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Report No: 23489

IMPLEMENTATION COMPLETION REPORT
(CPL-35440; COFN-03220; TF-20339; IDA-24490; TF-28633)

ON A

IBRD LOAN/IDA CREDIT/GEF GRANT

IN THE AMOUNT OF US$ 75 MILLION, $115 MILLION and $26 MILLION, RESPECTIVELY

TO

INDIA

FOR THE

RENEWABLE RESOURCES DEVELOPMENT PROJECT

June 21, 2002

CURRENCY EQUIVALENTS

(Exchange Rate Effective July 1992)

Currency Unit = Rupees (Rs.)
Rs.1,000,000 = US$ 38,462
US$ 1.00 = Rs. 26

Exchange Rate Effective December 2000
Rs. 1,000,000 = US$ 22,222
US$ 1.00 = Rs. 45

FISCAL YEAR
April 1 - March 31

ABBREVIATIONS AND ACRONYMS

AIEC	Average Incremental Energy Cost	LCB	Local Competitive Bidding
BDA	Business Development Associates	LIB	Limited International Bidding
CUF	Capacity Utilization Factor	LRMC	Long Run Marginal Cost
DANIDA	Danish International Development Agency	MNES	Ministry of Nonconventional Energy Sources
DEA	Department of Economic Affairs	MW	Megawatt
DFL	Dutch Guilders	MWp	Megawatt Peak
EIRR	Economic Internal Rate of Return	NABARD	National Bank for Agriculture and Rural Development
ESMAP	Energy Sector Management Assistance Program	NCB	National Competitive Bidding
FIRR	Financial Internal Rate of Return	NGO	Non-governmental organization
FY	Fiscal Year	NPA	Non-Performing Assets
GEF	Global Environment Facility	NPV	Net Present Value
GOI	Government of India	OPS	Operational Policy Statement
GON	Government of Netherlands	PFC	Power Finance Corporation
HUDCO	Housing and Urban Development Corp. of India	PV	Photovoltaics
IBRD	International Bank for Reconstruction and Development	RBI	Reserve Bank of India
ICB	International Competitive Bidding	Rs.	Rupees
ICICI	Industrial Credit and Investment Corp. of India	SCF	Standard Conversion Factor
ICR	Implementation Completion Report	SDC	Swiss Development Cooperation
IDA	International Development Assocation	SEB	State Electricity Board
IDBI	Industrial Development Bank of India	SERC	State Energy Regulatory Commission
IDFC	Infrastructure Development Finance Corporation	SFr	Swiss Francs
IFCI	Industrial Finance Corporation of India	SLA	Subsidiary Loan Agreement
IREDA	Indian Renewable Energy Development Agency	SPV	Solar Photovoltaics
JBIC	Japan Bank for International Cooperation	TAP	Technical Assistance Program
KfW	Kreditanstalt für Wiederaufbau	TNPL	Tamilnadu Newsprint & Papers Ltd
kW	Kilowatt	US$	US Dollars
kWp	Kilowatt Peak	Wp	Watt Peak

Vice President:	Mieko Nishimizu
Country Manager/Director:	Edwin Lim
Sector Manager/Director:	Penelope Brook/Vincent Gouarne
Task Team Leader/Task Manager:	Magdalena Manzo

INDIA
RENEWABLE RESOURCES

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Project ID: P010410	*Project Name:* RENEWABLE RESOURCES
Team Leader: Magdalena V. Manzo	*TL Unit:* SASEI
ICR Type: Core ICR	*Report Date: June 21, 2002*

1. Project Data

Name: RENEWABLE RESOURCES

L/C/TF Number: CPL-35440; COFN-03220; TF-20339; IDA-24490; TF-28633

Country/Department: INDIA

Region: South Asia Regional Office

Sector/subsector: PY - Other Power & Energy Conversion

KEY DATES

			Original	*Revised/Actual*
PCD:	10/31/90	*Effective:*	04/06/93	04/06/93
Appraisal:	06/29/92	*MTR:*	10/01/95	11/01/95
Approval:	12/17/92	*Closing:*	12/31/99	12/31/2001

Borrower/Implementing Agency: Government of India /Indian Renewable Energy Development Agency Limited

Other Partners: Private Sector, NGO

STAFF	Current	At Appraisal
Vice President:	Mieko Nishimizu	D. Joseph Wood
Country Manager:	Edwin Lim	Heinz Vergin
Sector Manager:	Penelope J. Brook	Jean-Francois Bauer
Team Leader at ICR:	Magdalena V. Manzo	Magdalena V. Manzo
ICR Primary Author:	Anil Cabraal	

Note: This ICR is for the components implemented by Indian Renewable Energy Development Agency (IREDA) supporting renewable energy investments and associated technical assistance. The TNPL Papermill component was completed within the original timetable. Loan 3544-IN was fully disbursed and closed on December 31, 1995; with a separate ICR issued (Report No. 15619), dated May 9, 1996.

2. Principal Performance Ratings

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HL=Highly Likely, L=Likely, UN=Unlikely, HUN=Highly Unlikely, HU=Highly Unsatisfactory, H=High, SU=Substantial, M=Modest, N=Negligible)

Outcome: S

Sustainability: L

Institutional Development Impact: SU

Bank Performance: S

Borrower Performance: HS

	QAG (if available)	ICR
Quality at Entry:		S
Project at Risk at Any Time:	No	

3. Assessment of Development Objective and Design, and of Quality at Entry

3.1 Original Objective:

Project Development Objectives: (a) Promote commercialization of renewable resources technologies by strengthening the Indian Renewable Energy Development Agency's (IREDA) capacity to promote and finance entrepreneurial investments in alternate energy; (b) create marketing and financing mechanisms for the sale and delivery of alternate energy systems based on cost-recovery principles; (c) strengthen the institutional framework for encouraging entry of private sector investments in non-conventional power generation; and (d) promote environmentally sound investments to reduce the energy sector's dependence on fossil fuels.

The project objectives were in line with the Bank's Country Assistance Strategy which provides for encouraging private participation in the power sector, and promoting environmental benefits including from feasible renewable energy alternatives. They were likewise supportive of India's national environmental action plan under which promotion of renewable energy was a key element. The project objectives were achievable, albeit a longer lead time for market development was required as well as a longer timeframe for project implementation. Several areas of project risks, ranging from technological, institutional to affordability issues, were identified at the outset and were duly addressed. However, the credit and collection risks associated with rural markets for solar PV applications were underestimated, but nevertheless successfully mitigated through innovative partnerships between energy service enterprises and self-help groups, farmers' cooperatives, NGOs and micro-finance institutions, among others.

Global Development Objectives. GEF's objectives were to demonstrate commercialization and catalyze wind energy and solar photovoltaic (PV) investments by strengthening IREDA's capacity to promote private investments in the sector. The GEF grant was to help reduce the project cost comparable to that of conventional alternatives and equivalent to displacing carbon dioxide emissions at a cost of about US$30 per ton.

3.2 Revised Objective:

Project objectives were not revised.

3.3 Original Components:

Investments: Financed through IREDA were the following: (i) irrigation-based small hydro projects with an aggregate capacity of 100 MW; (ii) aggregate capacity of 85 MW of wind farms; and (iii) a marketing and financing program to support the solar photovoltaic (PV) market and installation of 2.5 to 3.0 MWp of PV systems.

Technical assistance: to strengthen IREDA's capacity to promote renewable energy technologies and attract private sector interest; provide technical support and training for IREDA staff, investors and other stakeholders engaged in renewable energy market development and investment.

The project components were directly supportive of the development objectives. The small hydro and wind generation components involved similar policy frameworks and power delivery arrangements, although some operational and grid-interface issues differed. The solar PV component helped achieve the second development objective particularly in the context of improving rural access to alternate energy services. The investment components involved a significant expansion of IREDA's business portfolio consisting of loans to relatively new entrepreneurs investing in emerging technologies, while at the same time requiring that IREDA's finances remain sound. The technical assistance component supported improvements in IREDA's corporate administrative and financial management systems, enabling IREDA to creditably handle this business risk as evidence by its sustained, albeit modest, profit margins, and exponential growth

in asset base (from Rs. 862 million in FY1993 to Rs.23,918 million by FY2002).

3.4 Revised Components:
Project components were not revised. However, co-financing allocated to project components and the project implementation period were changed.

3.5 Quality at Entry:
Quality at entry is considered satisfactory. The policy framework for grid-based small hydro and windfarm programs were suitably in place in participating states in Southern India, and the investment pipelines based on identified schemes and investors were available. In contrast, the PV component did not have an indicative investment pipeline ready at time of project start-up, precisely due to the need to first develop alternative marketing and financing mechanisms particularly for those PV systems which would have to be retailed to end-users as consumer durables in the more difficult rural and peri-urban markets. The technical assistance program was thus designed to support market development activities for PV applications including training of technicians and entrepreneurs. However, the lead time needed for market development of solar PV especially in the rural areas, took longer than envisaged.

4. Achievement of Objective and Outputs

4.1 Outcome/achievement of objective:
The project's set of development objectives was fully achieved and overall project outcome is satisfactory.

(a) *Promote commercialization of renewable resources technologies by strengthening IREDA's capacity to promote and finance entrepreneurial investments in alternate energy.* Highly satisfactory. The project has led to substantial capacity enhancement of IREDA in undertaking its dual mandate of technology promotions and financing on several fronts. IREDA is now a mature financing institution specializing in lending for renewable energy and energy efficiency. Its staff has grown from about 20 in 1993 to 134 today, to support a growing and diverse portfolio. Its employee productivity has improved four-fold from Rs.18 million in loans sanctioned per employee in 1992-93, to Rs.80 million per employee today. It has committed financing for nearly 1,500 projects developed by the private sector and NGOs accounting for 1,720 MW. By FY 2002, IREDA's annual loan disbursement level reached $134 million compared to less than $4 million posted in 1993. To increase its outreach and client support, IREDA established a cadre of business development associates in selected business centers of the country and is now piloting five regional representative offices . IREDA has now attracted other international support including that from the Government of Netherlands, ADB, KfW, World Bank, and GEF in excess of $350 million.

Aside from the increase in capacity installation and number of private investments, commercialization of the three renewable energy technologies supported under the project is evidenced by significant reductions in gestation period and in equipment and installation costs (refer to section 4.2). Commercialization has been fully achieved in the small hydro sector with installed capacity rising to over 1,423 MW over the past 10 years with the vast majority of new installations being owned and operated by private sector companies for sale of power to the grid, captive generation or third party sale. India is now the tenth largest user of small hydro power. Similarly, commercialization has advanced rapidly in the wind power sector with over 90 per cent of the installed capacity of 1,507 MW implemented by the private sector, compared to 40 MW of state-owned facilities in 1992. IREDA's strong catalytic influence is evident as other financiers began to support wind farm investments after observing IREDA's experiences. India is now the fifth largest wind power generating nation. Finally, commercial market development has advanced in solar photovoltaic, as evidenced by: (i) the large private sector-led manufacturing base; (ii) a competitive market place where product costs are now among the lowest in the world; (iii) established retail

sales and service networks; and (iv) emerging participation of financial intermediaries. But as with traditional grid-based rural electrification, the rural PV market will continue to depend on the availability of affordable funding. India is now the fifth largest PV producer in the world with annual outputs of 20 MWp in 2000 with an installed capacity of 82 MWp.

(b) *Create marketing and financing mechanisms for the sale and delivery of alternate energy systems based on cost-recovery principles.* Satisfactory. IREDA's role in financing renewable energy investments has helped reduce their perceived risks, thus encouraging other lenders to support the sector. Now renewable energy project financing is available from a larger number of national and local banks, non-bank financial institutions, cooperatives, foundations/trusts as well as government-owned financial institutions, including ICICI, IDBI, IDFC, IFCI, HUDCO, PFC, Sundaram Finance, Tata Finance, Syndicate Bank, and State Bank of Hyderabad, compared to nil in 1993. IREDA has financed about 80 percent of private sector small hydro projects, 30 percent of wind projects and the major part of solar PV schemes outside of the more commercial PV applications in state-run sectors of telecommunications, railway, oil and gas, and defense.

Successful marketing and service delivery business models that IREDA has helped launch and nurture include renewable energy service companies; retail companies selling renewable energy products and services to consumers; private power developers selling to captive consumers, third parties and to SEBs; consumer financing offered through rural banks, saving and trading cooperatives, etc. The project has helped identify innovative approaches to addressing rural credit risks faced by PV energy entrepreneurs thus opening avenues for PV and other energy supply to penetrate the rural market. Participation of cooperatives or micro/rural financing entities has been a key to making the systems accessible to rural/poor consumers.

(c) *Strengthen the institutional framework for encouraging entry of private sector investments in non-conventional power generation.* Satisfactory. The project helped promote a critical shift in the Government's approach to renewable energy development from one that was largely state-administered to a more demand and market-driven approach with active involvement from the private sector. Entrepreneurial, technician and business development training services sponsored by IREDA has catalyzed new business formation and enhanced the capacity of renewable energy businesses. Today there are over 100 firms actively involved in renewable energy business (see Section 4.5). During the course of project implementation, IREDA's role in promoting policy and regulatory changes was through organization of business meetings in various states during which entrepreneurs were able to interface with policy makers. Policymakers became aware of renewable energy business as a means to help meet growing local power supply needs . Accordingly, in addition to the four states that initially participated in the project, i.e., Karnataka, Tamil Nadu,Andhra Pradesh, and Kerala, other states started to set up enabling policy frameworks in support of renewable energy investments. These encouraged the private sector to invest in renewable energy infrastructure and service delivery systems, expand modern energy services to under-served rural communities, and support local and global environmental improvement. Over 3400 MW of wind, small hydro, biomass, solar photovoltaic and other renewable energy power systems were in operation by December 2001, compared to about 100 MW in 1992, with the vast majority of these investments developed by the private sector/NGOs. IREDA has played a direct and catalytic role in successfully commercializing renewable energy by financing about half of these capacity additions with loans to private sector or NGOs.

(d) *Promote environmentally sound investments to reduce the energy sector's dependence on fossil fuels.* Satisfactory. The project helped catalyze an unprecedented growth in the renewable energy investments and industry such that the share of renewable energy in India's power generation capacity grew from a mere 0.13 percent in 1992 to nearly 3.4 percent by 2001.

Global Development Objective: *Demonstrate commercialization and catalyze wind energy and solar photovoltaic (PV) investments by strengthening IREDA's capacity to promote private investments in the sector.* Satisfactory. India is now the fifth largest producer of wind and PV worldwide, with the vast majority of investments made by the private sector and NGOs. In 1993, India was a minor producer with nearly 100 percent of the investments being made by the government. Indian products are now price competitive worldwide and companies are exporting wind and PV technology. In terms of greenhouse gas mitigation objective of the GEF, carbon emissions avoided as a direct result of the project are estimated at about 6.6. million tons, i.e., 5.4 million, 1.1 million and 94,000 tons over the lifetime of the small hydro, wind and PV sub-projects financed, respectively. Cost to GEF of carbon emissions avoided are $4/ton of carbon, or $19/ton of carbon if only wind and PV investments are included. The estimate at appraisal was about $30/ton of carbon avoided from solar PV and wind investments.

4.2 Outputs by components:

Small Hydro. An aggregate of 117.9 MW of small hydro capacity involving 35 projects were commissioned and financed under the project, exceeding the target of 100 MW. In addition, development of 17 more small hydro schemes (over 35 MW), commenced under this project, and will be completed under Credit 3396 and IBRD Loan 4571. During this period, IREDA financed an additional 155 MW using other resources, including domestic market borrowings. The small hydro schemes commissioned under this project produced an aggregate annual energy output of 485 million kWh at an average plant factor of 47% (range: 27% to 76%). The median value of unit cost is $1270/kW (range: $550-1760 per kW) while average cost is $990/kW. (All unit costs are given in year 2000 constant dollar terms.) Estimated average cost at appraisal was $1030/kW. By international standards, the unit cost of these low-head projects is low. It represents a significant reduction in cost from earlier public sector experiences in India which then generally exceeded $3,000/kW. Importantly, project cash flows have improved as time from ground-breaking to commissioning have decreased from 20-54 months in 1997, to 11-20 months today. A study commissioned by IREDA found that positive impacts of small hydro projects range from improved power supply to adjacent villages, increased employment opportunities, boosting of tourism potential, to improvement in agricultural production and small-scale industrial sector in the rural areas.

Wind Farms. Wind farm capacity financed under the project was 87.2 MW in 27 projects compared to 85 MW envisaged at the time of project appraisal. During this period, IREDA financed an additional 184 MW using other locally mobilized resources. Actual plant factors of wind farms established in 1993-1996 period, were below predicted levels due to limited experience in wind farm development and poor grid reliability. Overall performance has now improved with 27 wind farms generating 144 million kWh per year with an average capacity factor of 18.8 percent. Capacity factors of wind farms are now slightly more than estimated. Real average cost has remained at about $1,150/kW (range: $950-$1520 per kW), despite incurring additional investments to improve power evacuation. Unit costs compare favorably with international experience. Appraisal estimate was $1600/kW. A socioeconomic survey in Tamil Nadu commissioned by IREDA showed that rural employment, involving 7,000-9,000 jobs, resulted from the 800 MW wind farms installed in the State. Land price increases, improved quality and availability of power in the vicinity of the wind farms, and some infrastructure development, such as improved roads, are other benefits cited by the rural communities.

Solar Photovoltaic. PV capacity financed was 2.145 MWp in 78 projects, slightly below the target of 2.5 MWp. Products financed ranged from 5 Wp solar lanterns, 900 Wp PV irrigation pumps, 500-2500 Wp solar power packs, and 25 kWp village power schemes to a 200 kWp grid tied system. In addition, IREDA financed an additional 4 MWp of PV irrigation pumps with MNES assistance. IREDA stopped sanctioning new loans for an aggregate capacity of 578 kWp in May 2001, as completion of these investments before December 31, 2001 (project closing date), was doubtful. The 2,145 kWp of PV commissioned under this

project generates approximately 3 million kWh annually. Unit costs are $4.8-$14.2/Wp for various product types compared to average costs at appraisal of $16.5-$25.8/Wp. Time for commissioning from loan registration has decreased from about 20 months in 1997, to 10 months today. Evidence of positive development impacts from PV use among the poorer consumers are emerging. They include five-fold income increase among farmers using PV pumps (NABARD survey, Andhra Pradesh), 50 percent increase in net income by some traders using solar instead of kerosene lighting (Maharashtra); income of some rural households rising by about 15 to 30 percent, due to increased home industry output (Andhra Pradesh); and longer study hours for children under better lighting conditions. A more comprehensive development impact survey is needed to substantiate these field observations.

Technical Assistance Program (TAP). The TAP supported 51 activities that included technology promotion campaigns, training of IREDA staff and various stakeholders, upgrading IREDA computer facilities, improving its financial management systems, conducting business meetings, technical reviews of sub-projects, and a comprehensive review of IREDA's loan portfolio that included a financial audit of its operations by independent consultants.

4.3 Net Present Value/Economic rate of return:

The results of the economic analysis and a comparison with estimates made at appraisal are shown below with details provided in Annex 3. The results are based on an evaluation of 13 representative small hydro sub-projects including the best, worst and average projects; 27 wind sub-projects and a representative sample of solar PV projects drawn from among the 78 PV sub-projects that were financed.

The completed small hydro projects had EIRRs comparable to those estimated at appraisal, and in excess of the 12 per cent hurdle rate required under IREDA's Operational Policy Statement (OPS). The EIRRs estimated at appraisal for the wind farm projects were achieved on average. Some of the early wind projects did not exceed the 12 per cent rate due to lower than expected capacity utilization factors (CUF), but the later wind projects with good CUF were able to better the hurdle rate. The solar PV applications had EIRRs in excess of 12 per cent and better than estimated at appraisal when global environmental benefits were included. The significantly higher EIRR for PV compared to appraisal is mainly due to the large unit cost reductions experienced by PV. The results indicate that the grant support for global environmental benefits could be moderated for some applications.

Comparison of Actual and Appraised Economic Internal Rates of Return

Investments	Excluding Global Environmental Benefits		Including Global Environmental Benefits 1/	
	At Appraisal	Actual 2/	At Appraisal	Actual 2/
Small Hydro (Dam-toe)	19 to 65%	28%	GEF support not provided for small hydro	
Small Hydro (Canal and Run of River)	12 to 29%	33%		
Wind Farms	5 to 10%	9%	12%	14%
Solar PV Lanterns	1.5 to 3.3%	19%	14 to 14.6%	33%
Solar PV Home System		30%		108%
Solar PV Power Packs		-23%		21%
Solar PV Village Power		-3%		14%
Solar PV Water Pumping 3/		6%		43%

1/ Economic benefits including global environmental benefits, in the case of wind and PV include the GEF grant, which is $155/kW (10% of initial capital cost at appraisal) for wind, and $4.2/Wp (19% of initial capital cost at appraisal) for PV.

2/ Wind farm average EIRR is weighted by annual energy output. Similar weighting is not done for small hydro as one large successful sub-project skews the results. Solar lighting benefits include the consumer surplus from improved lighting. Benefits from PV pumping for irrigation includes additional income gained from irrigated crops. Wind and small hydro economic benefits taken as economic cost of avoided diesel generation as this was the basis of the economic analysis in appraisal report.

3/ With respect to solar PV water pumping, only the community drinking water option was considered at appraisal. The application financed was for irrigation.

4.4 Financial rate of return:

IREDA Financial Performance. Audited results for the 2000-01 fiscal year show IREDA's total income at Rs. 534 million, and its post-tax net profit increased to Rs. 163 million, compared to the previous year. Loan approval and disbursement levels in FY2001 were Rs.10.4 billion and Rs. 5.6 billion, respectively. IREDA remains in compliance with the Credit covenants. IREDA has met all provisions and financial performance targets under its Operational Policy Statement (OPS). Specifically, the OPS provides that IREDA should earn a positive return in real terms on net worth, maintain a debt service coverage ratio of more than 1.3, and a maximum debt to equity (including grants) ratio of 5:1. These requirements were met, except in FY1998 when IREDA had a negative real return on net worth. At the end of March 30, 2001, non-performing loan assets (NPA) accounted for 14.9 % of all outstanding loans. While this reflects a considerable improvement over the levels posted in the previous three years (i.e., 21.6% in FY1997-98 and to over 17% in FY1999 and FY2000), the NPAs involved have increased to Rs. 2.2 billion. Provisional financial results for FY2002 indicate that the NPA level was further reduced to 12.4%.

Financial Performance of Sub-projects. Representative financial performance of sub-projects financed by IREDA are given below with details in Annex 3. The financial rates of return for wind farms are generally high as they incorporate several incentives: (a) a 100% depreciation benefit in year 1 at national level; and (b) generous state-level incentives in some states, especially the deferral of sales tax payments. For PV systems, the financial analysis was done from the point of view of the end user. The significantly higher NPV compared to appraisal is mainly due to the large unit cost reductions experienced by PV. Many PV end- users also benefited from: (a) 100% depreciation allowance taken by intermediary or end user; and (b) direct subsidy from MNES. As noted in Section 4.6, such generous incentives which are not uncommon in the early years of renewable energy promotion, are being moderated.

Comparison of Financial Rates of Return and Financial Net Present Value of Investments

Investment 1/	Evaluation Criteria	Estimated at Appraisal	Actual
Small Hydro	FIRR on equity before tax	45 to 75%	35% (range: 25% to 67%)
Wind farm projects	FIRR on equity after tax	6 to 23%	94% (range: 5% to >100%) 2/
Solar PV Lanterns	Net Present Value at 12% (Year 2000 Rs per Wp)	-378 to -147	Rs. 776/Wp
Solar PV Home Systems		-293 to +457	Rs. 226 /Wp
Solar PV Power Packs		Not computed	Rs. 17/Wp
Solar PV Village Power schemes		-585 to +119	Rs. 0.1/Wp
Solar PV Water Pumping 3/		-148	Rs. 20/Wp

1/ Solar PV applications are evaluated from the point of view of the end user. Because of the wide variety of projects financed, they should be considered as examples.

2/ Wind farm average FIRR is weighted by annual energy output. Similar weighting is not done for small hydro as one large successful sub-project skews the results.

3/ With respect to solar PV water pumping, only the community drinking water option was considered at appraisal. The application financed was for irrigation.

4.5 Institutional development impact:

India now has a robust and growing renewable energy manufacturing, design and engineering, operation and maintenance capability compared to the conditions in 1993. This is attributable to the major shift in Government policy towards promoting private sector investments in renewable energy, backed up by IREDA's role in renewable energy financing for private sector schemes. The project requirement for competition in procurement to ensure access to state of the art products has fostered development of international joint ventures. The increased manufacturing capability is also due to the opening up of the Indian economy, renewable energy industry maturation, technology improvement and cost reduction. The industrial and business capacity includes:

- 16 small hydro equipment manufacturers, including international joint ventures (compared to 10 inactive firms in 1991). The small hydro design, engineering and construction capacity is even stronger. About 65 percent of the small hydro electromechanical equipment was sourced locally.
- 15 wind equipment manufacturers (compared to three assemblers in 1992); six are international joint ventures. Local content has risen from 15% in 1992 up to 80% today. Wind turbines as large as 1,000 kW are manufactured locally. Indian companies are exporting generators and blades. Specialized O&M companies have been set up indicating a maturation of the sector.
- Strong PV manufacturing base with a module/cell production capacity of 20 MWp/year, (over 20 companies compared to four companies in 1991). There are 45 companies that manufacture balance-of-systems components. India exports 40 percent of its PV output to Asia, the USA and Europe. Retail sales and service networks have been set up in 12 states and territories, compared to none in 1992. India has an internationally accredited PV testing center.
- IREDA's efforts to promote businesses owned by women and scheduled tribes and castes are bearing fruit as evidenced by several women-owned businesses (e.g., Dastkar Society for Crafts and Craftpeople (Gujarat), solar lantern leasing by self-help groups (Andhra Pradesh), Sagar Solar Shop (Vadodara), and Prakritik Lighting & Urja Systems Ltd., perhaps the first woman-owned PV module manufacturer).
- Local and international training offered through the technical assistance component has significantly influenced the growth of consultancy industry on wind power and solar PV. Establishment by IREDA of knowledge and information networks among technical consultant firms in the various regions has led

to increased awareness of business opportunities in renewable energy.

4.6 Policy Impacts

Beginning in 1991, economic liberalization and MNES success in getting states to adopt supportive renewable energy policies and incentives, set the stage for this project to have a significant impact. As the power sector opened up to private investments, several southern states, namely Tamil Nadu, Karnataka, Kerala, Andhra Pradesh and Gujarat announced policies for licensing, power purchase pricing as well as alternative power sales arrangements for renewable energy-based generation. Although fiscal incentives for selected renewable energy investments such as wind generation and solar PV were already in place, e.g., availing of 100 per cent depreciation in the initial year of commissioning, the investment community was not aware of the technologies nor of their commercial applications.

With support from the project, IREDA launched awareness and promotional campaigns as well as series of regional business development meetings which helped spread the word on emerging investment opportunities in renewable energy. Renewable energy investments began to take off with funds provided through the project. Moreover, progressive removal and/or reduction of import duties and introduction of policies to facilitate foreign investment and joint venture formation helped transfer advanced renewable energy technology to India to take advantage of India's low cost, highly skilled technical capacity. In recent years, additional states issued policies to actively promote private sector investments in renewable energy, i.e., Maharashtra, Himachal Pradesh, Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Orissa, West Bengal, and Rajasthan. Today, the private and nongovernmental sectors are undertaking the vast majority of renewable energy investments in India, with the government increasingly playing a market-enabling role. In contrast, the market in 1992 was mainly government administered and financed.

To attract more investors, some states supplemented the incentives offered at the national level, with generous state-specific incentive packages, including deferral of sales tax payments. The net result was high financial yields to those investors who were in a position to avail of the incentives. As the market matured, the national and state-level incentives are being moderated. For example, the introduction of the minimum alternative tax has moderated the impact of accelerated depreciation benefit. Some states have started to reduce/withdraw some of the incentives as part of their ongoing power sector reforms, such as increase in wheeling fees, removal of sales tax deferments, limitations on captive power sales.

Today, investor interest in renewable energy remains sufficiently strong as the demand for power continues to outstrip supply in many states. Renewable energy-based generation has become increasingly competitive in cost. Levels of investment required are manageable from the local entrepreneurs' perspective, encouraging some to go for increasingly larger projects. The continued interest of the business community is evidenced by the robust investment pipeline for small hydro under the Bank-financed Second Renewable Energy Project, as well as the many privately operated biomass and wind power plants that are being installed in the country. To further boost renewable energy use, particularly to meet rural energy needs, the government is considering the adoption of new mandatory market share policies similar to those being adopted in Europe, Australia and some US States.

Ultimately, for a fuller development of the renewable energy market in India, power sector reforms and good governance are essential. Tariff rationalization, adoption of appropriate performance efficiency benchmarks and opening up of the distribution business to service providers other than the SEBs will enable the cost-effective renewable energy systems to compete in the power market. At the time of appraisal, however, neither the Government nor the Bank had a clear vision of how sector reform would be carried out during the life of the project. Hence, in the last two years, as reforms started to take off in some states, the Project was buffeted by unanticipated and sometimes ad hoc state regulatory changes. Except for Rajasthan which had explicitly provided for renewable energy development in their reform agenda, other states did not address the renewable energy dimension of the sector. Incorporation of renewable energy

development in reform planning and ex-ante analyses of the value-added or otherwise of such a program will enable champions of renewable energy to have a place at the table in the sector reform dialogue.

5. Major Factors Affecting Implementation and Outcome

5.1 Factors outside the control of government or implementing agency:
The economic slowdown caused by the Asian financial crisis in 1997 hurt IREDA's financial performance, as many of IREDA's borrowers' core businesses suffered. This is reflected in IREDA posting for the first (and only) time, a negative real return on net worth in 1998 and NPAs rising to 21.6 percent in 1997-98.

The wind farm investment target was reduced to 30.5 MW in 1997 when DANIDA withdrew its $50 million equivalent in parallel co-financing after disbursing $3.94 million when it decided to finance wind turbines through its direct lending window. In 1996, the Government of the Netherlands provided DFL 0.8 million ($0.40 million) to strengthen the technical assistance program. SDC co-funding was reduced to SFr 3.75 million from SFr 6 million in FY1999-00. The SDC plans to make up the shortfall through a separate project for which a planning mission was fielded in February 2001, and a proposal submitted by IREDA in July 2001.

Implementation delays for the PV component occurred as a number of financial intermediaries earlier accredited by IREDA to access the credit lines were unable to comply with the Reserve Bank of India's (RBI) new prudential norms for non-banking financial institutions.

5.2 Factors generally subject to government control:
MNES subsidy programs sometimes conflicted with the market-oriented approach of IREDA-financed programs. For example, the MNES subsidy for solar lanterns directly competed with the more commercial approaches being fostered by IREDA. With respect to the small hydro component, implementation delays occurred when MNES announced subsidy support prompting some developers to pull out of IREDA's program, only to later return when the subsidy program did not fully materialize. In contrast, MNES and IREDA partnership in financing PV pumps has been effective in making such pumps affordable to farmers. In the more recent years, in order to leverage more investments with its limited budget, MNES has progressively shifted from extending subsidy grants to providing concessional financing through IREDA. This shift has increased the effectiveness of both MNES and IREDA support.

The Government of India (GOI) and IREDA did not sign a revised Subsidiary Loan Agreemnet (SLA), whereby instead of a fixed on-lending rate from GOI to IREDA, IDA's concessional terms would have been extended to IREDA with the latter bearing the foreign exchange risk. This hurt IREDA's financial position in the face of lower lending rates in the market and after the GEF grant for PV was exhausted. By year 2000, IREDA relent IDA funds (obtained at 14 percent interest up to August 2000 and 13.5 percent thereafter), at 2.5 to 5 percent for PV and 13.5 percent for small hydro. However, the SLA signed for the Second Renewable Energy Project (Cr3396-IN) did provide for passing on the IDA concessional terms to IREDA.

Efforts led by MNES in making comprehensive and reliable renewable resource information publicly available have contributed directly to India's success in renewable energy resource development.

5.3 Factors generally subject to implementing agency control:
During project implementation, in discussions between IREDA and the Bank concerning procurement methods, both parties agreed that modification of the original procedures defined in the legal agreement should be made to better match private sector approaches and characteristics of the PV investments. This helped accelerate the implementation of the PV component. IREDA also obtained the Bank's clearance to make small hydro civil works an eligible expenditure as higher civil works costs were making it difficult for

developers to raise the necessary funds.

Solar PV investments began only after the on-lending rates were reduced from 10.3 per cent to 2.5 percent for rural applications and 5 percent for other sectors. IREDA was able to reduce this interest rate while meeting its financial covenant of achieving a net positive real rate of return on net worth.

Staff retention has been difficult for IREDA as its government-specified salary structures are below private banking sector levels. This has led to staff attrition, with trained staff being lured to better-paying companies and banks. Repeated representations by IREDA to the Government for upgrading of its payscale has not been acted upon.

Following the mid-term review, IREDA established a Monitoring and Evaluation Cell. The Cell has been primarily responsible for ensuring that the financed investments had been made and the projects were functioning as expected. IREDA plans to expand the Cell's responsibilities to include assessment of development impacts of its projects.

IREDA's proactive reach-out to potential investors through its Best Practices publications, business meetings and the Business Development Associates (BDA) have been essential to business development, particularly for PV market development as the PV promoters were relatively smaller and less experienced.

A Bank review of the small hydro projects found that few adverse environmental or social impacts are caused by these projects. But two issues, land acquisition and relations with other water users, require early assessment and careful management to prevent project delays and avoid impacts (e.g., a project in Kuthungal, Kerala highlighted these concerns where land acquisition took three years due to strikes and court stay orders). While all landowners have received compensation and other entitlements, IREDA has started to document the impacts of all such projects. In this connection, a study commissioned by IREDA found that on the whole, no major land acquisition is involved in small hydro projects, and land acquisition matters are normally solved amicably between the promoter and the private land owners through mutual agreement and discussions. IREDA has trained its staff on social impact assessment of small hydro projects, and improved its social and environmental screening process.

The level of non-performing assets, although progressively reduced to 12.4 per cent, needs to be closely monitored. The proposed RBI plan to issue stricter norms for loss provision and write-off may increase the NPA in the portfolios. Accordingly, IREDA has taken actions to clean-up its portfolio following the recommendations in the Portfolio Audit and Diagnostic Study completed in mid-2001. They have increased their one-time recoveries, conducted more rigorous appraisals, allowed more flexibility to their loan officers in negotiating settlements, have appointed regional collection agents, and established tighter exposure limits.

5.4 Costs and financing:

Total project cost was $284 million (estimated to end of project) compared to $280 million at appraisal and resulted in 207 MW of capacity additions compared to 188 MW expected at appraisal. The IDA Credit ($115 millon, equivalent) and GEF Grant ($26 million, equivalent) were both fully utilized. Financing from DANIDA was reduced from $50 million to $3.9 million, SDC funding was reduced from $4 to $2.3 million equivalent. These shortfalls were made up by additional funding of $0.4 million from GON, and IREDA ($40.7 million vs. $17 million at appraisal), promoter/consumer contributions ($87.7 million vs. 68 million), and other loans ($12.5 million).

Small hydro: Actual costs for this component reached $166.0 million compared to $93.5 million at appraisal. A major reason for the higher cost of the small hydro component is due to the financing of more hydro capacity, i.e., compared to the 100 MW envisaged at appraisal, the project financed schemes involving an aggregate of 153 MW of which 117.9 MW was commissioned by project closing date.

Increased cost of the small hydro component is also attributable to the higher cost of civil works compared to appraisal estimate due to the following factors: (a) dam-toe projects which have lower civil costs than canal-based projects accounted for only 20 percent of the schemes compared to an estimated 40 percent at appraisal; (b) some low-cost technical solutions proposed in the ESMAP study were not practical to implement or were not adopted due to increased construction time; (d) irrigation departments required the developer to build additional canal lining upstream and downstream of the power plant; (e) under-estimation of civil works costs in the ESMAP study; and (f) higher than expected inflation. The higher civil works costs created a financing gap of approximately 25 percent as the IDA Credit Agreement had permitted only financing of equipment costs. In 1996, at mid-term, the Credit Agreement was amended to permit financing of civil works costs.

Wind: Actual costs for the windfarm component was $87.7 million compared to $125.3 million estimated at appraisal. The lower cost was due to equipment cost reductions resulting from significantly greater local content than envisaged at appraisal.

Solar PV: Actual costs for this component was $23.8 million compared to $54.9 million at appraisal. The lower cost of the PV component was primarily attributable to cost reductions due in part to improved cost efficiencies, reduction in import duties and worldwide PV price reductions. Further the aggregate capacity of PV systems actually financed under the project of 2.145 MWp was lower than the 2.5 to 3 MWp targetted at time of appraisal.

In November 1999 IREDA requested a two year extension in the closing date of the Credit citing the need to sustain the small hydro program to permit a smooth transition to the Second Renewable Energy Project (although negotiated in April 1998 this project was approved only in June 2000 due to sanctions). The Bank granted two, one-year extensions in 1999 and 2000, respectively. As a result of the extensions, development of over 35 MW of small hydro schemes were initiated under this project to be completed under the follow-up project. The extension also permitted the PV component to substantially achieve its targets.

6. Sustainability

6.1 Rationale for sustainability rating:

Sustainability is highly likely for IREDA as an institution. IREDA is now a mature financial institution. It has mobilized considerable additional financial resources and plans to broad base its equity with national and international participation. IREDA is also taking proactive steps to further reduce NPAs.

On-going power sector reform can help create a competitive investment environment resulting in an equal level playing field among energy sources and thus promote steady and sustainable development of renewable energy resources. The small hydro market is commercially sustainable. Similar to other countries, sustainability of wind farm market yet requires incentives to make the investment attractive vis-a-vis alternative investment opportunities. These incentives are being moderated as investor experience increases, and technology costs and performance improves.

Sustainability of PV industry is likely because of the increasing demand internationally and demand from the Indian infrastructure sector (e.g., telecommunications, railway). Sustainability of rural PV market will continue to depend on availability of affordable financing for some time to come. Although for some applications for which prices have significantly come down, even concessional financing may no longer be required provided appropriate collection and service delivery systems are already well in place. With the end of this project, grant or concessional financing for PV is available through the government. In addition, IREDA has flexibility to use the new KfW credit line to continue to offer concessional funding for PV, with the cost of funds partly shared by IREDA's more profitable loan windows. Additional affordable financial resources will be required to ensure that the capacity built and the market momentum created in the rural

areas will not stagnate; othewise, the positive developments that have occurred to date under the project would be negated. This would be especially unfortunate as the rural market is least able to afford to lose access to this modern energy source.

6.2 Transition arrangement to regular operations:
IREDA has been able to carry out its dual mandate as a financing institution as well as a technology promotion agency, and continues to generate modest profits. It maintains a sufficient cadre of qualified staff whose growth has matched the increase in its business. Due to its creditable performance as a development financing institution, IREDA has been able to mobilize funds from multiple national and international sources. There will however, be a need to expand its equity base to support its growing business operations. Given the budgetary constraints faced by the Government, IREDA is currently exploring alternative sources of equity, including from other financial institutions and private investors. Broad-basing of IREDA's shareholders equity would help ensure adoption of commercial business practices as well as pave the way for upgrading staff compensation and thus reduce the loss of qualified staff.

Prospects for sustained growth of the small hydro and wind power industries are high, though the wind industry may continue to require fiscal incentives, albeit lower than in the past. Except for some niche markets, the PV industry serving the rural areas will continue to depend on government and donors for concessional funding support, but less reliance on full grant funding. Active and broad participation by other financial institutions will be necessary if the government plan of adding up to 10,000 more MW of renewable energy generation and use of renewable energy to electrify 18,000 villages by 2012, is to be realized. The estimated costs are likely to be of the order of Rs.500 billion ($10 billion) over ten years, far greater than renewable energy investments made today. Such financial requirements may be beyond the capacity of IREDA and MNES. Introducing competition among financial institutions will be important for commercial development of the renewable energy sector at the scale envisaged. In addition, a more certain and conducive policy and regulatory environment, removal of energy pricing and market distortions, multiple product/service delivery agents as well as technology improvements will be necessary if this ambitious program is to be realized.

There remain two concerns with respect to the sustained regular operations. The first is the likely dissipation of infrastructure built to serve rural PV market and loss of PV market development momentum if adequate affordable financing is not available. The second concern is the uncertainty faced by private sector investors in grid-tied projects with respect to volatile and inconsistent changes in regulations and tariffs.

The Monitoring and Evaluation Cell of IREDA needs to continue to assess the performance and development impacts of investments financed under this project. Key indicators are energy performance of projects vis-a-vis estimates, unit costs and time to completion, global benefits, rural income and welfare improvement, and industry development. The financial performance of IREDA would be tracked through its annual audited financial statements. The Bank's involvement with IREDA will continue through the Second Renewable Energy Project.

7. Bank and Borrower Performance

Bank
7.1 Lending:
Lending is rated satisfactory. The project formulation is based on three ESMAP-funded studies on non-conventional energy systems, mini-hydro development and wind farms. The components were identified and detailed in subsequent studies funded by GEF and PHRD. The project design was consistent with the

government's energy sector strategy, trade and industrial policy reforms, and complied with the Bank's country assistance strategy. The project implementation approach was based on consultations with the government, financial sector as well as private sector investors. The decision to use IREDA as the implementation agency was taken after an assessment of the interest and capability of other financial institutions. At appraisal, the project had a robust pipeline of mini-hydro and wind farm projects. Most technical and financial risks were recognized and mitigation mechanisms were set up. However, the regulatory and policy risks with respect to wind and small hydro, such as those experienced during last two years of project implementation, were underestimated. The Bank recognized that implementation risks were highest for the PV component as it departed significantly from the business-as-usual approach of government tendering that existed in 1992. Capacity building was recognized as a key requirement to mitigate some of these risks and significant funds were mobilized (supplemented later by GON funds). Considerable resources were also allocated to strengthening IREDA's institutional capability. Agreement was reached on an Operational Policy Statement (OPS) which described IREDA's operating philosophy, objectives, programs and procedures and financial performance benchmarks. The co-financing partners, DANIDA and SDC, were closely involved in all aspects of project design and appraisal.

7.2 Supervision:
Supervision is rated satisfactory. Further, the project was reviewed by QAG under the "quality of supervision assessment" in October 2000, and the overall supervision effort was rated as "satisfactory". The Task Team Leader who prepared the project, continued to supervise the project. Typically two to three supervision missions per year were undertaken which included field visits and consultations with beneficiaries and business communities. The supervision teams consisted of financial/economic, technical, social/environmental, and procurement specialists, as needed. Technical specialists from outside the Bank who were directly involved in windpower, solar PV and small-hydro power developement, respectively, participated in some missions and were asked to provide independent review of the respective programs. The aide memoire and project supervision reports are comprehensive and realistic. When issues arose the team took timely corrective actions, including revising procurement rules and amending legal agreements. Procurement supervision based at the Bank's New Delhi Office was particularly useful in timely resolution of problems and in advising IREDA on procurement matters. Considerable attention was paid to achieving the physical targets and ensuring IREDA's financial health. However, more attention could have been paid to monitoring of project outcomes and post-installation performance. Before recommending extensions of the closing date, the supervision team outlined specific measures needed to be taken by IREDA, including the conduct of a comprehensive financial and portfolio audit. As the project drew to a close, an independent study to document the lessons learned and emerging best practices was conducted. The cofinanciers, in particular, SDC participated in supervision. SDC, Government of Netherlands and DANIDA joined the mid-term review. As a consequence, GON, which had been an early supporter of IREDA, contributed an additional $0.4 million to strengthen the IREDA technical assistance program.

7.3 Overall Bank performance:
Overall Bank performance is satisfactory.

Borrower
7.4 Preparation:
Borrower preparation was satisfactory. The borrower (represented by MNES and IREDA) facilitated consultations with key stakeholders, supported the preparation of the components and established policies to ensure that IREDA had the operational independence to undertake its responsibilities.

7.5 Government implementation performance:
Government implementation performance was satisfactory. During the course of the project, as part of the

overall opening up of the Indian economy, import duties and other barriers were substantially removed allowing greater private sector participation in the sector. The GOI provided equity contributions and permitted IREDA to access the domestic financial markets (37 percent or Rs.4.9 billion of funds are sourced through tax free bonds and local bank loans). MNES proactively convinced state governments to give incentives and permit private firms to invest in renewable energy generators and sell electricity to the SEBs or other customers.

7.6 Implementing Agency:
IREDA's performance is deemed highly satisfactory. Despite its innately risky business portfolio, IREDA has exceeded the goals set under this project while meeting or exceeding the performance requirements established under the OPS. Follow-on financial support in excess of $350 million provided by other international financial institutions and coursed through IREDA for renewable energy and energy efficiency, testifies to its success. It has effectively used technical assistance to not only strengthen its own capabilities, but also to develop the overall sector, reach out to rural and disadvantaged communities, and to assess its performance and correct deficiencies. The project is in full compliance of covenants (Annex 8). IREDA issued their audited annual financial statements in a timely fashion and prepared comprehensive quarterly progress reports to aid project supervision. IREDA was proactive in engaging the Bank on discussions for introducing procurement methods which seem a better match for the private sector approach of the project. These discussions eventually resulted in modifications being made to the legal agreements that had been constraining achievement of the project objectives. Project implementation has benefited from the continuity of the IREDA Managing Director who has remained in the position for the duration of the project.

7.7 Overall Borrower performance:
Overall performance is highly satisfactory.

8. Lessons Learned

As one of the first renewable energy projects financed by the Bank, the project provides invaluable experience and knowledge on development of market-based approaches to promoting renewable energy through public-private sector partnership. The key lessons learned from the project are presented below. The increased investments in small hydro, wind generation and solar PV have helped make these technologies more cost effective and their scale and modularity lend themselves well to addressing energy needs of the rural poor. Based on the satisfactory outcome of the project, a follow-up operation was approved by the Bank to support expansion of the small hydro program to include investments in other states. But for renewable energy systems to develop to its full potential and be competitive in India's power market, structural reform, tariff rationalization and good governance in the power sector are essential. Accordingly, any future Bank lending for renewable energy should be closely linked with the reform program.

Renewable energy market development takes time. Allowance must be made for the longer lead time needed to develop these innovative projects and pace of market development must consider alternative business opportunities available to investors – this is particularly true for PV projects. Much of the first four years was spent on capacity building and working with prospective investors in PV. It was only in the fifth year that the pace accelerated. Compounding these commercial market development difficulties were low transaction-cost opportunities such as government PV tenders for telecommunications and MNES PV subsidy schemes.

There is a need to systematically monitor development outcomes and impacts. Given the positive impact of renewable energy schemes to rural communities and users, the establishment of baseline information and monitoring of program benefits will facilitate evaluation of the contribution of rural energy programs in

redressing poverty.

Specialized financial institution such as IREDA was essential in beginning the commercialization of new technologies, but if market growth is to expand, broader participation by the financial sector is essential. Prior to 1992, few, if any, other financial institutions would finance renewable energy given the limited knowledge about the new technology. IREDA's path breaking investments helped reduce the perceived risks so that other lending institutions have begun to finance such projects. Greater outreach to, and capacity building of other financial institutions is needed to mobilize the necessary additional resources.

Similar to rural electrification the world over, affordable financing accessible to rural consumers are essential for selling PV products in rural areas. Given the high first-cost of PV, consumers require financing to make PV products affordable to them and/or grants to buy down the first cost. Financing also helps to deepen the market as more consumers in an area can afford the products – in contrast, cash sales are affordable only to the richest consumers, even with a capital subsidy. It is also essential that financing is available locally - the rural market for lanterns, solar lighting kits expanded only when savings cooperatives, micro-finance institutions and rural banks that are closer to the customers, began to finance such products.

Delivering rural PV services needs a partnership between key actors: rural financing institutions, product/service suppliers and preferably organized consumer groups. Rural financing institutions are important for delivering credit rather than expecting PV suppliers to also be credit suppliers. A supplier with quality products and services accessible by rural consumers is essential. Working with organized consumer groups reduce risks as there is peer pressure to ensure repayment and helps minimize the transactions costs.

Assessment of land acquisition as well as payment of compensation should be completed prior to commencement of civil works to avoid delays in project implementation. This is particularly important for development of small hydro schemes.

Procurement rules and contract value limits need to reflect the goal of the project and the strategy for achieving the goal. In the PV market development component, where the market creation incentive rested with private sector suppliers, progress was constrained by procurement rules that limited direct contracting to less than $10,000 per contract. This required suppliers to spend considerable resources marketing a client with the risk that others who had not incurred these marketing costs, could undercut its bid. This was a disincentive for market development. Implementation progress improved when the direct contracting limit was raised to $50,000 and on a case-by-case basis to $250,000 for consumer durable goods.

Policy Development

The renewable energy program should be consistent with and embedded into the plan for power sector reform and restructuring. Sector reforms and good governance are essential for the development of the renewable energy market. Tariff rationalization and adoption of appropriate performance efficiency benchmarks in the power sector will result in a better appreciation of the growing competitiveness of renewable energy systems. Except for Rajasthan which had explicitly provided for renewable energy development in their reform agenda, other states did not address the renewable energy dimension of the sector. Incorporation of renewable energy development in reform planning and ex-ante analyses of the value-added or otherwise of such a program will enable champions of renewable energy to have a place at the table in the sector reform dialogue.

Supportive and predictable policies and regulatory framework are essential for market development. Wind and hydro development progressed fastest in states with favorable policies and regulations and not necessarily in states with the best renewable resources. However ad hoc policy revisions retroactively applied in some states such as ban on third-party sales, restrictions on captive generation and increased

wheeling charges, are discouraging potential investors and increasing the financial risks.

Tariffs and power sales rules should be fair to all parties for sustainable development of the sector. Allowing third party sales and captive generation led to the developers cherry-picking the SEB's highest paying industrial/commercial customers. As a result, SERCs began backing off earlier incentives offered to developers. The tariff computation needs to be made rationally, transparently and be predictable, within reason. If renewable energy development is a declared government priority, extra incentives should be funded transparently from government resources rather than requiring one sector to mainly bear the cost.

Careful attention should be paid to maximizing energy output rather than installed capacity. For wind farm projects in the early days, given the embryonic state of knowledge, inadequate attention was paid to maximizing energy output. Also, significant tax incentives that were available made power generation (kWh) of secondary importance to commissioning a wind farm within the tax year. With the tax incentives becoming less significant and energy tariffs increasing, developers are paying greater attention to maximizing energy production. Monitoring performance is important and feedback must be provided to developers.

Regular review and rationalization of subsidy policy is necessary. In the initial formative stage, given the high perceived risks, stronger incentives are needed to encourage developers to invest and gain experience as poor project formulation and construction inefficiencies extract their toll on development profits. Once a body of experience is established, a larger number of developers see opportunity for profit and enter the market. At this stage, the government should review the incentives they offer, and revise them as necessary to lead to an increasingly commercial market.

9. Partner Comments

(a) Borrower/implementing agency:

Summary of IREDA Comments: The physical achievements far exceed the original estimates, except in case of PV. Nevertheless considerable momentum has been generated in PV development through the private sector to fully meet the market development objectives. The sustainability of the wind and small hydro programs depend on stable policy and regulatory environment at state and federal levels; and for PV, on the availability of adequate low cost financing. Streamlining procurement practices helped improve speed of implementation. The procedures for obtaining statutory clearances from state agencies need to be streamlined as these remain a bottleneck in some states. Thanks to simplification of Bank procedures, reimbursement of funds occurred without much delay. Speedy clearance of IREDA's proposals by the Bank shows the confidence it had in IREDA.

The technical assistance program was a critically important component that contributed directly to the success of the IREDA investment program, and for overall sector and market development. In particular, entrepreneurship and training programs have resulted in the entry of new entrepreneurs and development of skilled manpower, including future trainers. Many of these programs benefited women and weaker sections of society.

Bank supervision missions had regular interactions with stakeholders, including end-users to understand site conditions and actual problems. Their enthusiasm to visit remote rural areas of the country to encourage end-users and clients contributed to the success of this project. This interaction helped formulate strategies and action plans; adapt rules, procedures and guidelines; and streamline procurement and documentation. There was constant sharing of knowledge, experience and expertise between IREDA, the Bank and other partners. The success of the project also lies in the contribution by Bank technical experts. This project was been a learning experience for all stakeholders for a number of reasons - the concept of commercial financing for renewable energy was new, as were the technologies, scale of investments, private

sector participation, and procurement procedures. Mission members are commended for their seriousness and interest in steering the project.

Thanks to the credibility built through this project, IREDA has successfully sourced additional funds from international donors, including the Bank. The government has contributed additional equity to IREDA. Authorized share capital of IREDA will be increased from Rs.3,000 to Rs.4,000 million. The GoI has proposed a massive PV market development plan to be implemented by IREDA in the 10th Five Year Plan (2002-2007). The Bank's second line of credit for IREDA is already in operation for small hydro and energy efficiency investments. KfW funds are available for wind, PV and cogeneration. KfW is considering a second credit line for energy conservation, biomass, wind, etc. IREDA is discussing PV financing with SDC. Assistance from the JBIC of $85 million and from the US Exim Bank of US $100 million are in the pipeline. IREDA has begun discussions with the ADB for support of its lending operations.

The IREDA evaluation report, IREDA/DCCS/WB-1/23/01, February 21, 2002, and its update of May 10, 2002 are in the project files.

(b) Cofinanciers:
Government of the Netherlands, Ministry of Foreign Affairs: "We are very pleased that IREDA's performance has been deemed highly satisfactory and that the organization met or exceeded the performance requirements established under the OPS. The follow-up financial support provided by other international financial institutions for renewable energy and energy efficiency, testifies to IREDA's success."
Comments from other co-financiers were invited but none were received.

(c) Other partners (NGOs/private sector):
The ICR mission consulted with small hydro and solar photovoltaic project developers and financial intermediaries who have accessed financing from IREDA. Overall, they expressed positive sentiments towards IREDA's implementation of the project and the importance of the project in commercial market development. They indicated that loan processing time and complexity had reduced considerably compared to the early days of IREDA. Nevertheless, the high transactions cost and time needed to travel to New Delhi to meet IREDA was a concern particularly to the smaller developers. Small hydro developers are also concerned about the evolving regulatory environment in some states where rules detrimental to private sector power development are being promulgated. The continued need for concessional financing was noted by PV developers who are serving the rural market. Comments were not received from the Wind Power Producers Association or any of the wind developers. Written comments submitted are in the project files.

10. Additional Information

Annex 1. Key Performance Indicators/Log Frame Matrix

Outcome/Impact Indicators:

Indicator	Projected in SAR	Latest (Dec '01)
1. Renewable energy cost is competitive		
1.1 Unit development cost (Year 2000 $)		
- Small Hydro	$ 1030/kW (over $3000/kW pre-project)	$ 990/kW (average) and $ 1270/kW (median)
- Wind Farms	$ 1600/kW	$ 1150/kW
- Photovoltaics	$ 16.5-25.8/Wp	$ 4.8 to 14.2/Wp
1.2 Average capacity factors for small hydro, wind and PV, respectively	60%, 18.7%, 15%	47%, 18.8%, 17%
2. There is increased access to renewable energy by consumers		
2.1 Energy output from small hydro, wind and PV from project investments	525, 139, 3.2 GWh/year, respectively	485, 144, 3.1 GWh/year respectively
2.2 No. of rural consumers benefitting from PV	Not estimated	More than 44,400
2.3 Aggregate national renewables capacity		
- Small Hydro	256 MW (FY97)	1423 MW (Dec '01)
- Wind Farms	118 MW (FY97)	1507 MW (Dec '01)
- PV	12 MWp (FY97)	82 MWp (Dec '01)
2.4 Renewable energy as percent of total power generation capacity	0.4% (FY95)	3.4% (Dec '01)
3. National/state capacities to develop/support renewable energy is enhanced		
3.1 National/state-level policies are in place to encourage private investment in renewable energy	National government and 4 states had supportive policies in place in 1993.	National government and 13 states have supportive policies and incentives. But recent SERC rulings in some states call for revisions in policies for power sales.
3.2 Other financing institutions include renewable energy in their portfolio	not estimated	Ten other financial institutions are financing renewables.
3.3 IREDA is financially sound and growing: Positive return on net worth	range of 8.2% - 18.2% for period FY94-99	range of 1.8% - 22% for period FY93-99; 11.6%(FY01)
- Annual disbursements	Rs.1091 million (FY99)	Rs. 2261million (FY99); Rs 5607 million (FY01);
- Net profit after tax	Rs. 93 million (FY99)	Rs 189 (FY99); Rs. 163 million (FY01)
- Provision for NPA	Rs 28 million (FY99)	Rs 89 million (FY99); Rs 137 million (FY01)
- Employment Productivity (value of loans sanctioned)	Not projected; was Rs.18 million/employee (FY92)	Rs.80 million/employee (FY01)
3.4 Hydro, wind and PV firms in manufacturing/services, respectively	Not estimated	16, 15, 65 firms, respectively
4. Adverse environmental impacts are reduced		
4.1 Carbon emissions mitigated by wind and PV over lifetime of investments	0.9 - 1 million tons carbon	1.2 million tons carbon
4.2 Direct cost to GEF of carbon emissions mitigated by wind and PV	$ 30 per ton carbon	$ 19 per ton carbon
4.3Direct cost to GEF of carbon emissions mitigated by small hydro, wind and PV		$ 4 per ton carbon

Output Indicators:

Indicator	Projected in SAR	Latest (Dec '01)
1. Renewable energy investments are financed through credit line		
1.1 Small Hydro	100 MW	117.9 MW commissioned with development of 35 MW started under the project; another 155 MW financed by IREDA using locally mobilized resources.
1.2 Wind	85 MW (reduced to 30.5 MW after withdrawal of DANIDA parallel financing)	87.2 MW with another 184 MW financed by IREDA using locally mobilized resources.
1.3 Solar PV	2.5 MWp	2.145 MWp with another 4 MWp financed by IREDA using MNES and other locally mobilized resources.
2. Technical Assistance	IREDA institutional development & strengthening capacity; technical support and training for IREDA staff; technical support, outreach and training for investors and others	Over 51 activities successfully completed.

Annex 2. Project Costs and Financing

Project Component	Appraisal Estimate	Actual	Percentage of Appraisal
Small Hydro	93.5	166.0	178%
Windfarms	125.3	87.7	70%
Solar Photovoltaics	54.9	23.8	43%
Technical Assistance	6.0	6.4	106%
Total	279.7	283.8	101%

Actual includes estimate of remaining disbursements computed at Rs. 48.24/US$.
Price/physical contingencies and IDC included in above for ease of comparison.
Amounts may not add up exactly due to rounding

Details are given below:

	Estimated at Appraisal			Actual
(Millions of dollars)	Physical contingences	Price contingencies	Interest during construction	Interest during construction
Small Hydro	6.7	11.2	8.1	13.9
Wind Farms	10.2	9.0	4.4	0
Solar Photovoltaics	3.9	9.8	2.6	0
Technical Assistance	1.5	0	0	0

Summary of Procurement Arrangements At Appraisal
(US$ millions)

Project Component	ICB	LCB	Commercial Practices[1]	Other[2]	Total
Small Hydro	25.0	20.0	40.0	-	85.0
	(25.0)	(20.0)	(25.0)	-	(70.0)
Windfarms	15.0	10.0	38.0	58.0	121.0
	(15.0)	(3.0)	(10.0)	-	(28.0)
Solar Photovoltaics	7.0	-	35.0	10.0	52.0
	(7.0)	-	(26.0)	(7.0)	(40.0)
Technical Assistance	1.0	3.0	-	2.0	6.0
	(1.0)	(2.0)	-	-	(3.0)
Total[3]	48.0	33.0	113.0	70.0	264.0
	(48.0)	(25.0)	(61.0)	(7.0)	(141.0)

Summary of Procurement Arrangements (Actual Estimates to end of project)[a]
(US$ millions)

Project Component	ICB/LIB	LCB	Commercial Practices[1]	Other[2]	Total
Small Hydro	48.4	29.8	74.0	-	152.1
	(39.8)	(20.8)	(0.9)	-	(61.5)
Windfarms	17.9	-	62.5	7.3	87.7
	(10.6)	-	(44.5)	-	(55.1)
Solar Photovoltaics	3.3	-	20.5	-	23.8
	(1.7)	-	(14.6)	-	(16.3)
Technical Assistance	-	-	-	6.4	6.4
	-	-	-	(3.6)	(3.6)
Total[3]	69.5	29.8	156.9	13.7	269.9
	(52.1)	(20.8)	(60.1)	(3.6)	(136.6)

[1] "Commercial Practices" includes quotations, direct contracting etc.

[2] "Other" includes consultant selection using Bank guidelines etc. and procurement using DANIDA guidelines for parallel equipment financing of wind turbines

[3] Total excludes IDC

[a] Contract values include taxes and duties, but excludes interest during construction. Values in parentheses reflect IDA and GEF-financed portions

Project Financing by Component

Appraisal Estimate

Component	IDA	GEF	IREDA	Cofinanciers			Promoters/ Consumers	Other Loans	Total
				DANIDA	SDC	GON			
Small Hydro	70	0	0	0	0	0	24	0	94
Wind	15	13	16	50	0	0	31	0	125
Solar Photovoltaics	30	10	0	0	2	0	13	0	55
Technical Assistance	0	3	1	0	2	0	0	0	6
Total	115	26	17	50	4	0	68	0	280

Actual [Estimated to end of project - December 31, 2001]

Component	IDA	GEF	IREDA	Cofinanciers			Promoters/ Consumers	Other Loans	Total
				DANIDA	SDC	GON			
Small Hydro	61.5	0.0	36.1	0.0	0.0	0.0	56.0	12.4	166.0
Wind	41.6	13.5	3.6	3.9	0.0	0.0	25.0	0.0	87.7
Solar Photovoltaics	7.3	9.0	0.0	0.0	1.0	0.0	6.5	0.0	23.8
Technical Assistance	0.0	3.6	1.0	0.0	1.3	0.4	0.0	0.0	6.4
Total	110.4	26.2	40.7	3.9	2.3	0.4	87.5	12.4	283.8

Actual as a Percentage of Appraisal Estimate

Component	IDA [1]	GEF [2]	IREDA	Cofinanciers			Promoters/ Consumers	Other Loans	Total
				DANIDA	SDC	GON			
Small Hydro	88%	-	n/a	-	-	-	233%	n/a	177%
Wind	277%	104%	23%	8%	-	-	81%	-	70%
Solar Photovoltaics	24%	90%	-	-	48%	-	50%	-	43%
Technical Assistance	-	121%	100%	-	67%	n/a	-	-	106%
Total	96%	101%	239%	8%	57%	n/a	129%	n/a	101%

n/a - Cannot be computed since denominator is zero.

[1] IDA disbursement is 96% in US$ but expected to be 100% in SDR.

[2] GEF disbursement in US$ is 101% but 100% in SDR.

Note: Totals may not add up exactly due to rounding

Annex 3. Economic Costs and Benefits

Comprehensive details of the economic and financial analyses, including cash flows are given in: Meritec Ltd., "India Renewable Resources Development Project: Review of Project for Implementation Completion Report," April 2002. The report is in the project files.

(a) Small Hydro Component

A comparison of the economic and financial internal rates of return of the small hydro schemes at appraisal with those constructed and commissioned is as follows:

Table 3.1 Comparison of Estimated and Actual EIRR and FIRR for Small Hydro Sub-projects

State	EIRRs at Appraisal		EIRRs Achieved *		FIRRs at Appraisal @	FIRRs Achieved @ #
	Dam-Toe	Canal Drop	Dam-Toe	Canal Drop		
Karnataka	19 to 65%	12 to 29%	28% (21%)	27 to 35% (22 to 30%)	45 to 75% for schemes in various states	25 to 36%
Tamil Nadu	20 to 44%	-	-	-		-
Andhra Pradesh	41%	14 to 23%		28 to 38% (20 to 32%)		30 to 51%
Kerala	13 to 41%	-	-	ROR 48% (37%)		67%

* EIRRs are based on an economic benefit taken as the economic cost of diesel generation. This was the basis of the economic analyses in the Staff Appraisal Report. EIRRs in parenthesis are based on an economic benefit taken as the LRMC of grid supply.
@ FIRRs estimated on investors' equity before tax.
# Results based on the analysis of 13 of the 33 projects considered as a representative sample, and including the best, worst and average projects.

The economic and financial results achieved are generally in the same range as the EIRRs/FIRRs envisaged at appraisal. The average economic and financial results of the 13 small hydro schemes analyzed in detail are as follows:

Table 3.2 Average Actual EIRR and FIRR for Sample of Small Hydro Sub-projects

EIRR / FIRR Analysis	Average (mean)	Average Weighted by Annual Energy Output*
EIRR (real):		
Benefit taken as the cost of diesel generation	32%	39%
Benefit taken as the LRMC of generation	26%	31%
FIRR (current) on total capital	27%	36%
FIRR (current) on equity before tax	35%	49%
FIRR (current) on equity after tax	30%	44%
* Figures are skewed by one large successful project (Kuthangal, 21MW)		

(b) Wind Power Component

A comparison of the economic and financial internal rates of return of the wind farm projects at appraisal with those constructed and commissioned is as follows:

Table 3.3 Comparison of Estimated and Actual EIRR and FIRR for Wind Sub-projects

States	EIRRs Estimated at Project Appraisal		EIRRs Achieved * with benefits based on:		FIRRs Estimated at Project Appraisal		FIRRs Achieved **
	Without GEF	With GEF	Without GEF	With GEF	Without GEF	With GEF	
Tamil Nadu	5 – 10%	12%	3 to 14% (-1 to 13%)	4 to 17% (1 to 16%)	6 - 23%	10 - 41%	7 to 37%
Gujarat			-1 to 7% (-4 to 4%)	0 to 9% (-3% to 6%)			5 to 17%
Andhra Pradesh			4% (1%)	5% (3%)			9%
Maharashtra			9 to 11% (3 to 5%)	11 to 13% (4 to 8%)			62 to >100%
Karnataka			20 to 23% (11% to 14%)	22 to 27% (14% to 18%)			39 to 53%
Rajasthan			12% (6%)	15% (8%)			20%

The analysis of commissioned schemes uses an SCF or 0.9, as compared with an SCF of 0.8 assumed at appraisal.
* EIRRs are based on an economic benefit taken as the economic cost of diesel generation (this was the basis of the economic analyses in the Staff Appraisal Report). The EIRRs in brackets assume an economic benefit taken as the LRMC of grid supply.
** FIRRs on investors equity after tax.

The average economic and financial results of the 27 wind power projects is as follows:

Table 3.4 Average Actual EIRR and FIRR for Sample of Wind Sub-Projects

EIRR / FIRR Analysis	Average (mean)	Average Weighted by Annual Energy Output
EIRR (real): *		
Without GEF	9% (5%)	11% (7%)
With GEF	11% (7%)	14% (10%)
FIRR (current) on total capital	13%	16%
FIRR (current) on equity after tax	114%	94%

* EIRRs are based on an economic benefit taken as the economic cost of diesel generation (this was the basis of the economic analyses in the Staff Appraisal Report). The EIRRs in brackets assume an economic benefit taken as the LRMC of grid supply.

The main points to note are:

- Fourteen of the 27 projects financed achieved an EIRR of 12% or greater (based on a benefit of avoided diesel generation and accounting for global environment benefits). This was generally as expected at appraisal where EIRRs, with GEF, were estimated to be 12% (also based on a benefit of avoided diesel generation). GEF grant represents the global environmental benefit of the project.
- Some of the early projects (in Tamil Nadu, Gujarat and Andhra Pradesh) showed actual capacity utilization at about half that expected at appraisal. Consequently these projects were not economic and show poor financial returns.
- Most of the later wind farm projects achieved high returns due to improved wind farm performance and to sales tax deferment incentives offered by some states.
- The averages on FIRR on equity after tax is skewed to the high side due to the ten projects in Maharashtra which were exceedingly profitable due to the generous sales tax deferment incentives.

(c) Solar PV Component

Because of the wide range of solar PV products financed under the project, and the variety of financing mechanisms applying a sample of solar PV sub-projects has been selected for analysis as follows:

1. Solar PV Lanterns – Wahan Dharak example with 5Wp PV-CFL lanterns. IREDA project code 1996

and Case Study Number 3 in report titled "Emerging Lessons and Best Practice", Winrock, October 2001.

2. Solar Home Lighting Systems - 37Wp systems, data taken from field observations.
3. Grid Interactive Solar Power Packs – The Social Work & Research Centre, 5.1kWp system. IREDA project code 1170.
4. Isolated Solar Power Plant - WBREDA 25kWp isolated grid supply system on Sagar Island. IREDA project code 854 and Case Study Number 4 in Winrock report.
5. Solar PV Pumping System – Polyene Film Industries example with 860Wp floating water pumping systems for irrigation. IREDA project code 617 and Case Study Number 5 in Winrock report. Information was also obtained directly from Polyene Film Industries.

Estimated EIRR at appraisal for PV sub-projects was 1.5 to 3.3 percent excluding global benefits and 14 to 14.6 percent when global benefits were included. The results of the analysis of the representative solar PV sub-projects are summarized below in Tables 3.5 and 3.6:

Table 3.5 Comparison of Actual EIRR With and Without Global Environment Benefits

Solar PV Sub-project	With Global Environmental Benefits	Without Global Environmental Benefits
Solar PV Lanterns (5 Wp) Economic benefits equal to avoided cost of kerosene used in hurricane lamp of Rs 3/day	47%	29%
Economic benefits, including consumer surplus, measured in terms of lighting benefits valued at Rs 20/kWh	33%	19%
Solar PV Home Lighting (37 Wp) Economic benefits equal to avoided cost of kerosene used in petromax lamp of Rs 7/day	60%	15%
Economic benefits, including consumer surplus, measured in terms of lighting benefits valued at Rs 20/kWh	108%	30%
Grid Interactive Solar Power Pack (5.1 kWp) Economic benefits equal to avoided cost of uninterruptible grid power supply	21%	-23%
Isolated Solar Power Station for Village (25 kWp) Economic benefits equal to avoided cost of small diesel generation	19%	-3%
Solar PV Pumps for Irrigation (860 Wp) Economic benefits equal to avoided cost of diesel driven pumps	>100%	2%
Economic benefits, including reurn from increased agricultural production for small farms	43%	6%

Table 3.6 FIRR and Financial NPV for Solar PV Sub-projects

Solar PV Sub-Project	FIRR *	Financial NPV Year 2000 Rs./Wp * #
Solar PV Lanterns (5 Wp)	>100%	776
Solar PV Home Lighting (37 Wp)	48%	226
Grid Interactive Solar Power Pack (5.1 kWp)	>50%	17
Isolated Solar Power Station for Village (25 kWp)	29%	0.1
Solar PV Pumps for Irrigation (860 Wp)	17%	20
* From the solar PV user/owner's perspective. # Financial NPV calculated at a 12% discount rate.		

It is clear from Tables 3.5 and 3.6, the level of incentives for solar lighting can be moderated or even eliminated.

Assumptions and Basis for Cost and Benefit Estimates

Economic analyses of small hydro and wind sub-projects is in constant border price terms at the year of start of construction. Economic analysis of solar PV sub-projects is in constant 2000 domestic prices. Financial analyses are in current prices. Parameters used in the analyses are given in Tables 3.7 to 3.9. Figures are in constant year 2000 prices unless otherwise indicated:

Table 3.7 Assumptions and Basis for Cost and Benefits Estimates for Small Hydro and Wind Sub-projects

Parameter	Small Hydro Sub-projects	Wind Farm Sub-projects
Number of projects analyzed	13 out of 33 projects considered as a representative sample, and including the best, worst and average projects.	27 in total, 14 commissioned between 1993 and 1997, 13 commissioned during 2000 and 2001
Plant size per Sub-project	0.8 to 21 MW, average of 3.5 MW	1 to 15 MW, average 3.4 MW
Capital cost US$/kW	Project specific, ranges from: ROR $ 522 to 1,644 / kW; Dam-toe $ 743 to 1,105 /kW; Canal $ 900 to $ 1,754 /kW	$ 950 to $ 1,520/kW
Project implementation disbursements	Project specific. Typically 2 to 3 years but ranging up to 4 years.	100% in the first year
Plant load factors	27% to 58% with average of 47%	11% to 31% with average 18%
Wheeling fee	2% of generation	2% of generation
Inflation	5% per year from 2000 onwards	5% per year from 2000 onwards
Electricity selling price (2000 prices)	Varies between projects but predominantly based on a 1995 price of Rs 2.25 / kWh escalating at 5% per year.	• Commissioned before 1996: Between Rs 3 to 4/kWh escalating at 10%. • Commissioned after 1996: Around Rs 3.5 /kWh escalating at 5%.
% Equity investment	20% to 61% of total capital with average of 36% (compared with 25% at appraisal)	16% to 68% of total capital with average of 33% (compared with 25% at appraisal)
Loan interest rate	Project specific - ranges from 12.5% to 15.5%	Project specific – ranges from 12.5% to 14.5%
Loan term	10 years	Project specific – ranges from 8 to 10 years
Grace period	For period of construction (Max 4 years)	1 year
O&M cost (% of plant cost)	2% of plant cost constant in real terms	2% of plant cost constant in real terms
Insurance	0.5% of capital cost	0.2% of capital cost
Financial incentives: • Tax holiday	First 5 years of operation	First 5 years of operation
• Accelerated depreciation	n/a	100% for 25 out of 27 projects. Assumes investors can offset 100% of losses against other business.
• Capital subsidies	n/a	For 15 projects (between 1.5 and 2.0 million Rs per project)
• Sales Tax Exemption	n/a	100% of plant cost for 10 projects, over 6 years. Assumes investors can take advantage of total incentive.
Tax rate	Marginal tax rate of 35% Minimum Alternative Tax of 7.5%	Marginal tax rate of 35% Minimum Alternative Tax of 7.5%
Depreciation	Straight-line over 20 years.	Over 1 year for projects with accelerated depreciation incentive. Straight-line over 20 years for rest.
Economic life	30 years	20 years
Basis of economic costs	Financial costs converted to border prices sing an SCF of 0.9.	
Global environment benefit	n/a	US$ 155,000 / MW (Based on GEF contribution)
Economic Benefits:	• Avoided economic cost of diesel generation (Rs 4.1/kWh in 2000 prices based on diesel fuel cost of US$ 0.30/litre non-escalating in real terms). • Avoided LRMC of grid supply (Rs 3.0/kWh in 2000 prices. Estimate based on coal-fired generation and Rs 1/kWh for transmission.)	
Economic discount rate and hurdle rate	12%	12%

Table 3.8 Assumptions and Basis for Cost and Benefits Estimates for Solar PV Sub-projects

Parameter	Solar Lanterns	Solar Home Systems	Grid-Interactive System	Solar Power Station	Solar PV Pumps
Size (Wp)	5 Wp	37 Wp	5.1 kWp	25 kWp	860 Wp
System financial cost (US$/Wp)	$16.2	$7.68	$8.45	$7.70	$6.73
Disbursements	100% at the beginning of year 1				
Solar plant output (net)	0.0045 kWh per Wp per day				
Battery replacement	Rs 600 per 3 years	Rs 3,500 per 3 years	Rs 0.5 million per 5 years	Rs 2.164 million per 5 years	No battery
Battery charge controller replacement	Rs 350 every 5 years	Rs 500 every 7 years	n/a	n/a	n/a
Light Bulbs	Rs 80 every 2 years	Rs 160 every 2 years	n/a	n/a	n/a
Other O&M costs				2% of capital cost	Replace pump every 10 years
Inflation	5% per year from 2000 onwards				
Financial costs / financing (from the user's perspective)	Lease cost of Rs 1 / day	Loan at 2.5%	Loan at 2.5%	Connection cost of Rs 1000 plus a monthly fee Rs 120	Up front lease fee of Rs 80,000 (incl. maintenance fee)
MNES capital subsidy	not available to lessee	Rs 6,000	Rs 940,000	Rs 5 million	not available to lessee
Financial benefits (from the user's perspective)	Avoided costs of hurricane lamp	Avoided costs of petromax lamp	Avoided UPS (Rs 0.6 million) and battery (Rs 0.5 million) + avoided grid supply tariff of Rs 3/kWh	Savings from avoided diesel generation	Avoided cost of diesel pumping (excl. capital cost of pump)
Global environment benefit	Rs 189/Wp [Based on allocation and use of GEF grant for PV component by IREDA]				
Basis of economic cost	Financial costs converted to border prices using an SCF of 0.9				
Economic benefits: • Economic return calculation	Consumer surplus (CS) of Rs 20/kWh. For SHS, CS benefits from lighting attributed to half electricity used as balance displaces battery-powered appliances without net increase in CS.				Net income gain of Rs 21,000 per year for small farm *
• Least economic cost comparison for lighting	with hurricane lamp	with petromax lamp	with grid supply and UPS	with diesel generation on Sagar Island with an AIEC of Rs 21/kWh	with diesel driven pumps
Economic life	10 years	15 years	15 years	15 years	20 years

* NABARD survey of farms with similar pump sizes and "Supply of Power to Agriculture – Haryana Report" give net income gains of around Rs 7,000 per acre.

Table 3.9 Inflation and Exchange Rate Assumptions

	1993	1994	1995	1996	1997	1998	1999	2000
Domestic Inflation	9.5%	9.2%	8.7%	7.5%	7.0%	7.9%	3.5%	4.1%
International Inflation	1.4%	4.3%	7.5%	-2.6%	-3.9%	-4.0%	1.7%	-3%
Rs / US$	30	31	32	35	36	41	43	45

Sample Calculations

RENEWABLE RESOURCES PROJECT - SMALL HYDRO COMPONENT
ECONOMIC ANALYSIS
PROJECT: Guntur Branch Canal
(constant 2000 Rs millions)

Year	Annual Generation (MWh/yr)	Capital Cost	Operating Costs	Total Cost	Benefit / Avoided Cost	Net Benefit
1		31.19		31.19		-31.19
2		7.8		7.8		-7.8
3	3365		0.81	0.81	10.1	9.29
4	3365		0.81	0.81	10.1	9.29
5	3365		0.81	0.81	10.1	9.29
6	3365		0.81	0.81	10.1	9.29
7	3365		0.81	0.81	10.1	9.29
:			:	:	:	
	:					:
:			:	:	:	
	:					:
:			:	:	:	
	:					:
:			:	:	:	
	:					:
32	3365		0.81	0.81	10.1	9.29

EIRR - net cash flow	**20%**
ENPV - net cash flow @12%	**37.6 millions of Rs**
AIEC (at 12%)	**0.04 USD/kWh**

Notes: Figures given in border pricing terms using an SCF of 0.9; Costs and benefits are assumed to occur at the end of each year; Capacity 0.8MW;Plant Load Factor of 49%; Economic Life of 30 years; O&M costs of 2% of capital cost; Insurance of 0.5% of capital cost; Wheeling fee of 2% of generation; Avoided LRMC of supply of Rs 3.0 / kWh

RENEWABLE RESOURCES PROJECT - SOLAR PV HOME LIGHTING SYSTEM
ECONOMIC ANALYSIS

(2000 Rs)

Benefit based on consumer surplus (50% of electricity for improved lighting)

Year	Initial Cost	Battery	Bulb	Controller	Total Cost	Economic Benefit	Total Cash Flow
0	10,236				10,236	6993	-3,243
1					0	3,932	3,932
2			128		128	3,932	3,804
3		2,797			2,797	3,932	1,135
4			128		128	3,932	3,804
5					0	3,932	3,932
6		2,797	128		2,925	3,932	1,007
7				400	400	3,932	3,532
8			128		128	3,932	3,804
9		2,797			2,797	3,932	1,135
10			128		128	3,932	3,804
11					0	3,932	3,932
12		2,797	128		2,925	3,932	1,007
13					0	3,932	3,932
14			128		128	3,932	3,804
15					0	3,932	3,932
Assumes nil implementation period with costs at beginning of year 1 and benefits starting at the end of year 1.						***EIRR***	**108%**
						NPV	**17,822**

Renewable Resources Project – Small Hydro Component
Financial Analysis
Project: Guntur Branch Canal
(Current Rs millions)

Year	1	2	3	4	5	6	7	8	...	20	21	22
Plant Output	0%	0%	100%	100%	100%	100%	100%	100%		100%	100%	100%
Energy Available for Sale (MWh)	-	-	3,365	3,365	3,365	3,365	3,365	3,365		3,365	3,365	3,365
Sale Price (Rs/kWh)	2.87	3.02	3.17	3.32	3.49	3.67	3.85	4.04		7.26	7.62	8.00
Revenue	-	-	10.66	11.19	11.75	12.34	12.95	13.60		24.42	25.64	26.93
Other Revenue	-	-	-	-	-	-	-	-		-	-	-
Total Revenue	-	-	10.66	11.19	11.75	12.34	12.95	13.60		24.42	25.64	26.93
O&M Expenses	-	-	0.98	1.08	1.18	1.30	1.43	1.57		4.94	5.44	5.98
Insurance	-	-	0.26	0.27	0.28	0.30	0.31	0.33		0.59	0.62	0.65
Other Expenses (Royalties)	-	-	-	-	-	-	-	-		-	-	-
Total Operating Expenses	-	-	1.24	1.35	1.47	1.60	1.75	1.90		5.53	6.06	6.63
Net Operating Income	-	-	9.42	9.84	10.28	10.73	11.21	11.70		18.89	19.59	20.29
Salvage Value	-	-	-	-	-	-	-	-		-	-	5.36
Capital Cost (incl. VAT, excl. IDC)	32.32	8.08	-	-	-	-	-	-		-	-	-
Total Net Cash Flow	(32.32)	(8.08)	9.42	9.84	10.28	10.73	11.21	11.70		18.89	19.59	25.65
Financial Evaluation on Total Capital												
FIRR on Net Cash Flow		**23.3%**										
AIFC	**12.0%**	**2.46 Rs/ kWh**										
FNPV on Net Cash Flow @	**15.5%**	**20.8 millions of Rs**										
Loan Outstanding	23.84	33.76	38.37	34.53	30.70	26.86	23.02	19.19		-	-	-
Interest During Construction	1.85	4.61	-	-	-	-	-	-		-	-	-
Interest Payment on Loan	-	-	5.95	5.35	4.76	4.16	3.57	2.97		-	-	-
Annual Loan Repayment	-	-	3.84	3.84	3.84	3.84	3.84	3.84		-	-	-
Equity Investment	8.48	-	-	-	-	-	-	-		-	-	-
Net Operating Cash Flow	-	-	9.42	9.84	10.28	10.73	11.21	11.70		18.89	19.59	20.29
Value Added Tax	-	-	-	-	-	-	-	-		-	-	-
Total Net Cash Flow before Tax	(8.48)	-	(0.36)	0.65	1.69	2.73	3.80	4.88		18.89	19.59	25.65
Financial Evaluation on Equity Capital - Before Tax												
FIRR on Net Cash Flow		**29.6%**										
FNPV on Net Cash Flow @	**15.5%**	**19 millions of Rs**										
Book Value												
Depreciation	-	-	2.11	2.11	2.11	2.11	2.11	2.11		2.11	2.11	2.11
Accounting Profit Before Tax	-	-	1.36	2.37	3.41	4.46	5.52	6.61		16.77	17.47	18.18
Corporate Tax	-	-	-	-	-	-	-	2.31		5.87	6.12	6.36
Minimum Alternative Tax	-	-	0.10	0.18	0.26	0.33	0.41	-		-	-	-
Net Cashflow After Tax	(8.48)	-	(0.47)	0.47	1.43	2.40	3.39	2.57		13.02	13.47	19.29
Financial Evaluation on Equity Capital - After Tax												
FIRR on Net Cash Flow		**24.7%**										
FNPV on Net Cash Flow @	**15.5%**	**10 millions of Rs**										
Debt Service Cover a/			0.96	1.07	1.20	1.34	1.51	1.38				
Debt Service Cover b/			0.96	1.02	1.07	1.13	1.20	1.22				
Cumm. equity cash flow (post tax)	(8.48)	(8.48)	(8.95)	(8.48)	(7.05)	(4.65)	(1.26)	1.31		111.06	124.53	143.82
Cashflow break-even year								**7.5**				

Notes

a/ Yearly figures of net profit after tax but with interest and depreciation added back, divided by debt service cost.

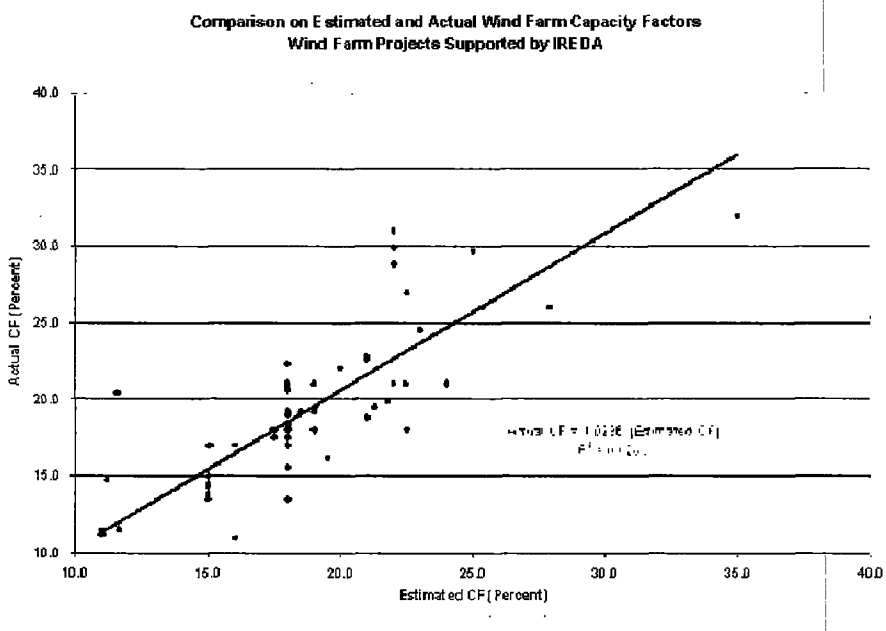
b/ Cummulative effect of net profit after tax but with interest and depreciation added back, divided by debt service cost.

Renewable Resources Project – Solar Home Lighting System
Financial Analysis
(Current Rs)

Year	0	1	2	3	4	5	...	14	15
kWh	0	60.8	60.8	60.8	60.8	60.8		60.8	60.8
Total system cost	12,800								
MNES capital subsidy	6,000								
Equity	3,200								
Loan	3,600	3,240	2,880	2,520	2,160	1,800			
Loan repayment		360	360	360	360	360			
Loan interest		90	81	72	63	54			
Battery replacement				4,052					
Bulb replacement			176		194			317	
Controller replacement									
Financial Savings (avoided petromax lighting)		2,683	2,817	2,958	3,106	3,261		5,059	5,312
Total Cashflow	(3,200)	2,233	2,199	(1,526)	2,488	2,847		4,742	5,312
FIRR on equity before tax	**48%**								
FNPV at	**12%**	**8,368**		**226** /Wp					

ESTIMATED AND ACTUAL CAPACITY FACTORS OF WIND FARMS

While the early projects had lower-than-expected capacity factors, due to lack of experience, overall actual performance of wind farms was better than expected. On the average, wind farm capacity factors were nearly 3 percentage points better than estimated values.



UNIT COSTS OF PV SYSTEMS

(Year 2000 $/Wp)

Product	Appraisal	1997-98	2000-01	Cost Reduction Relative to:	
				Appraisal	1997-98
Lantern (5 Wp)	-	19.19	14.22	-	26%
Lantern (10 Wp)	25.80	12.13	9.33	64%	23%
Solar Lighting	17.07	12.61	7.67	55%	39%
Grid-tied Solar Power Plants (0.5 kWp)	-	25.86	12.47	-	52%
Grid-tied Solar Power Plants (2.5-3 kWp)	-	13.20	7.56	-	43%
Centralized grid (50-200 kWp)	-	6.58	4.76	-	28%
Irrigation Pumping (900 Wp)	-	9.71	6.67	-	31%
Village Power	16.50	18.29	12.47	24%	32%

Highlights of IREDA's Financial Performance (Audited)

Financial Indicators	Units	OPS Requirement	FISCAL YEARS 1991-92	1992-93	1993-94	1994-95	1995-96
Total Income	Million Rs		38	60	61	115	231
Net profit after Tax	Million Rs		16	50	31	53	77
Annual loan Approvals	Million Rs		248	307	1,624	2,426	6,049
Annual Disbursements	Million Rs		102	182	559	1,303	2,385
Total Assets	Million Rs		619	723	1,218	2,542	4,714
Capital Base	Million Rs		295	425	516	1,146	1,477
Return on Invest Capital	Percent		8.4%	11.8%	7.4%	5.8%	7.2%
Real Return on Net Worth	Percent	Positive	1.78%	1.05%	0.10%	0.19%	0.34%
Debt service Coverage Ratio		>1.3	1.77	5.55	6.78	11.77	4.91
Debt Equity Ratio		<5:1	0.99	0.59	0.49	0.66	1.61
Reschedulment % of Loan Outstanding		<10%	Complied	Complied	Complied	Complied	Complied
Liquidity	Month of Disbursement	>3	Fulfilled	Fulfilled	Fulfilled	Fulfilled	Fulfilled
NPA Loans to Total Loans	Percent		---	---	---	1.91%	4.21%
NPA Loan	Million Rs		---	---	---	34	157

Financial Indicators	Units	OPS Requirement	FISCAL YEARS 1996-97	1997-98	1998-99	1999-00	2000-01
Total Income	Million Rs		325	255	478	533	534
Net profit after Tax	Million Rs		140	16	188	195	163
Annual loan Approvals	Million Rs		3,288	4,990	6,841	9,285	6,650
Annual Disbursements	Million Rs		2,375	1,874	2,257	4,194	5,607
Total Assets	Million Rs		7,352	8,949	11,045	13,719	18,574
Capital Base	Million Rs		1,952	2,221	2,811	3,465	3,990
Return on Invest Capital	Percent		11.9%	8.1%	9.4%	9.6%	9.2%
Real return on Net Worth	Percent	Positive	1.15%	-6.59%	5.75%	1.38%	2.63%
Debt service Coverage Ratio		>1.3	2.45	1.32	1.36	2.47	1.70
Debt Equity Ratio		<5:1	2.30	2.58	2.51	2.34	2.68
Reschedulment % of loan Outstanding		<10%	Complied	Complied	Complied	Complied	Complied
Liquidity	Month of Disbursement	>3	Fulfilled	Fulfilled	Fulfilled	Fulfilled	Fulfilled
NPA Loan to Total Loans	Percent		5.07%	21.60%	17.50%	17.32%	14.94%
NPA Loans	Million Rs		276	1,332	1,303	1,813	2,218

Annex 4. Bank Inputs

(a) Missions:

Stage of Project Cycle	No. of Persons and Specialty (e.g. 2 Economists, 1 FMS, etc.)		Performance Rating	
			Implementation	Development
Month Year	Count	Specialty	Progress	Objective
Identification/Preparation				
06/91				
Appraisal/Negotiation				
06/92				
11/92				
Supervision				
05/93	*2*	Energy Specialist, Environmental Consultant		
07/93	*5*	Energy Specialist, Renewable Energy Specialist, Power Engineer, Procurement Engineer, Procurement Assistant		
10/93	*7*	Renewable Energy Specialist, Power Engineer, Procurement Engineer, Pr. Financial Analyst, Sr. Operations Advisor, Research Assistant, Dutch DGIS		
11/95	*5*	Task Manager, Renewable Energy Specialist, Hydro Specialist Engineer, Finance, Project Assistant	S	S
11/96	*4*	Mission Leader, Climate Change, Financial Analyst Consultant, Solar PV Consultant	S	S
12/97	*5*	Task Leader, Financial Analyst, Economist, Engineer, Procurement Engineer	S	S
07/98	*3*	Task Leader, Private Sector Development Specialist, Project Assistant	S	S
12/98	*4*	Sr. Operations Officer, Anthropologist, Sr. Power Engineer, Solar PV Engineer	S	S
11/99	*4*	Sr. Operations Officer, Financial Analyst, Solar Engineer, Sr. Renewable Energy Specialist	S	S
4/00	*3*	Sr. Operations Officer, Sr. Renewable Energy Specialist, Procurement Engineer	S	S
11/00	*5*	Sr. Operations Officer, Sr. Financial Specialist, Social Development Specialist, Energy Specialist, Hydropower Specialist	S	S
4/01	*4*	Sr. Operations Officer, Sr. Financial Specialist, Energy	HS	HS

ICR 11/01	*4*	Specialist, Hydropower Specialist Sr. Operations Officer, Sr. Renewable Energy Specialist, Renewable Energy Consultant/Economist, Procurement Engineer	HS	HS

(b) Staff:

Stage of Project Cycle	Actual Latest Estimate	
	No. Staff weeks	US$ ('000)
Identification/Preparation	109.8	260.7
Appraisal/Negotiation	31.8	86.9
Supervision	153	308.6
ICR	11	32.5
Total	305.6	688.7

Annex 5. Ratings for Achievement of Objectives/Outputs of Components

(H=High, SU=Substantial, M=Modest, N=Negligible, NA=Not Applicable)

	Rating
☐ *Macro policies*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☒ *Sector Policies*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☒ *Physical*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☒ *Financial*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☒ *Institutional Development*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☒ *Environmental*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
Social	
☐ *Poverty Reduction*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Gender*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Other (Please specify)*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☒ *Private sector development*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☐ *Public sector management*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☒ *Other (Please specify)*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
Global environment	

Note: While the project did not have a poverty/gender-specific objectives, the PV component in particular did have substantial positive impacts.

Annex 6. Ratings of Bank and Borrower Performance

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HU=Highly Unsatisfactory)

6.1 Bank performance	*Rating*
☒ *Lending*	○ *HS* ● *S* ○ *U* ○ *HU*
☒ *Supervision*	○ *HS* ● *S* ○ *U* ○ *HU*
☒ *Overall*	○ *HS* ● *S* ○ *U* ○ *HU*

6.2 Borrower performance	*Rating*
☒ *Preparation*	○ *HS* ● *S* ○ *U* ○ *HU*
☒ *Government implementation performance*	○ *HS* ● *S* ○ *U* ○ *HU*
☒ *Implementation agency performance*	● *HS* ○ *S* ○ *U* ○ *HU*
☒ *Overall*	● *HS* ○ *S* ○ *U* ○ *HU*

Annex 7. List of Supporting Documents

1. Douglas F. Barnes, Kevin Fitzgerald, and Henry M. Peskin, The Benefits of Rural Electrification in India: Implications for Education, Household Lighting, and Irrigation, Draft Working Paper, The World Bank, March 2002.
2. IREDA, 14th Annual Report - 2000-2001, New Delhi, India, August 7, 2001.
3. IREDA, Renewable Energy, Energy Efficiency Financing Guidelines, New Delhi, India, March 5, 2001.
4. IREDA, Status Report for Small Hydro Power Sector for the World Bank First and Second Credit Lines, New Delhi, India, October 31, 2001.
5. IREDA, Status Report for SPV Market Development Component for the World Bank Credit Line, New Delhi, India, November, 2001.
6. IREDA, Status Report for Wind Power Sector for the World Bank Credit Line, New Delhi, India, November, 2001.
7. IREDA, Partner Comments: Project Implementation Evaluation Report, Report No. IREDA/DCCS/WB-1/23/01, February 21, 2002 (preliminary) and dated May 10, 2002 (latest).
8. IREDA, Various Data as Input to ICR, December 21, 2001 to March 2002.
9. Meritec Inc. Renewable Resources Development Project: Economic and Financial Review of Project for Implementation Completion Report, Consultant Report, April 2002.
10. Ministry of Non-conventional Energy Sources, Renewable Energy in India - Business Opportunities, New Delhi, India, 2001.
11. Polyene Film Industries Ltd., Feedback from Polyene Film Industries Ltd., Comments from Promoter, November 2001.
12. Shri Shakti Alternative Energy Ltd., Feedback to World Bank/IREDA on SPV Project Implementation, Comments from Promoter, November 2001.
13. Solar Energy Equipment Manufacturers Association, World Bank Line of Credit - 2449-IN SPV Market Development Program, Trade Association Commentary, November 27, 2001.
14. Srikanth, J. and D. Swamy, A Comprehensive Study on Socio-economic and Environmental Implications of Wind Energy Generation in Coimbatore, Tirunelveli and Kanyakumari Districts of Tamil Nadu, Dr. GRD College of Science, Coimbatore, India, 2001.
15. Sungrace Energy Solutions, Feedback on Project Achievements under IREDA-World Bank SPV Market Development Programme and Market Analysis of Solar PV Sector in India, Comments from Promoter, November 2001.
16. The World Bank, Implementation Completion Review Mission - India Renewable Resources Development Project, Aide Memoire, Washington DC, USA, November 19-30, 2001.
17. The World Bank, India Renewable Resources Development Project, Staff Appraisal Report, Report No. 11240-IN, Washington DC, USA, November 30, 1992.
18. The World Bank, Joint Mid-Term Project Review Mission - India Renewable Resources Development Project, Aide Memoire, Washington DC, USA, November 1-10, 1995.

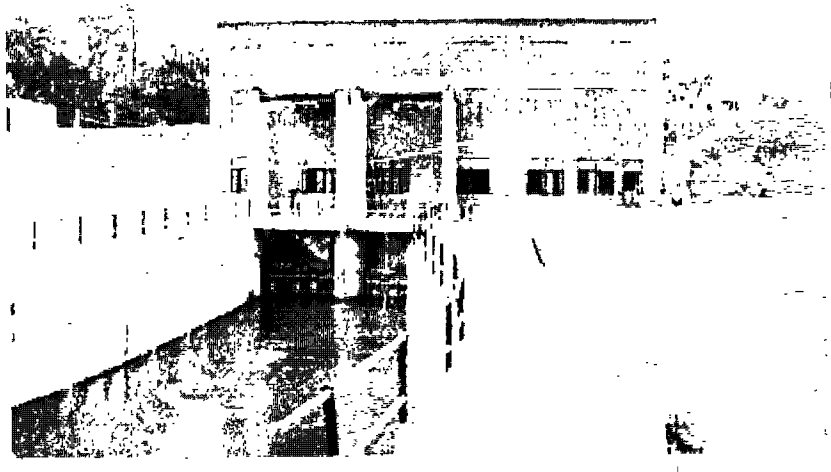
Annex 8. Legal Covenants

Agreement	Description of Covenant	Covenant Status
Development Credit Agreement		
2.02 (b)	GOI to open a Special Deposit Account with the Reserve Bank of India.	Complied with
4.01 (b)	GOI to furnish audit of Special Account to Association not later than six months after FY end.	Complied with
Project Agreement		
3.02	IREDA to take out and maintain insurance	Complied with
4.01 (b)	IREDA to furnish to the Association audited financial statements within nine months after FY end, along with the auditor's report.	Complied with
4.01 (c)	IREDA to furnish to the Association unaudited records, accounts, financial statements not later than six months after FY end.	Complied with
Schedule 2 Para (1)	IREDA to implement an organizational structure and increase staff based on agreed timetable.	Complied with
Schedule 2 Para 4(a)	IREDA shall review with the Association by July 1,1993, the interest rate for loans for solar PV schemes, based on the results of the PV market survey under the Japan Grant.	Complied with
Schedule 2 Part 4(b)	IREDA shall review with the Association by May 1, 1995, the interest rate for loans for small hydro and windfarm schemes based on the mid-term review of the project.	Complied with
Schedule 2 Para 5	IREDA to carry out a mid-term review of the project and furnish the findings of the review to the Association no later than March 31, 1995.	Complied with
Schedule 2 Para 6(a)	IREDA to submit financial statements for the current year and projections for the next five years, comparing with parameters in the OPS, by December 31 of each year.	Complied with
Schedule 2 Part 6(b)	IREDA to furnish by March 31 each year, evidence of equity support from GOI to enable IREDA to meet liquidity levels agreed to.	Complied with
Schedule 2 Para 3	Each scheme estimated to cost the equivalent of US$5 million or more shall be subject to prior approval by the Association. First two schemes each of small hydro, windfarm and solar PV shall also be subject to prior approval.	Complied with

Annex 9. Examples of Projects Financed under the India Renewable Resources Development Project

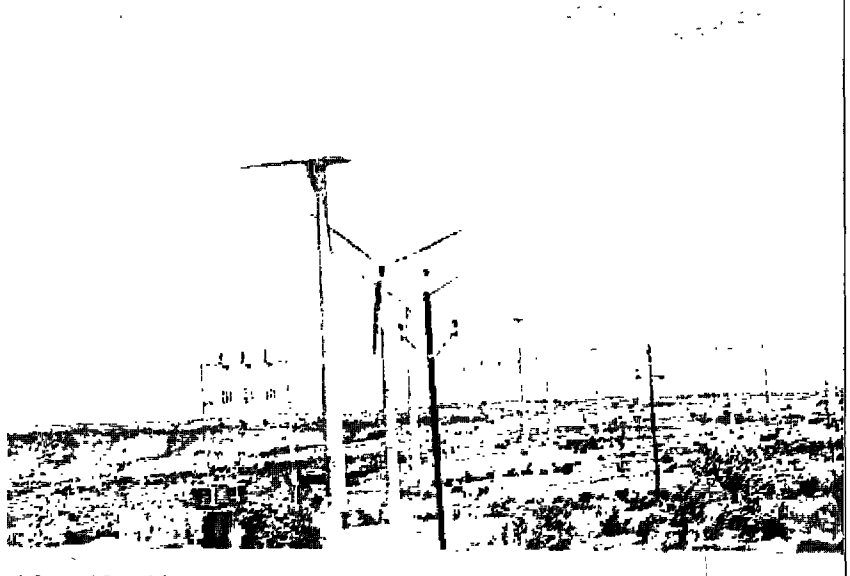
Small Hydro Power

Under the RRD project, IREDA has financed 52 irrigation-based small hydro projects ranging in size from 500 kW to 21 MW in Andhra Pradesh, Karnataka, Kerala, and Maharashtra. The facility shown in the photograph is Sriramadevarakatte Mini Hydel Scheme in Hassan District, Karnataka, India was developed by Amogha Power Projects (Pvt) Ltd. Sanctioned in 1998, the cost of the facility was Rs. 74 million (US$1.8 million in Year 2000 dollars), or about $1200/kW. It was commissioned within 20 months of loan agreement signing. It sells 5.3 GWh annually to Karnataka Power Transmission Corporation Ltd.



Wind Farm Projects.

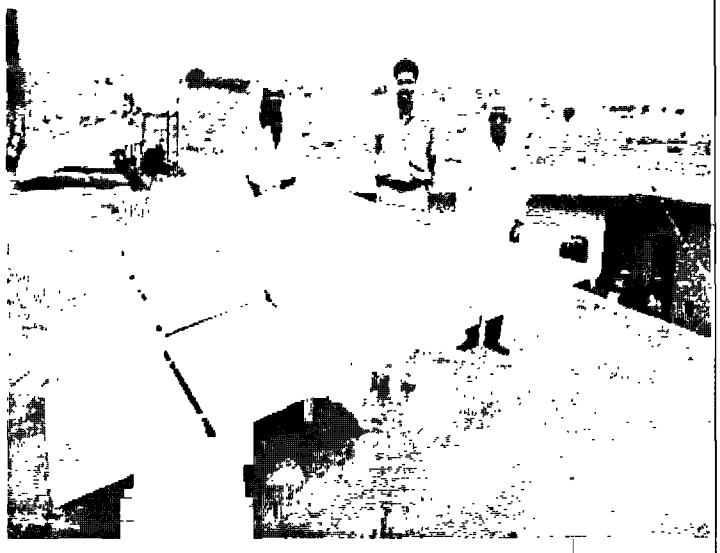
Under this project, IREDA has financed 34 wind farms ranging in size from 1 to 15 MW each. Average capacity of the wind farms was 3.25 MW. The wind farms are located in Maharashtra, Rajasthan, Karnataka, Tamil Nadu, Gujarat and Andhra Pradesh. Implementation has taken one to nine months. Turbine sizes have increased from 225-250 kW in the early days to 600-750 kW. Capacity factors have ranged from 15 to 31 percent.



Solar Lantern Leasing Program by a Savings Cooperative Wahan Darak Nagari Sahakari Patsantha Maryadit is a savings cooperative located in Kolhapur, Maharashtra They obtained a loan from IREDA to purchase solar lanterns from Sungrace Energy Solutions Ltd. This company also warrants the product and provides training to cooperative staff on repair and maintenance of the lanterns. The lanterns are leased to their members at about Rs 1 per day. The members include petty traders, farmers and dairymen, among others. The traders, who operate roadside stalls or small shops have found that the high quality of lighting and lack of kerosene fumes attracted more customers during the main business hours from 6-9pm and their income increased by Rs.50-100 per day, corresponding a 50% net income increase. The dairymen find the lanterns far safer, cleaner and brighter than the kerosene lanterns they previously used. User expenses are also reduced as they used to pay about Rs. 2-4/day for kerosene. The 5 Wp lantern cost is approximately Rs. 3500. IREDA has supported similar lantern leasing programs run by companies, foundations and cooperatives. About 40,000 lanterns rated at 5-10 Wp each have been leased with support from this project through various intermediaries.

Sagar Island Solar PV Village Electrification. The West Bengal Renewable Energy Development Agency obtained financing under this project and installed 3x23 kWp mini-grid PV systems in Sagar Island, West Bengal to meet the power needs of communities living in this environmentally sensitive area of the Sundarbans The system provides power to 350-400 households for lighting, television, fans etc and the households pay Rs. 8 kWh (\$0.18 kWh), higher than tariffs paid by grid-supplied customers in West Bengal. Commissioned in 1998, the system cost Rs. 10 million. Unit cost of the system is about \$11.50 (Year 2000 dollars). Based on the success of this first project, three more 25 kWp systems were commissioned in Sagar Island. The second project commissioned in 1999 cost Rs. 8.7 million (\$8/Wp in Year 2000 dollars), a 30 percent cost reduction.

Leasing of Grid-tied Solar PV Power Packs. NPR Finance Ltd. is a non-bank financial institution engaged in hire purchase and leasing of equipment. They obtained financing from IREDA to procure and lease 103 solar power packs, each 400 Wp capacity with a 48V, 180 Ah battery for a variety of applications. These have been leased to hospitals, educational institutes, transport companies, private companies and for domestic uses. These systems are even used in electrified areas to help users protect their critical appliances during power outages or fluctuations. Based on the success of this project, three more projects promoted by different intermediaries have been supported by IREDA. The unit cost of the first project was over $20/Wp. The unit costs of the subsequent projects have come down substantially to under $10/Wp.



Solar PV Irrigation Pumps Leasing. Nagarjuna Finance availed of credit from IREDA and leased 85 solar PV pumps to farmers in Andhra Pradesh. These farmers who originally were dependent on rain fed agriculture have seen their incomes increase five fold, according to a survey done by NABARD. These 900 Wp pumps are used in open wells with heads of less than 10 meters and can irrigate 1.2 to 2 hectares. Taking advantage of the tax incentives available and a grant of Rs. 55,000 from state agencies, the lease fee to the farmers is a one-time Rs.30,000 payment, or about 10% of the cost of the pumping system. The pump supplier, Polyene Films Ltd. trains the farmers and provides maintenance support. The company notes that these pumps reduce the pressure on the SEBs to provide grid supply to irrigation pumps and avoid an incremental investment cost of Rs. 160,000 per pump. In addition to the 85 pumps financed under this project, in parallel, IREDA financed another 4400 solar PV pumps with support from MNES.

HDFC Bank Grid tied Solar PV System The HDFC Bank installed a 75 kWp grid interactive power plant in their Bank building located in Mumbai. It provides power for their computer operations and lighting It includes a battery bank to provide backup power during power cuts Based on the success of this project, the HDFC Bank installed several more such systems in their branch offices Total project cost was Rs 27.7 million (\$ 670,000 year 2000 dollars) or about \$9 Wp. installed The project was commissioned in 1998.