation study, by confirming the repayment status of sub-project loans that were still outstanding, it was found that three loans for wind power projects were overdue. As of the end of March 2017 one of these was classified as NPA. Nevertheless, operations were continuing and as of the time of the ex-post evaluation study, this project was in the process of being sold to a new owner.

According to interviews with beneficiaries, in Maharashtra State, more than one year delay in payment from state government for power purchases affected the wind power project, which became an NPA. According to IREDA, as of May 2017, the Maharashtra State government was going to settle unpaid obligations. There are similar arrears in other state governments such as Rajasthan. While it is only one sub-project that has been classified as NPA because of arrears in payment by the state government, this issue can affect the borrower's financial situation and can be a cause of delay in repayment to IREDA, thus it requires continued attention.

From the viewpoint of monitoring the second lending by IREDA that utilizes repayments from the sub-projects, JICA requested IREDA to submit a statement of loan outstanding of each approved sub-project; this document was submitted for the first time when the ex-post evaluation study was conducted. Examining the statement, it is evident that the total amount of loans outstanding of the projects financed by IREDA exceeded the total repayment by sub-projects. In general, it can be said that funds repaid by sub-projects are regarded as being used for financing the projects with the same objective of this project.

No major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project aimed to provide medium- and long-term funding for new and renewable energy power generation and energy efficiency promotion projects in India, confronting a shortage of electric power generation capacity, by means of a two-step loan through IREDA, thereby contributing to the securing of electric power supply, diversifying its source, and alleviating the environmental burden. This project is supposed to respond to the growth of energy demand resulting from rapid economic growth and to improve the environment, is consistent with both the policy and development needs of India and the development assistance policy of Japan and thus is highly relevant. The project cost and period were within the plan and efficiency of the project is high. Wind power and solar power projects funded through IREDA are on the whole being operated as planned. This is recognized as substitution for thermal power generation which is the main source of electricity in India, reducing coal and other fuel consumption, resulting in reduction of CO_2 emission, and thus having impact on environment improvement. Further, employment creation impact at the sub-project sites is observed, and therefore effectiveness and impact of the project are high. With regard to sustainability of the project, although IREDA has to increase its staff, to strengthen their capabilities and to strengthen the monitoring system of

loan projects responding to the rapid increase of loans, as of the time of this ex-post evaluation, no major problems have been observed in the institutional, technical, financial aspects and current status of the project operation and maintenance system. Thus, the project sustainability is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Concerning the data system for project monitoring and evaluation that is being developed through technical assistance for Phase 2 of this project, IREDA is supposed to renew and maintain the system, for use in the project monitoring after loan disbursement completion. It is recommended that procedural rules for project monitoring using this system be determined at the earliest and the personnel be assigned so as to make effective and maximum use of the system.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Consideration at the early stage of project preparation for support to strengthen project monitoring capability of an executing agency

For IREDA, it was necessary from the commencement of this project to establish the information collection system related to sub-project completions and operation, in addition to the information collected at the time of project appraisal. At the time of the project appraisal, it was planned that the executing agency report quarterly to JICA the capacity factor of sub-projects, applying the lesson learned from similar past projects. At that time IREDA lacked a system for tracking capacity factor of all projects financed by them. Thus, attention had to be paid to this situation at the time of appraisal, and necessary support should have been considered through technical assistance. In the Phase 2 of this project, technical support was provided for building an information system for monitoring of sub-project operation status, but it would have been even better if technical assistance was started for implementation of this project.

Renewable energy and energy conservation projects represent relatively high investment risks, as they are vulnerable to changes in policies, economy, and natural conditions of the nation following project completion. Further, particularly in the case of large countries such as India these projects are likely to be influenced by change in the policies or economic conditions of the state government where the projects are located. When there is insufficient monitoring arrangement at the executing agency, apart from insufficiency in technical screening ability, it may be possible to take measures to raise effectiveness and ensure sustainability, by providing

support for building a monitoring system at an early stage. Such a system can also serve for strengthening loan management capacity. It is desirable that in future projects similar to this one, that JICA analyzes the monitoring arrangements and capability of the executing agency at the stage of project preparation survey, and prepare a plan for strengthening project monitoring by the executing agency, by providing technical assistance by JICA if necessary and possible, or through cooperation with another donor support.

End

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	Two step loans from the ODA loan borrower IREDA to end users	As planned
(1) Number of sub-loans	none	18
(2) Terms and Conditions		
Eligible end user	Private or public companies investing in new/ renewable energy development or energy conservation /energy efficiency improvement projects	As planned
Eligible sub-projects	・ Photovoltaic and solar thermal power generation ・ Wind power generation (corporate finance or 5MW and more in case of nonrecourse project finance) ・ Small hydro power ・ Cogeneration (bagasse) power generation ・ Biomass power generation ・ Energy conservation, energy efficiency improvement promotion	As planned
Interest Rate	In principle, no conditions regarding the interest rate. The interest rate that IREDA determines considering the credit risk and other aspects of end users (10.5-12.75% per annual as of December 2010)	9.6-13.88 % per annual
Repayment Period	Maximum 14 years	9 – 12.8 years (including half year to one year grace period after commencement of operation)
2. Project Period	June 2011 – March 2016 (58 months)	June 2011 – December 2014 (43 months)
3. Project Cost		
Amount Paid in Foreign Currency	30,535 million yen	30,349 million yen
Amount Paid in Local Currency	3,000 million yen	3,000 million yen
Total	33,535 million yen	33,349 million yen
Japanese ODA Loan Portion	30,000 million yen	30,000 million yen
Exchange Rate	1 rupee=1.78 yen (As of November 2010)	1 rupee=1.69 yen (average IFS annual rate between 2011 and 2014)
4. Final Disbursement	December 2014	