Indian Renewable Energy Development Agency Limited
Republic of India

Preparatory Study for Renewable Energy and Energy Efficiency Project for India

FINAL REPORT

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JAPAN INTERNATIONAL COOPERATION AGENCY

The Japan Economic Research Institute Inc.

Contents

Abbreviations and Acronyms

ACC	Associated Cement Company Ltd
ADB	Asia Development Bank
AFD	Agence Française de Développement
APP	The Asia-Pacific Partnership on Clean Development and Climate
APPCB	Andhra Pradesh Pollution Control Board
BDA	Business Development Associate
BEE	Bureau for Energy Efficiency
CCT	Clean Coal Technology
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CDQ	Coke dry quenching equipment
CER	Certified Emissions Reduction
CGTMSE	Credit Guarantee Fund Trust for Micro and Small Enterprises
CII	Confederation of Indian Industry
CIL	Coal India Limited
CPCB	Central Pollution Control Board
CRAR	Capital to Risk Asset Ratio
C-WET	Center for Wind Energy Technology
DANIDA	Danish International Development Agency
DBJ	Development Bank of Japan
DOE	Designated Operational Entity
DRI	Direct Reduced Iron
DSCR	Debt Service Coverage Ratio
DSM	Demand Side Management
EAC	Environmental Appraisal Committee
EC	Environmental Clearance
EC	Energy Conservation
ECCJ	The Energy Conservation Center, Japan
ECX	European Climate Exchange
EE	Energy Efficiency
EEC	Energy Efficiency and Conservation
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environment Management Plan
ERPA	Emission Reduction Purchase Agreement
ESCO	Energy Services Company
ESP	Electro Static Precipitator
FI	Financial Institution
FICCI	Federation of India Chambers of Commerce and Industry
FIRR	Financial Internal Rate of Return
GEF	Global Environment Facility

GHG	Greenhouse Gas
GMP	Good Manufacturing Practice
HS	Hot Stove
HUDCO	Housing and Urban Development Corporation
IDBI	Industrial Development Bank of India
IGCC	Integrated coal Gasification Combined Cycle
IIT	Indian Institute of Technology
IREDA	Indian Renewable Energy Development Agency
ISTSL	India SME Technology Services Ltd.
JASE-World	Japanese Business Alliance for Smart Energy Worldwide
JBIC	Japan Bank for International Cooperation
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JSPL	Jindal Steel & Power Ltd.
KfW	Kreditanstalt für Wiederaufbau (German Reconstruction Credit Institute)
LPC	Local Productivity Council
MNES	Ministry of Non-Conventional Energy Sources
MNRE	Ministry of New and Renewable Energy
MoC	Ministry of Coal
MOEF	Ministry of Environmental Forest
MoP	Ministry of Power
MoPNG	Ministry of Petroleum and Natural Gas
MOUD	Ministry of Urban Development
MSME	Ministry of Micro, Small and Medium Enterprises
MSW	Municipal Solid Wastes
NAPCC	National Action Plan on Climate Change
NBFC	Non-Banking Financial Companies
NEDO	New Energy and Industrial Technology Development Organization
NGO	National Governmental Organization
NIB	Nordic Investment Bank
NPA	Nonperforming Asset
NPC	National Productivity Council
NTPC	National Thermal Power Corporation
PCB	Pollution Control Board
PCO	Private Consultancy Organization
PDD	Project Design Document
PEC	Power Electrification Corporation
PFC	Power Finance Corporation
PLR	Prime Lending Rate
PWC	Price Waterhouse Coopers
RBI	Reserve Bank of India
RDF	Refuse Derived Fuel

RE	Renewable Energy
REC	Rural Electrification Corporation
REEC	Regional Energy Efficiency Center
RHF	Reheating furnace
RINL	Rashtriya Ispat Nigam Ltd
RRDP	Renewable Resources Development Project
SAIL	Steel Authority of India Limited
SDC	Swiss Agency for Development and Cooperation
SEAC	State level Expert Appraisal Committee
SEB	State Electricity Board
SEC	Solar Energy Centre
SEIAA	State Environment Impact Assessment Authority
SHP	Small Hydro Power
SIA	Social Impact Assessment
SIDBI	Small Industries Development Bank of India
SME	Small and Medium Enterprise
SNA	State Nodal Agency
SPC	Special Purpose Company
SPCB	State Pollution Control Board
SPV	Solar Photovoltaic Power
SSMF	Social Safeguard Management Framework
STG	Solar Thermal Generator
TA	Technical Assistance
TCO	Technical Consultancy Organization
TI&A	Technical Institutions and Agencies registered under Societies Act
TNPL	Tamilnadu Newsprint and Papers Limited
toe	Ton Oil Equivalent
TRT	Top pressure recovery turbine
TSL	Two Step Loan
ULB	Urban Local Bodies
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
UTPCC	Union Territory Pollution Control Committee
WB	World Bank
WHRS	Waste Heart Recovery System

Chapter 1 Project Background, and Identification of the need for the Project

1-1 Economic and Energy Environment in India

After the liberalization in early 1990, India has been attaining rapid economic growth as a part of BRICs, the growth center of the world. As the consequence, India has become the second largest energy consuming country, following to China. India's overall energy intensity, measured as primary energy consumption per unit of GDP, has declined significantly since 1980, mainly thanks to the growing share of the services sector in GDP, which is less energy-intensive. Improved efficiency of energy use and a changing fuel mix in the industry sector also contributed. However, the primary energy consumption per GDP in 2006 is more than 5.5 times higher than that of Japan, it could be said that there is plenty of room for the energy conservation in the Indian market.

Table 1-A World Energy Intensity –Total Primary Energy Consumption per Dollar of GDP (using market exchange rates) (Btu per (2000) USD)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
India	28,778	28,316	27,106	25,810	25,927	24,961	24,616
Japan	4,805	4,756	4,725	4,656	4,653	4,566	4,467

Source: Energy Information Administration (EIA), "International Energy Annual 2006"[1]

The average GDP growth rate for India from 2005 to 2030 is projected to be 5.8%, which exceeds the world average of 4.0%. The shares of primary energy consumption and CO_2 emission to the world are estimated to be increased, from 3.5% (2005) to 4.8% (average annual rate for 2026-2030), and 4.1% (2005) to 5.3% (average annual rate for 2026-2030), respectively.

Table 1-B World Gross Domestic Product (GDP) by Region (in PPP)

	Actual	Projections（Average per annum during the designated period）					
	2005	2006-2010	2010-2015	2016-2020	2021-2025	2026-2030	2005-2030
India	**9.2**	**8.5**	**6.8**	**5.4**	**4.3**	**3.9**	**5.8**
China	10.4	10.2	6.6	5.6	5.0	4.5	6.4
Japan	1.9	1.9	1.3	0.8	0.6	0.6	1.1
USA	3.1	2.5	2.7	2.4	2.3	2.4	2.5
OECD Europe	2.2	2.8	2.3	2.2	2.1	2.0	2.3
Total World	4.9	5.1	4.2	3.7	3.5	3.3	4.0

Source: Energy Information Administration, "International Energy Outlook 2008"

[1] http://www.eia.doe.gov/pub/international/iealf/tablee1g.xls

Table 1-C Projections for Indian Primary Energy Consumption and CO_2 Emissions

	Actual (% / Total World)	Projections (% / Total World)					Average Annual Percent Change
	2005	2006-2010	2010-2015	2016-2020	2021-2025	2026-2030	2005-2030
Primary Energy Consumption	3.5	3.8	4.1	4.4	4.6	4.8	2.9
World Carbon Dioxide Emissions	4.1	4.3	4.7	4.9	5.1	5.3	2.6

Source: Energy Information Administration, "International Energy Outlook 2008"

Due to the advancement of the industries, accompanied its rapid economic expansion, rising population, and a quest for improved quality of life, International Energy Agency (IEA) projected that the primary energy demand for India will be growing on average by 3.6% per year till 2030, which results in more than doubling the current energy demand[2].

Increasing pressure of population and increasing use of energy in different sectors of the economy is an area of concern for India. With a targeted GDP growth rate of 9% during the Eleventh Five-year Plan from 2007 to 2012, the Government set the target to increase the energy generation capacity at 9% per annum for the same period. While it is essential to add new power generation capacity to meet nation's growing energy requirement, it is equally important to reduce energy demand by enhancing energy efficiency and conservation efforts in order to avoid the energy market to become overstrained.

Currently, India is heavily dependent on coal as their energy source, which accounts for 40% of primary energy demand[3], and 53% for the electricity output. In order to sustain India's rapid economic growth, coal is expected to be remaining as an important source of generation[4] in the 11th 5-year plan of Government of India. At the same time, it is said that the future energy infrastructure investment decisions in India will have long-term impacts on global GHG emissions.

[2] Source: IEA, World Energy Outlook 2007, http://www.iea.org/textbase/nppdf/free/2007/weo_2007.pdf
[3] Source: IEA, World Energy Outlook 2007, http://www.iea.org/textbase/nppdf/free/2007/weo_2007.pdf
[4] According to 11th 5-year plan, India's annual coal consumption is projected to increase from 460 million tonnes in 2006-07 to 730 million tonnes by the terminal year 2011-12 of the 11th Five Year Plan. It will further increase to 1,125 million tonnes in 2016-17, 1,600 million tonnes in 2026-27 and over 2,000 million tonnes in 2031-2032.

Table 1-D Installed Generation Capacity（As of April 30, 2009）

(Unit: MW)

	Thermal				Nuclear	Hydro (Renewable)	Renewable*	Grand Total
	Coal	Gas	Diesel	Total				
State	42,537.5	3,672.1	602.6	46,812.2	0.0	27,055.8	2,247.7	76,115.7
Private	5,791.4	4,565.5	597.1	10,954.0	0.0	1,230.0	10,994.7	23,178.8
Central	29,620.0	6,639.0	0.0	36,259.0	4,120.0	8,592.0	0.0	48,971.0
Total	77,948.9	14,876.6	1,199.8	94,025.2	4,120.0	36,877.8	13,242.4	148,265.4
(% of Total)	52.6	10.0	0.8	63.4	2.8	24.9	8.9	100.0

Source: Ministry of Power, India
http://cea.nic.in/power_sec_reports/Executive_Summary/2009_04/27-33.pdf

India currently imports about 70% of its oil requirements, and it is estimated that India would become the fourth largest net importer of oil in the world by 2025, behind the United States, China, and Japan by the Energy Information Administration（EIA）[5]. Currently, about 70% of India's oil imports are coming from Middle Eastern countries - however, due to the vulnerability of the energy price in the recent years, and the political instability of the Middle East, India has been trying to reduce the oil dependence on that region, and also concerning to keep depending only on the conventional energy sources.

On the other hand, the renewable energy utilizes inexhaustible and domestic natural resources such as solar light, hydraulic power, and force of wind. As the investments for renewable energy facilities in India are the important investment from long-term perspective, to explore domestic supply options to attain energy self-sufficiency, it is imperative to increase its share from the viewpoint of Indian energy security, stable energy supply, self-independent economic development, and reduction of greenhouse gas emissions.

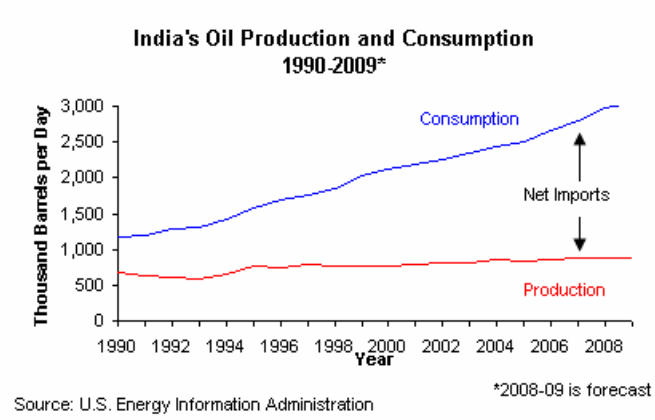

Figure 1-A India's Oil Production and Consumption

[5] http://www.eia.doe.gov/emeu/cabs/India/Oil.html

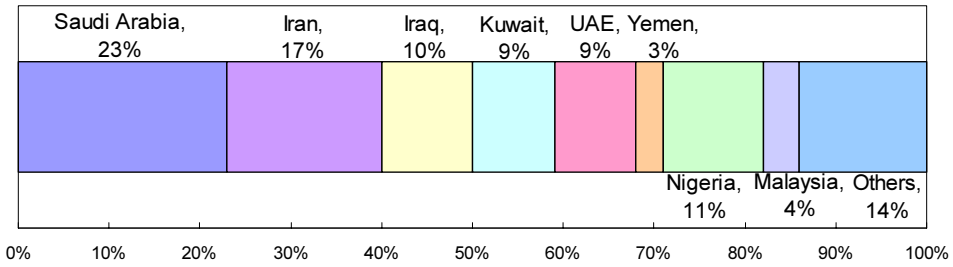

Figure 1-B India's Crude Oil Imports by Source, 2007

Source: World Trade Atlas

1-2 Policy Analysis in the area of Renewable Energy and Energy Efficient and Conservation of the Government of India

In its five-year plan which the economy of India will be based, the Government of India addresses the environmental and energy related issues with relevant numerical targets, especially since 10th five-year plan (targeted period : April 2002 to March 2007), in order to attain poverty eradication and to achieve sustainable economic development.

In the 11th five-year plan (targeted period: April 2007 to March 2012), the Government of India laid out its capacity addition plan of 78,577MW as in the following two tables, in order to ensure a staple supply of energy, and to preserve the environment. At the end of 12th five -year Plan (2012 to 2017), further addition of 82,200 MW[6] in the generating capacity has been envisaged to deal with peak power demand.

In the 11th five-year plan, it is analyzed that the development of power sources from renewable energy (RE) remains low even though there remains much rooms for the potential development.

Table 1-E India's Oil Production and Consumption

(in MW)

	Central	State	Private	Total
Projects commissioned (as on 18 October 2007)	1,360	1,350	250	2,960
Projects under construction	28,765	16,342	7,378	52,485
New Projects	9,740	10,260	3,132	23,132
Total	39,865	27,952	10,760	78,577

Source: 11th five-year plan, Central Electricity Authority and Planning Commission[7]

[6] Includes 40,200 MW coal based generation.

[7] http://planningcommission.nic.in/plans/planrel/fiveyr/11th/11_v3/11v3_ch10.pdf

Table 1-F Sector-wise, Mode-wise, Capacity Addition during the Eleventh Plan

(in MW)

Source	Central	State	Private	Total
Hydro	9,685	3,605	3,263	16,553
Thermal	26,800	24,347	7,497	58,644
Nuclear	3,380	0	0	3,380
Total	39,865	27,952	10,760	78,577

Note: Of Thermal generation, coal-based generation accounts for 52,905MW.
Source: 11th five-year plan, Central Electricity Authority and Planning Commission[8]

With the growing concern for India's energy security and securing energy self-sufficiency, the role of new and renewable energy has increased its significance in recent years. In response, the Government of India changed the name of Ministry of Non-Conventional Energy Sources to Ministry of New and Renewable Energy (MNRE) in October 2006, to strengthen its function to develop and deploy new and renewable energy for supplementing the energy requirement of the country.

In the 11th Plan Proposals for New and Renewable Energy prepared in December 2006, MNRE suggested that the aim of power generation installed capacity from renewable sources is at least 10%, with 4-5% share in the electricity mix, by the end of the 11th plan. As in the table above (titled "Sector-wise, Mode-wise, Capacity Addition during the Eleventh Plan"), 16,600MW of the total capacity addition plan is expected to come from the hydropower generation. In the 11th Plan, the Government of India also set the separate numerical goal of the capacity addition of 14,000MW from the wind and renewable resources, to correspond with the sharp increase of the domestic demand.

Table 1-G Generating Capacity Anticipated at the End of the Eleventh Plan

(in MW)

	Hydro	Thermal	Nuclear	Wind and Renewables	Total
Installed Capacity as on 31 March 2007	34,653.77	86,014.84	3,900.00	7,760.60	132,329.21
Addition during Eleventh Plan	16,553.00	58,644.00	3,380.00	14,000.00	92,577.00
Total Capacity Anticipated as on 31 March 2012	51,206.77	144,658.84	7,280.00	21,760.60	224,906.21

Source: 11th five-year plan, Central Electricity Authority and Planning Commission[9]

[8] http://planningcommission.nic.in/plans/planrel/fiveyr/11th/11_v3/11v3_ch10.pdf
[9] http://planningcommission.nic.in/plans/planrel/fiveyr/11th/11_v3/11v3_ch10.pdf

In order to reduce their vulnerability of the impacts of climate change, the National Action Plan on Climate Change (NAPCC) was released by Dr. Manmohan Singh, the Prime Minister of India on 30th June 2008. It outlines a national strategy that aims to enable the country adapt to climate change and enhances the ecological sustainability of India's development path, which includes eight national missions, representing long-term and integrated strategies to achieve key goals in the context of climate change till 2017.

<Eight National Missions>

- National Solar Mission,
- National Mission on Enhanced Energy Efficiency,
- National Mission on Sustainable Habitat,
- National Water Mission,
- National Mission for Sustaining the Himalayan Eco-system,
- National Mission for a Green India,
- National Mission for Sustainable Agriculture and
- National Mission on Strategic Knowledge for Climate Change.

Of which, the details on National Solar Mission and the National Mission on Enhanced Energy Efficiency, which are relevant to this JICA study, are as follows[10]:

- The National Solar Mission

  The National Solar Mission aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes:

  (i) Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments;
  (ii) A goal of increasing production of photovoltaics to 1000 MW/year; and
  (iii) A goal of deploying at least 1000 MW of solar thermal power generation.

  Other objectives include the establishment of a solar research center, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

[10]Source: PEW centre for Global Climate Change, Website (http://www.pewclimate.org/international/country-policies/india-climate-plan-summary/06-2008)
Prime Minister of India, Website (http://pmindia.nic.in/Pg01-52.pdf)

- National Mission for Enhanced Energy Efficiency

  Current initiatives are expected to yield savings of 10,000 MW by 2012. Building on the Energy Conservation Act 2001, the plan recommends:

  (i) A market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.

  (ii) Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.

  (iii) Creation of mechanism that would help finance demand side management programmes in all sectors by capturing future energy savings.

  (iv) Developing fiscal instruments to promote energy efficiency

1-3 Partnership of Energy Related Policy between Government of Japan and Government of India

To make the strategic use of Japanese experiences and knowledge in the energy efficiency and conservation (EEC) field, the Japanese government decided to implement the cooperation focusing on the energy efficiency and conservation to China and India at the third Overseas Economic Cooperation Council held in August 2006. In addition to that, the Japanese government announced its comprehensive assistance on energy, including the support for the development and implementation of the legal framework of EEC, through the establishment of Asian Energy Conservation Program and promotion, or support for promoting new energy sources in the New National Energy Strategy announced by Ministry of Economy, Trade and Industry (METI), in order to strengthen EEC cooperation with Asian countries in the future.

In addition to that, based on the agreement made at the Toyako summit in July 2008, focused on the issues on environment and climate change, Japanese government has extending its assistances for climate control related projects, such as to improve energy efficiency and environment conservation, as one of their priority assistance areas to India.

In addition to that, in order to conduct comprehensive discussion on energy related issues between Japan and India, the Japan-India Energy Dialogue was launched in April 2007 – to date, 4 meetings have taken place.

At the 3rd meeting held on September 2008, it was agreed to strengthen the cooperation in the energy efficiency and conservation and the renewable energy sector.
In this regard, the Government of Japan suggested extending its assistance for 1) the operation

of the Energy Efficiency Centre to be established by the Government of India to promote energy efficiency on a national basis, 2) the continuation of New Energy and Industrial Technology Development Organization (NEDO)'s "energy conservation diagnoses" programme in the steel and cement sectors, part of an Asia-Pacific Partnership on Clean Development and Climate (APP)[11] projects, to identify possible areas to improve energy efficiency in these sectors, 3) the technical training programme provided by JICA to foster Indian energy managers. The Government of India, on the other hand, suggested promoting wider deployment of these energy-efficient technologies through the international energy consumption conservation model project by NEDO[12].

At the working groups for the 4th Japan-India Energy Dialogue held in March 2009 in Delhi, India side asked to continue supporting and developing ongoing projects, to promote transferring the training programs to the EEC training facilities (such as boiler and pump) supported by NEDO at National Productivity Council (NPC) in Chennai, as well as the future cooperation at other regional energy efficiency centre which plans to build heat pump and thermal storage facilities.

For the renewable energy sector, the Indian side showed their interest for the possible project development for the small-scale power generation, based on the "Power for All by 2012" policy being promoted by the Rural Electricity Supply Technology (REST) mission at Ministry of Power, which targets 100% rural electrification in India.

On top of this, as a part of the activities of APP's Renewable Energy and Distributed Generation Task Force, NEDO is going to start the demonstration experiment for solar power generation system till August 2009, and NEDO shows its intention to extend its further support if Indian side wants to expand into the off- and on-grid solar power generation business. Furthermore, NEDO and relevant Indian entities are going to start the discussions to conduct joint research and development on the technical evaluation for the life of solar cell, and the possible cooperation for the development of renewable energy sources such as solar energy and biofuels.

[11] The Asia-Pacific Partnership on Clean Development and Climate (APP), founded in 2005, is a voluntary partnership among seven major Asia-Pacific countries (Australia, Canada, China, India, Japan, Korea, and the United States) which consumes more than half of the world energy, which are cooperating in an effort to address increased energy needs and the associated issues including energy security and climate change. Japan chairs steel task force which India sub-chairs with, and cement task force.

[12] India is a priority country for NEDO's model projects. So far, NEDO conducted 4 International Projects for Increasing the Efficient Use of Energy, and 1 International Coal Utilization Projects.

Figure 1-C Power for ALL by 2012

The Government of India has an ambitious mission of POWER FOR ALL BY 2012. This mission would require that our installed generation capacity should be at least 200,000 MW by 2012 from the present level of 144,564.97 MW. Power requirement will double by 2020 to 400,000MW.

Objectives

- Sufficient power to achieve GDP growth rate of 8%
- Reliable power
- Quality power
- Optimum power cost
- Commercial viability of power industry
- Power for all

Strategies

- Power Generation Strategy with focus on low cost generation, optimization of capacity utilization, controlling the input cost, optimisation of fuel mix, Technology upgradation and utilization of Non Conventional energy sources
- Transmission Strategy with focus on development of National Grid including Interstate connections, Technology upgradation & optimization of transmission cost.
- Distribution strategy to achieve Distribution Reforms with focus on System upgradation, loss reduction, theft control, consumer service orientation, quality power supply commercialization, Decentralized distributed generation and supply for rural areas.
- Regulation Strategy aimed at protecting Consumer interests and making the sector commercially viable.
- Financing Strategy to generate resources for required growth of the power sector.
- Conservation Strategy to optimise the utilization of electricity with focus on Demand Side management, Load management and Technology upgradation to provide energy efficient equipment / gadgets.
- Communication Strategy for political consensus with media support to enhance the genera; public awareness.

Rural electrification

Jharkhand, Bihar, Uttar Pradesh, Orissa, Uttranchal, West Bengal etc are some of the states where significant number (more than 10%) of villages are yet to be electrified.

- Number of Villages (1991 Census) - 593,732
- Villages Electrified (30 May 2006) - 488,173
- Village level Electrification % - 82.2%

Source: Ministry of Power (http://www.powermin.nic.in/indian_electricity_scenario/power_for_all_target.htm,, etc

Currently, the industrial sector consumes almost half of the total commercial energy available in India. Of which, 70% is said to be consumed by the energy-intensive sectors including fertilizers, aluminum, textiles, cement, iron, steel and paper. In formulating the ODA yen concessional loan which JICA intends to provide based on the result of this study, it would be appropriate for putting emphasis on the steel and cement sectors based on APP's action plans set by the steel and cement task forces which the Japanese government chairs. In addition to that, the coal sector which India serves as a vice-chairman at APP, will also be appropriate as one of the priority sectors, to further disseminate clean coal technology, which is one of the NEDO's model projects that Japan has the world's highest standards.

Table 1-H Electricity Consumption in India by Sector (2005)

Sectors	Gigawatt-Hour (GWh)	Percent
Industry	210,040	43.9
Residential	103,368	21.6
Agriculture	95,685	20.0
Commercial	34,761	7.3
Transport	10,424	2.2
Others	23,659	5.0
Total	477,937	100.0

Source: International Energy Agency, 2005

In addition to that, this study analyzes the targeted areas and project details to support the development of RE and EEC activities, from the perspective of providing comprehensive support from relevant Japanese government entities including NEDO and JETRO, by making use of NEDO and JETRO's ongoing/past activities in India.

Table 1-I NEDO Model Projects in India

International Projects for Increasing the Efficient Use of Energy

Clean Coal Energy Verification and Demonstration Projects

Project Name	Counterpart	Implementation Site	Term
International Projects for Increasing the Efficient Use of Energy			
The Model Project for Utilization of Sensible Heat from Blast Furnace Hot Stove Waste Gas	Department of Economic Affairs, Ministry of Finance /Ministry of Steel	Tata Iron and Steel Co., Ltd.	2001～2003
The Model Project for Waste Heat Recovery System of Cement Plant	Department of Economic Affairs, Ministry of Finance /Ministry of Commerce and Industry	The India Cements Limited	2001～2004
The Model Project for Increasing the Efficient Use of Energy Using a Coke Dry Quenching System (CDM)	Department of Economic Affairs, Ministry of Finance /Ministry of Steel	Tata Steel Limited	2006～2009
The Model Project for Converting a Diesel Generator to Dual-Fuel Operation	Department of Economic Affairs, Ministry of Finance /Ministry of Power	TATA Motors Ltd.	2008 ～2009
The Model Project for Sinter Cooler Waste Heat Recovery	Department of Economic Affairs, Ministry of Finance /Ministry of Steel	RINL/VIZAG Steel Plant	2009 ～2011
The Model Project for Bagasse Ethanol Production at the Sugar Factory	(Feasibility Study now underway)		-
Clean Coal Energy Verification and Demonstration Projects			
The Model Project for Highly Efficient Coal Preparation Technology	Department of Economic Affairs, Ministry of Finance /Ministry of Coal	Monnet Ispat & Energy Limited	2008 ～2011

Source：NEDO Website（ http://www.nedo.go.jp/kankobutsu/pamphlets/kokusai/nedo_english2008.pdf, etc）

1-4 Financial Environment for the Projects of Renewable Energy, Energy Efficiency and Conservation in India

The Government of India set up an independent financing institution in 1987, called Indian Renewable Energy Development Agency (IREDA) as a public sector undertaking for providing institutional finance exclusively in the field of renewables and energy efficiency. IREDA entered the market when lending to the renewables sector was considered a high risk and low profit business. Through the finance received by the international donor agencies including the World Bank, ADB, KfW etc, IREDA has implemented the renewal energy projects and supported the commercialization of those projects, as well as conducted energy efficiency and conservation projects.

Small Industries Development Bank of India (SIDBI) has also been extending loans for financing energy saving and environmental-friendly projects for micro, small and medium enterprises, through the ODA assistance from KfW and JICA[13].

In addition to that, several commercial banks have also implemented several SME EE financing mechanisms in India, such as the State Bank of India under the Project Uptech, a cluster lending strategy[14], which was followed by several banks including Canara Bank, Union Bank of India, Bank of India, Bank of Baroda, ICICI and Yes Bank under their respective EE schemes in order to facilitate their cluster lending for SMEs[15].

The success of IREDA aimed for the commercialization of the renewable energy projects enabled some wind power and small-hydro project entities to borrow from the commercial conventional loans. For the EEC projects, the bigger companies in the steel and coal sectors which this study targets at, are able to raise funds directly from the market or from the commercial banks without any difficulties. Based on these facts, the targets of prospective Japanese ODA Loan should be scrutinized to determine the areas which have limited financial access due to the lack of project commercialization, but requires adequate official support.

[13] JICA signed loan agreement with SIDBI in November, 2008, for the Micro, Small and Medium Enterprises Energy Saving Project. The total amount is 30,000 million Yen, with annual interest of 0.3%. The repayment period will be 15 years, including 5-year grace period.

[14] Cluster lending refers to lending operations targeted at industries that share economic interests or policy concerns. Cluster lending programs support investments that (i) increase SME competitiveness through the upgrading of technologies, (ii) decrease operational and production costs through reduced wastage and increased efficiencies, (iii) increase productivity, or (iv) improve product mix.

[15] Lending to SMEs is a government-mandated priority for Indian banks, which reflects the government's view that SME play a critical role in generating economic growth, employment, and exports.

1-5 The Role of Prospective Japanese ODA Loan

Based on the detailed analysis of the relevant policies on renewable energy and energy efficiency and conservation by the Government of India and the policy assistance by Japanese government, and the result of the interview surveys to JICA, IREDA, relevant Indian government entities, the JICA study team confirmed that the necessity and priority of the prospective Japanese ODA Loan as follows;

1-5-1 Necessity

One of the Japanese government's priority assistance area to India is to improve energy efficiency and to facilitate environment conservation. In this connection, the Japanese government has provided several measures to India including organization of Japan-India Energy Dialogue or through the activities of APP, and assistances from NEDO and JICA to strengthen the cooperation in the energy efficiency and conservation and the renewable energy sector as explained above.

In order to facilitate the existing Japanese assistance to India, and to further support the policy on India's energy security, securing energy self-efficiency and to mitigate the impact to the global climate change, the prospective Japanese ODA Loan should be used for India to help attain their policy targets as outlined in the "Power for All" policy, 11th plan for New and Renewable Energy and the National Action Plan on Climate Change.

1-5-2 Priority

Eligible subprojects for the Japanese ODA Loan will be suggested as follows;

(1) **Energy Efficiency and Conservation**

Considering the policy supports on EEC field extended by Japanese and Indian governments, and considering the prospective Japanese ODA Loan will be funded from Japanese ODA account, the eligible subprojects will be identified from the standpoint of following points;

(i) Japanese government's policy collaborations and supports to India

As mentioned above, the Japanese government chairs the Steel Task Force and Cement Task Force, and Indian government co-chairs the Coal Task Force under APP. In this regard, steel, cement, and coal sector will be considered as eligible, and priority subsectors for EEC investment to be supported by the Japanese ODA Loan.

(ii) Technology transfers which Japanese companies are having superiorities

Even though IREDA intends to increase its loan to EEC sector, the portion of EEC loans is not significant. In order for IREDA to facilitate the EEC promotion, it is important for IREDA to enlarge their scope for eligible EEC projects.

So far, through NEDO's model projects, some equipment made by Japanese companies employing superior EEC technologies is proved to be effective to attain EEC in India. In addition to that, there are several Japanese companies having advanced EEC technologies showing their interest to enter into world market including India, and the specs of those equipments as well as EEC effectiveness are complied in a book, titled "Japanese State-of-the Art Smart Energy Products & Technologies" by the JASE – World, which IREDA might refer to, to understand the EEC related technologies and their EEC effects.

(2) **Renewable Energy**

(i) Wind power sub projects

Considering some of the wind power projects are fully commercially viable, Japanese ODA Loan could only be extended for a project with the minimum generation capacity of 5 MW with non-recourse based finance, which IREDA has expertise. In order to facilitate IREDA to expand its new business, Japanese ODA Loan could be also applicable for IREDA's consortium funding for bigger sized wind power sub projects with the generation capacity less than 50 MW.

(ii) Solar power sub projects

Solar power sub projects such as solar photovoltaic and solar thermal power are applicable for Japanese ODA Loan by taking into account of the National Solar Mission in India.

(iii) Small hydro power generation

The Japanese ODA Loan is applicable for the small hydro power sub projects with less than 5 MW generation capacities, subject to the full examination of the environmental and social considerations.

(3) **Financing to ESCO**

Japanese ODA Loan is applicable to expand the activities of ESCO, however, the required high initial investment cost made it difficult for ESCO to apply for the IREDA loan. IREDA agreed to make consultation with Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) so that ESCO can obtain credit guarantee for applying required financing from IREDA. (For the detailed explanation, please find Chapter 9).

(4) Microfinance for the Renewable Energy

Taking into account the size of the sub projects and awareness raising effect through the microfinance for the renewable energy sub projects are applicable for Japanese ODA Loan.

In addition to that, the study also promoted the dialogues and cooperation with the Japanese companies and with the member companies of Japanese Business Alliance for Smart Energy Worldwide (JASE-World)[16] who are aiming to expand relevant businesses in India. The study also discussed the possibilities of facilitating the interactions between the Japanese companies and associations in India, such as PCRA who collaborates with Energy Conservation Center, Japan (ECCJ), and the industry organization such as the Confederation of Indian Industry (CII), Federation of India Chambers of Commerce and Industry (FICCI). (For details, please refer to Chapter 9).

Japan has abundant experiences to promote energy efficiency and conservation through policy-based finance, including the policy-based low-interest finance for energy conservation which Development Bank of Japan (DBJ) started providing soon after the oil shock, which worked as the effective and efficient policy tool, which deployed the list of eligible equipment to help the loan officers who don't necessarily have enough technical knowledge to judge the eligibility for financing the equipments concerned. The list, made by METI, NEDO, and private industrial companies, has been revised time to time with the participation of above entities, so that the list always involves leading technologies. DBJ has also been providing preferential interest rates on financing according to an organization's environmental rating awarded through interview survey. The study suggests the appropriate scheme which will be useful for IREDA to manage the prospective Japanese ODA Loan, by applying Japanese relevant experiences as stated above (Please refer to Chapter 9 for details).

[16] The JICA study team introduced "Japanese State-of-the Art Smart Energy Products & Technologies", the list of technical specifications of member companies' equipments, as a reference of the Japanese leading technologies enable to attain energy efficiency and conservation, compiled by the JASE-World, to IREDA for their perusal to determine the IREDA's targeted area for EEC.

Chapter 2 Verification of the current development in Renewable Energy

Following the requests by IREDA dated December 18, 2008, the two field surveys (21 days: 26 April-16 May, 2009 and 26 days: 7 July-1 August 2009) were conducted regarding the supports by JICA in the field of renewable energy. It has mainly the sub-sectors of wind power generation, small hydropower generation (≦25MW), solar photovoltaic power generation, biomass/bagasse plants, waste to energy. Apart from IREDA, MNRE, PCRA, BEE, REC, SEC and C-WET, and private companies (including industry association, NGO/NPOs) such as PWC, NPC, FICCI, WII, CII and TERI were visited for information exchange.

Status of the targeted sub-sectors

According to MOP and MNRE websites, the total capacity of power generation facility in India was 150,323.41MW as of 30 June 2009. As the capacity of the renewable energy power generation facility (wind, small hydro, biomass/bagasse, solar photovoltaic and dispersed power source) was 14,801.42 MW as of 31 March 2009 and the ratio of the renewable energy to the total capacity of power generation facility is 9.8%. The feasible power generation by renewable energy is estimated as 84,776MW and the ratio to the potential capacity is 17.4%.

2-1 The ratio of renewable energy in power generation capacity by energy source

As listed in Table 2-A, the composition of the total power generation capacity is 52.5*(50.8)% (State sector), 34.0(32.6)% (Central Sector) and 13.5(16.6)% (Private Sector including individuals, IPP (Independent Power Producer)), and State Sectors account for the large parts. *the figures in ( ) are the recalculated ones based on the facility capacity (MW). The slight increase (2,358.0MW) from 31 March 2009 is due to the increase of State Sector (249.0MW) and Private Sector (2,109.0MW).

Table 2-A Sector-wise Installed Capacity of Power Utilities (as of 30 June 2009)

Ownership Sector	Installed Capacity（MW）	Proportion (%)
State Sector	76,364.67	50.8
Central Sector	48,970.99	32.6
Private Sector	24,978.75.	16.6
Total	150,323.41	100.0

(Source: MOP website)

However, the above table (Table 2-A) uses MNRE data of the power generation capacity by renewable energy as of 30 September 2008, therefore the revised chart using Grid-interactive renewable power as of 31 March 2009 (source: MNRE website) is as follows. The total power generation capacity (MW) is estimated to be 151,566.23MW including the increase by 1,242.82MW. This increase is from renewable energy source such as wind energy (486.65MW), small hydropower (85.0MW), biomass grassfire, biomass power (20.0MW) and urban & industrial waste power and cogeneration-bagasse (15.0MW). The share of wind power maintained high followed by small hydropower.

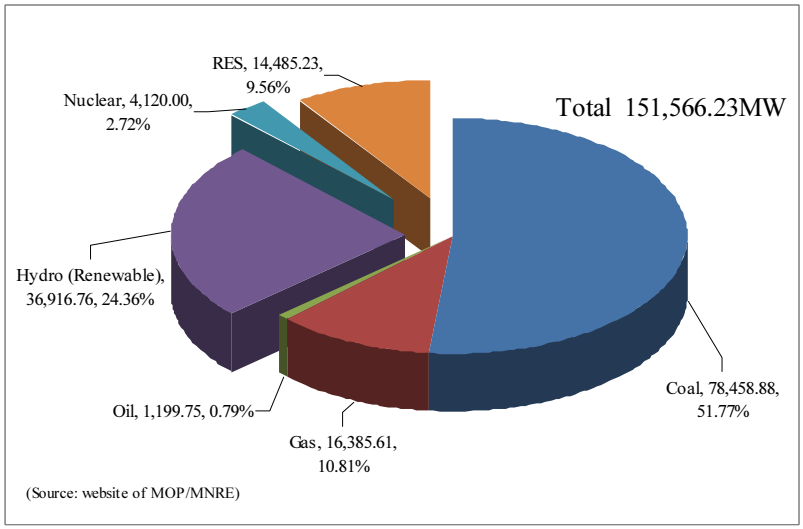

Figure 2-A Installed capacity of Power utility by power source (MW) As of 30 June 2009

Grid-interactive and off-grid of RE are in Figure 2-B and Figure 2-C, respectively.

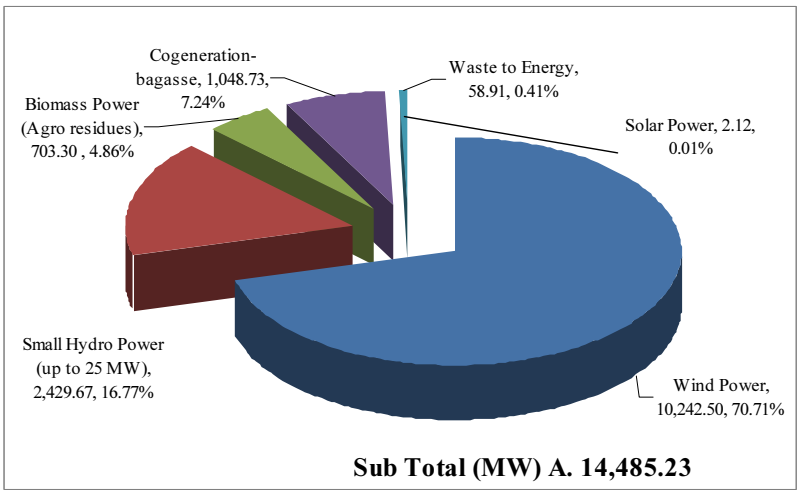

Figure 2-B Grid-interactive renewable power; cumulative achievement up to 31 Mar 2009

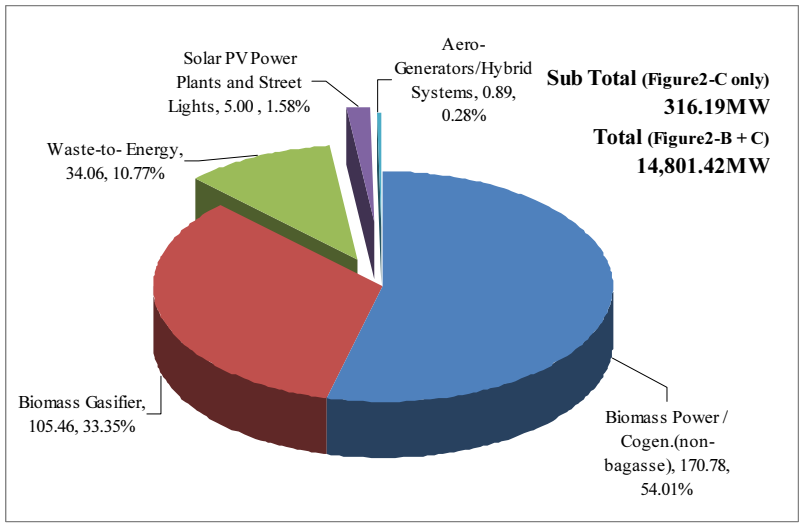

Figure 2-C Off-grid/Distributed Renewable Power (including Captive/CHP Plants); cumulative Achievement up to 31 Mar 2009

The power composition in Japan in FY2005 is in Figure 2-D. There are the big difference between India and Japan.

(i) In Japan, the nuclear power (31%), the coal (26%) and the natural gas (24%) are dominant since it aims to equalize various energy sources based on the energy strategy. On the other hand, the coal based power generation is more than half in India.

(ii) In Japan, the others including renewable energy account for a little while the renewable energy, mainly wind, accounts for about 9.6% in India.

(iii) In India, "Power for All by 2012" is promoted to supply the electricity including off-grid power across India by FY2012. In Japan, the distribution network is in place and the high quality power supply was achieved.

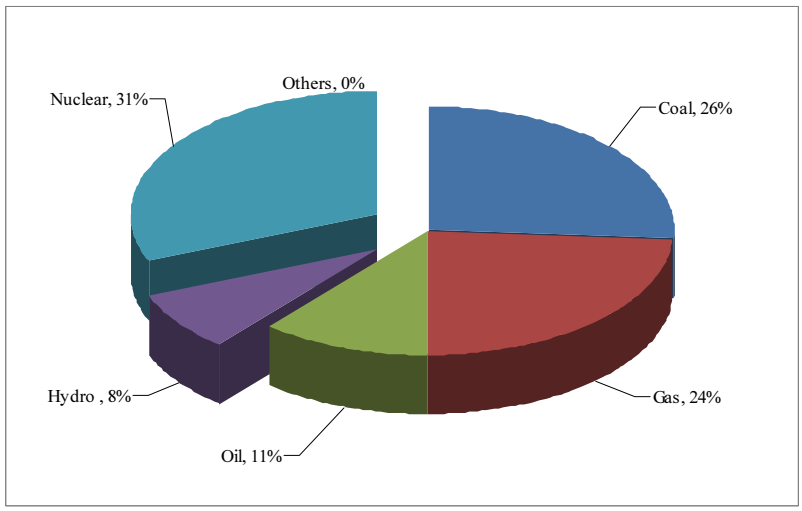

Figure 2-D Power capacity by power source in Japan FY2005

2-2 Wind power generation

Wind power generation program in India started in the end of the Sixth Five Year Plan (1983-84). Receiving the government supports, the current capacity of wind power generation is 10,242.50MW (power generation facility based) as of 31 March 2009, while its potential capacity is 45,195MW. (the current to potential capacity, 22.7%) In the potential capacity by renewable energy power generation, the wind power generation accounts for 53.31%. The large-scale facilities (2MW per facility) are set up as a demonstration project in Sogi in Karnataka and a commercial project in Chettikulam in Tirunelveli Dist Tamil Nadu. As the small-scale facilities, Small Wind Energy and Hybrid Systems (i.e. Water Pumping Windmills, Aero-generators and Wind-Solar Hybrid Systems) are applied and extended to nationwide along with the system development.

In the wind power generation in India, which owns vast land, the domestic companies are also growing based on the effective use of wild land and the current electricity situation: more priority in the quantity than in the quality. One of the domestic companies is Suzlon Energy Limited who is the world's third total engineering company in wind power generation business.

According to Suzlon, the wind power generation business in India considered the technology from Europe as engineering for the first time in the world: Not only to supply power generators on its own, but also to structure the business as total engineering including development of sub-stations to grid-interactive. In addition, the investment in wind power generation business costs Rs. 6 crore/MW and can be recovered in the very short period, 3-6 months, compared with 3-5 years for thermal/hydropower generation. The potential capacity of renewable energy power generation in India is as follows. (Source: documents from REC and CII)

Table 2-B Potential generation capacity of Renewable Energy in India (based on data from REC)

RE source	Potential Generation Capacity (MW)	(%)
Wind Power	45,195	53.31%
Small Hydropower ≦25MW	15,000	17.69%
Biomass Power (Agro-residue + Bagasse)	21,881	25.81%
Urban and Industry Waste	2,700	3.18%
Solar Power	4-7kWh/m^2/Day	
Total	84,776	100.00%

Table 2-C Potential generation capacity of Renewable Energy in India (based on data obtained from CII)

RE source	Potential Generation Capacity (MW)	(%)
Wind Power	45,000	7.11%
Small Hydropower ≦25MW	15,000	2.37%
Biomass Power (agro-residue + Bagasse)	66,000	10.43%
Urban and Industry Waste	7,000	1.11%
Solar Power	500,003	78.99%
Total	633,003	100.00%

Depending on the technological development of solar power generation, the potential capacity of renewable power generation and the leading source (either wind or solar) will differ.

2-2-1 Wind energy potential capacity

(Source: 25 years of Renewable Energy in India)

The chart in the following page is published by C-WET (Center for Wind Energy Technology) in Chennai under MNRE and based on the data from 11 States and 2 Union Territories at 50 meters high. In this chart, Class 1 is colored by white (wind speed below 5.6m/sec and wind power below 200W/m^2), Class 2 is colored by red (wind speed 5.6-6.4 m/sec and wind power 200-300 W/m^2), Class 3 is colored by green (wind speed 6.4-7.0 m/sec and wind power 300-400 W/m^2), Class 4 is colored by orange (wind speed 7.0-7.5 m/sec and wind power 400-500 W/ m^2) and Class 5 is colored by blue (wind speed 7.5-8.0 m/sec and wind power 500-600 W/ m^2). The installable MW for Class 2, 3, 4 and 5 is 43,106, 4,680, 397 and 16 MW, respectively and in total 48,199MW.

According to C-WET, the measurement points were added by 130 and there are 5 points at 120 meters above the ground. Suzlon said that the potential generation capacity will reach 72TW (equivalent to about seven times of the current consumption) at 80 meters high. Hereafter, the generation capacity of wind energy will increase as the possible installation points increase, and the installation method on the ocean will be developed as well. In this process, it can be expected that the demand for Japanese technology for stabilization in the grid-interactive will be increased.

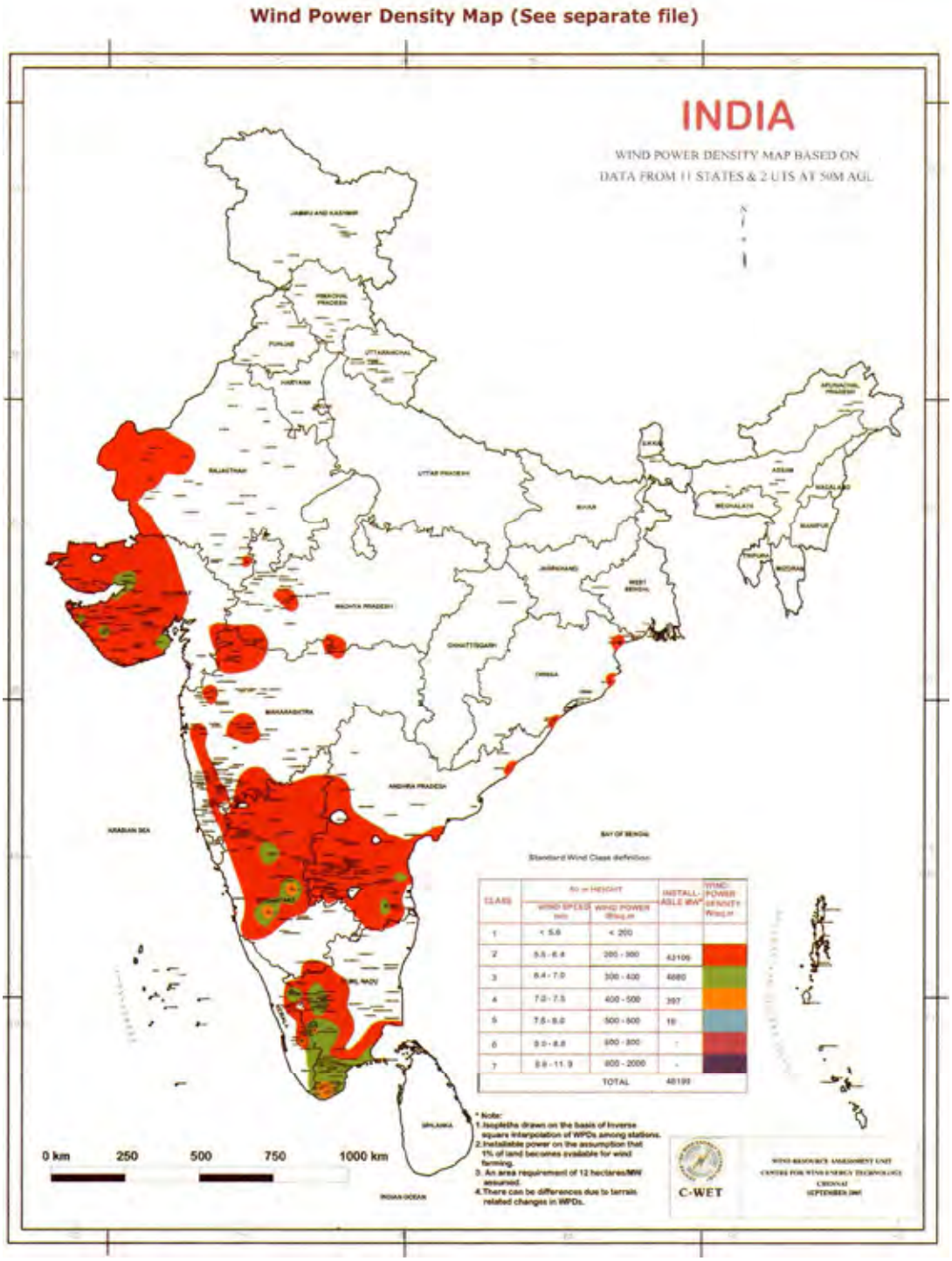

Figure 2-E

2-2-2 Future plan and outlook of wind power generation

In the Eleventh Five Year Plan, the target of wind power generation is 10,500MW and the accumulated value is 97.5% as of 31 March 2009. The wind power generation accounts for the large parts, 70.71%, out of renewable energy source in grid-interactive and will lead in India for

the moment receiving the subsidy by each State government.

Table 2-D Eleventh Five Year Plan (01 Apr 2007 - 31 Mar 2012)

No.	RE Programme Component	Target (MW)	Assistance Amount (crore (10^7) Rs.)
1	Wind Power	10,500	75 *
2	Small Hydropower	1,400	700
3	Co-generation	1,200	600
	Biomass Power	500	200
4	Urban Waste to Energy	200	150
5	Industrial Waste to Energy	200	75
	Sub-total (A)	14,000	1,800
6	Solar Power (Grid-interactive/DRPS)	50	200 **
7	DRPS (excluding Solar)	950	1,900
	Sub-total (B)	1,000	2,100
	RE power generation Total (A+B)	15,000	3,900
8	Performance Testing	-	25
	Total	15,000	3,925

*: To be used for demonstration projects.
**: Subsidy per household is limited to Rs. 50,000.
DRPS: Distributed Renewable Power Systems
(Source: MNRE-Website)

Table 2-E: State-wise policies for Wind Power Projects & Renewable Purchase Standards

	Andhra Pradesh*	Haryana*	Karnataka*	West Bengal	Madhya Pradesh*	Maharashtra*	Rajasthan*	Tamilnadu*	Gujarat*	Kerala*
Wheeling*	2% of energy, in addition to very high transmission charges	2%	2 % of energy	Rs 0.30/u which would be revised time to time	Allowed 2% of energy + transmission charges as per ERC	2% of energy + 5% transmission loss	10% of energy	5% of energy	4% of energy	5% of energy
Banking	12 Months	Allowed	2% per month for 12 Months	6 Months	Not allowed	12 Months	3 Months	5% (12 months)	---	9 Months (Jun.-Feb.)
Buy-back	Rs 3.37/ kwh for FY 2004-05 w.e.f. 1.4.2004, freezed for 5 years	Rs.4.08.unit escalation 1.5% base year 07-08	Rs.3.40/ kwh Fixed for 10 years	To be decided on case to case with a cap of Rs.4/kwh	Rs. 3.97 (with decrease of 7 paisa upto 4th year) then fixed at Rs.3.30/ kwh from 5th year onwards uniformly for 20 years (w.e.f.11.6.2004)	Rs. 3.50/kwh Escalation of Rs 0.15/u per year for 13 years from DOC of the project	Rs.3.59/unit for jaisalmer ,jodhpur etc. and Rs.3.67/unit for other districts (base year 08-09)	Rs. 2.90/ kwh (Levelised)	Rs. 3.37/ kwh fixed for 20 yrs.	Rs.3.14/ kwh fixed for 20 years
Open Access transaction	Allowed under Electricity Act 2003	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
RPS	5% energy, subject to half of 1% of total consumption from wind	06-07 & 07-08 -3% upto 2%	5-10% energy from RE sources	Upto 4% energy from RE sources	0.5% of total consumption from wind	06-07- 3% 07-08- 4% 08-09- 5% 09-10- 6%	06-07-2% 07-08-4% 08-09-5% 09-10-6% 10-11-6.75% 11-12-7.5% from wind	10% of energy from RE	Upto 2% from RE	5% from RE

Indian Government sufficiently gained the technical and operational experience of wind power generation and it is in the stage of the take-off. In addition, the government takes agriculture protection policy, therefore it intends to utilize the wind power generation partly for the supports of socio-economic development. The impacts of wind power generation are expected to be the

direct employment of approximately 90 individuals in the proposed projects, assuming 1 skilled labor and 2 unskilled labors per MW. (According to C-WET, 6 skilled labors are necessary for the actual operation.) In terms of the reduction of the environmental burden, the annual possible reductions[17] are estimated as follows: SO_2 90,000-128,000 tons, NOx 45,000-109,000 tons, total suspended particles 6,400-12,800 m ton and CO_2 22M tons against the potential wind power generation installation of 45,195 MW.

2-3 Small Hydropower generation (≦25MW)

India has approximately 110 year history of hydropower generation since the small hydropower generation (130kW) in 1897. Hydropower generation is considered as one of renewable energy sources. The energy cost per 1kWh by small hydropower generation is 1 / 250 or below of the costs by the coal or oil power generation, 1 / 125 or below of uranium power generation and 1 / 50 or below of natural gas power generation. The small hydropower generation projects are the powerful tools for CDM[18].

The categories of hydropower generation in India are as follows:

Table 2-F

Class	MW
Large Hydro Power (LHP)	LHP > 50
Medium Hydro Power (MHP)	25 < MHP ≦ 50
Small Hydro Power (SHP)	2.0 < SHP ≦ 25
Mini Hydro Power (MinHP)	0.1 < MiniHP ≦ 2.0
Micro Hydro Power (MicroHP)	MicroHP ≦ 0.1

The current small hydropower installation is 2,429.67MW (current to potential ratio: 16.2%) as of 31 March 2009 against the potential installation of 15,000MW. The feasibility of hydropower generation projects significantly depends on the locations due to geophysics, limnology, geology and accessibility. While the energy costs by the small hydropower project are relatively low: Rs. 1.5-3.5/kWhr, the project costs per MW of small hydropower generation are relatively high: about Rs. 50-80 millions. This main reason is that the investment costs of hydropower generation largely differ depending on the location of the power generation. In addition, the construction of the transmission grid to the power load center located far from the power sources, requires the large investment. In this regard, the finance is also the issue in hydropower generation.

[17] Source: "JBIC Line of Credit to IREDA-Identification of suitable sub-sectors eligible for ODA funding" (p.6)
[18] Source: 25 years of Renewable Energy in India-P.162

2-3-1 Small hydropower generation potential

(Source: 25 years of Renewable Energy in India)

Receiving the supports by the State government and MNRE, Alternate Hydro Energy Centre (AHEC) in IIT (India Institute of Technology), Roorkee is building the database of small hydropower generation. According to this, there are 5,403 locations and the potential is 14,294.24MW.

2-3-2 The future plan and outlook of small hydropower generation

In the Eleventh Five Year Plan, the target of small hydropower generation is 1,400MW and the current accumulated value reached 173.5% as of 31 March 2009. The small hydropower generation accounts for 16.9% after the wind power generation in the grid-interactive renewable energy source. The amount of the assistance of hydropower is the highest, which is Rs. 700 Crore (10^7) (38.9%). The hydropower is the important one among the stable energy sources.

The installations applied in the small hydropower generation related projects are required to follow IEC (International Electrotechnical Commission) and IS (Indian Standards). The domestic production capacity of small hydropower generating facilities in India is about 250MW annually. In addition, there are five manufacturers of micro hydropower generation and waterwheel facilities. Regarding manufacturing of small hydropower generating facilities, the collaboration between the local and Western companies is ongoing. In respect to the ones with Japanese companies, Fuji Electric and Hitachi with BHEL, Bhopal and Ebara with Kirloskar, Pune are in cooperation.

Indian government promotes the small hydropower generation by setting up 124 installations, equivalent to the total capacity of 245MW, as the State sector projects in 21 States and Union Territories. It is said that the commercial projects has the potential capacity of more than 2,300MW in 15 States, but 64 commercial projects with 251.20MW capacity in total are implemented.

After the successful demonstration of waterwheel by UNDP-GEF Hilly Hydro Project in India, the comprehensive approaches such as the technical development, formulation of systems including simulation and trainings are promoted 17 demonstration projects are implemented and 500 waterwheel generators are installed and implemented in the local participation approach in Uttarakhand State.

2-4 Solar Power Generation

(Source: 25 years of Renewable Energy in India)

India is an ideal location to use solar radiant energy as it is located in the Sunbelt in the vicinity of the equator. In 1954, National Physical Laboratory in Delhi developed a solar cooker which is based on hotbox type solar cooker developed in Switzerland in 1776. From solar energy, SPV can be utilized as well as heats. Solar power use in India is in steady progress in the last 25 years.

MNRE conducts variety of the programs in order for the system and equipment using sun energy to be utilized among citizen, commercial, organizational and industrial sectors. As a result, more than 1.4 million SPV systems, solar water heating systems which produce about 2 million m^2, 7,000 solar pumps and 617 thousands of the solar cookers are installed and they contribute to the reduction of power consumption, which could have been ordinarily used.

The current status of solar power generation in India is 2.12MW (grid-interactive) and 5MW (off-grid) in terms of the installation capacity as of 31 March 2009 against the potential capacity of 20MW/ km^2 and the target of the Eleventh Five Year Plan of 50MW (14.2%: achievement rate) and still in the stage of development.

2-4-1 Solar power generation potential

The annual clear days in India are between 250 and 300 days and India receives approximately 5 peta kWh / year of solar radiant energy. The average insolation in all over India is about 5.5kWh/m^2 per day and the required power in all over India by 2030 is 1% of insolation in the country. According to the document from CII, the solar power generation potential is 500,003MW (0.5TW) and higher by one digit than wind and biomass power generation.

2-4-2 Plans and outlook of solar power generation

Indian National Action Plan on Climate Change includes the technology development related to solar energy in order to achieve national SPV energy mission. This is intended to increase the ratio of solar power energy in the total energy composition inside and outside of the country, while Indian government recognizes that the other renewable energy sources need to be expanded. In this regard, the government provides the preferential treatment to IREDA in order to increase Grid-interactive: the Demonstration Programme on Grid Interactive Solar PV Power Generation, Demonstration Programme on Grid Interactive Solar Thermal Power Generation. On the other hand, in order to expand SPV energy system to the large scale as off-grid power sources, it is planned to promote solar photovoltaic plant installation with the capacity of 1 GW

(1,000MW) by 2017.

The issues of solar photovoltaic are high costs, expansion of scale and the introduction of the latest technology. In order to address these issues, there are possibilities to support the solar photovoltaic by off-grid (rural electrification) and solar thermal power generation in addition to the projects to deal with the power peak of the grid interactive. (The hybrid with small hydropower is also considered for the purpose of the stable energy production.)

The demonstration plant of STG, consisted of Parabolic Trough Collectors in 1989 and the steam turbines, is installed in Solar Energy Centre in Gwalpahari and the basic data is collected. STG is in the stage of development. SEC installed 50kWe boiler with biomass gasification together with TERI and the hybrid technology was tried in order to stabilize the output. SEC considers that the improvement of more precise control technology with STG and biomass gasifier and the equipment is necessary.

According to ISA Solar PV Conclave 2008 (provided by IREDA), MNRE will announce the new policy regarding MNRE Demonstration Programme on Grid Interactive Solar Power Generation by 31 March 2010. In addition, the table below is listed as the targets of cost reduction of solar PV.

Table 2-G

Effects of R&D – Cost of Solar PV				
Technology		2012	2017	2022
PV Module price	Rs./Wp	120	60	30
PV System price (Non storage)	Rs./Wp	160	100	60
PV System price (with storage)	Rs./Wp	185	120	80
PV System price (low storage, hybrid)	Rs./Wp	170	110	70

In Japan, the following policy is put up in the measures for economic crisis in April 2009 based on “action plan for achieving low-carbon society” approved by the Cabinet in July 2008. Following the SPV technology development of “SPV power generation roadmap (PV2030+)” by NEDO, SPV power generation is aimed to be 20 times more than the current generation.

Table 2-H Progress plan for Renewable Energy Power Generation in Japan (*actual)

Items	FY2005*	FY2020	FY2030
SPV generation（MW）	1,400	28,000	54,000
Cost of SPV generation （JPY/kWhr）	50	14	7
Nuclear （%）	31	44	49
LNG （%）	24	20	16
Coal （%）	26	20	17
Oil （%）	11	6	4
Hydropower （%）	8	8	10
Others （%）	0	2	4
SPV Generation Module Conversion Efficiency (%)	-	20	30
SPV Generation Module Price (JPY)	-	75	50

2-5 Biomass/Bagasse plants power generation

(Source: 25 years of renewable energy in India)

Biomass energy has been contributing to the life of human being for a long time. In India, biomass was always the important energy source and provided the main supports to energy for cooking and heat source. The import of 30 million ton crude oil will be needed annually if it would have been replaced by oil. Biomass power generation potential is said to be 21,881MW, which are composed of 16,881MW by biomass power generation from agro-residues and 5,000MW by bagasse cogeneration. The installation capacity of biomass power generation as of 31 March 2009 is 2,028.27MW, which is composed of 1,752.03MW (grid interactive) and 276.24MW (off-grid), in which biomass gasifier decreased by 54.85MW. This is 9.26% of the potential capacity and 12.10% of renewable energy in grid interactive, which is after wind and small hydro power generation.

2-5-1 Biomass power generation potential

Biomass potential is estimated about 500 million tons annually using the residual rates between 1998-2004 based on the 2006-07 outputs of the main agricultural products in India such as rice, wheat, millet, sugarcane, coconuts, cotton, oilseed, beans and jute. However, this figure contains the accidental errors, 15-20%. Indian household uses approximately 220 million tons of agro-residues for cooking fuel with the efficiency of less than 10%. If this efficiency is improved to 20 %, about 100 -110 million tons of agro-residues can be effectively used annually. 160-180 million tons / year of agro-residues can operate 16,000-18,000MW power generation installation with the utilization rate of 60-80%. On the other hand, the output of sugarcane accounts for 64% of the total agricultural products. 550 operating sugar mills crush about 200 million tones of sugarcanes and produce 60 million ton bagasse with 50% moisture. About 8 million tons of bagasse are required for paper manufacturing. Approximately 50 million tons are used for power generation and vapor generation. The task force in 1993 noted that it becomes

possible to generate the additional 3,500MW by modernizing the all existing sugar mills and applying the technologically and economically appropriate level of cogeneration from bagasse. 6,000-7,000MW power generation will be possible if all sugarcane is crashed and produced bagasse is processed. Furthermore, 2,000MW can be potentially produced if about 20 million tons per year of the trash, equivalent to about 7% of sugarcane usually incinerated as dried leaf in the field, are used. Therefore, bagasse power production potential is estimated 8,000-9,000MW.

2-5-2 Plans and outlook of biomass/ bagasse plant power plans

In the Eleventh Five Year Plan, the target of biomass/ bagasse plant generation is 1,700MW in total, which is comprised of cogeneration 1,200MW and biomass power generation 500MW. The cumulative power installation as of 31 March 2009 reached 119.3%. The amount for the assistance also focuses on cogeneration, Rs. 600 crores, and biomass power generation, Rs. 300 crores.

As for agro-residues biomass generation, the cumulative power installation as of 31 March 2009 is 703.30MW against the feasible capacity of 16,881MW and is only 4.2% of the feasible capacity, i.e. at the development stage. There are two approaches for cogeneration programs: bagasse and non-bagasse based. Bagasse based is sugar mill oriented and non-bagasse is for all industrial sectors. The issue is that the operation of bagasse cogeneration is limited to the harvest seasons and the operation days of the facilities are 160-180 days in Northern and Western areas and 200-240 days in Southern area. In order to increase the operation days, the combined use of agro-residues such as rice is partly tried. In biomass gasification plants, the composition of the generated gas is CO 18-22%, H_2 15-20%, CH_4 1-5%, CO_2 10-12% and the calorie of the generated gas is 1,000-1,200Kcal/m^3 . Along with the oil price increase, the focus of development is on 100% gas engine use. At present, biomass gasification plants (5-500kW) are manufactured by about 15 companies in India. These systems use 250kW/ plant of the gas engine, which is used up to 1MW. The biomass gasification plant is greatly affected by the economy and harvest. Due to abeyance / cessation of operation, biomass gasification was decreased by 54.85MW in the end of March 2009 from the end of January and the volatility is high in the sector.

2-6 Waste to Energy

(Source: 25 years of Renewable Energy in India)

It is estimated that 423 cities in India produce about 4.2 million tons of solid wastes and 6 billion m^3 of liquid wastes annually. MNRE installed the facilities of 65MW capacity since 1995

and has the following programs for urban waste and industrial waste energy recovery.

The program of urban waste energy recovery provides the financial assistance between about 20-40% to implement a project for energy recovery from various urban wastes. Five pilot projects are developed regarding energy recovery of municipal solid wastes. In this process, the following issues are recommended by the expert committee.

(i) Project development including the characteristic of the waste, a project size, selection of technology, project design, management model, coordination and financial assessment
(ii) Application of integrated method to waste processing
(iii) Selection of the technology based on the characteristics of the waste to be processed and local conditions
(iv) Development of biomethanation technology to fractionated and uniform wastes
(v) It is necessary to promote the integrated system for selection/ collection/ transportation/ processing of wastes in order to set up the pilot project.

The program regarding the industrial waste to energy, the capital subsidy is provided from Rs. 50 lakh (10^5) to Rs. 150 lakh per MW depending on the applied technology and final purpose.

The projects in the program include the following:
(i) Biomethanation of solid and liquid industrial wastes and effluent
(ii) Biogas power generation from the boiler and steam turbine or biogas engine
(iii) Power generation from industrial solid wastes through boiler and steam turbine

2-6-1 Trend of urban waste power generation

The projects based on MSW are implemented in Hyderabad, Vijayawada and Lucknow. As the first phase of the project, SIL (Selco International Ltd.) installed the heat recovery plants using refuse derived fuel (RDF) combined with coal in Hyderabad in 1999. As the second phase of the project for RDF use, 6.6MW power installation started to operate in November 2003. The total project costs are Rs. 43.50 crore. The operation is ongoing while 1-3 days per month are shutdown for the maintenance. On the other hand, there is information that the plant in New Delhi stops operating, since the calorie of waste is low and waste is mixed. It seems that the integrated municipal waste processing complex at Ghazipur in Delhi is also not operating smoothly.

The demonstration project which mixes sewage sludge disposal with MSW is implemented by

Vijayawada Municipal Corporation in June 2004 with the costs of Rs. 283.00 lakh and under operation. It uses the waste from vegetable and fruit market, 16 tons per day, and from slaughterhouses, 4 tons per day, and sewage sludge from the wastewater treatment plant adjacent to them. By supplying Biogas with reduced H_2S to biogas engine, 150kW power is generated. Out of the generated electricity, the remaining after captive consumption is sold externally to the grid interactive. In the Eleventh Five Year Plan, the following generation potential of MSW is estimated.

Table 2-I Potential Power Generation of MSW (Source: Eleventh Five Year Plan)

Period	Projected MSW Generation(TPD)	Potential for Power Generation (MWe)
2007	148,000	2,550
2012	215,000	3,650
2017	304,000	5,200

2-6-2 Trend of industrial waste to energy

Regarding industrial wastes, the projects are implemented to the industrial sectors such as distilled liquor, paper mill and starch factories. TNPL (Tamilnadu Newsprint and Papers Limited) has the paper production capacity of 230,000 tons per year. TNPL consumes about 1 million sugarcanes (wet) per year in order to produce bagasse pulp chemically and mechanically. In March 2003, biomethanation plants of bagasse wash water with 15,000m^3 biogas production started to operate using about Rs. 4.00 crores. At present, the generated methane gas in the paper mill (CH_4: 82～85%、CO_2: 15～18%, S< 1%) is 6,000kcal/Nm^3 in the calorie and produces 23,000Nm^3 per day. After the expansion, it will be increased to 40,000 kcal/Nm^3 per day and 80% of the consumed fuel of lime kiln will be covered. In addition, the expansion plan is in progress to increase the annual paper output up to 400 thousands tons and this plan includes to install the 125t/hr steam boilers with multi-fuel. In the Eleventh Five Year Plan, the following potential by waste to energy is estimated by industrial sector.

Table 2-J Potential Generation from Industrial Waste by sector

Sector	Potential (MWe)		
	2007	2012	2017
Sugar	363	453	567
Pulp & Paper	58	72	90
Sago/Starch	24	30	37
Maize Starch	105	132	164
Distillery	503	628	785
Dairy	69	77	96
Others	165	206	258
Total	1,287	1,598	1,997

(Source: Eleventh Five Year Plan)

2-7 Involvement of Japanese companies/technologies

Based on the findings of the first field mission, the relevant institutions and the project in India were surveyed in terms of the possible involvement of Japanese companies/technologies. Accordingly, the following were examined: to specify the sub-sectors which require the public assistance by Japan, selection criteria of sub-project, contents of the business and its necessity.

Indian government is promoting all sub-sectors in RE following Indian government policy, which is suitable for the local context and in this regard, no specific sub-sectors in renewable energy are required for special attention. On the other hand, the leading sector of wind power generation is intended to contribute to support socio-economic development of the farmers under the agricultural protection policy while the total power supply is limited. Therefore, the public support from JICA would be effective.

When IREDA will provide the loans to the sub-projects through Japanese ODA Loans, it will assess the facilities to be installed. As more attention is expected to be paid to the strength of Japanese companies such as stability, sustainable high efficiency and precise control, the Team proposes the format for the potential project list consisted of the common items in the sub-sectors and comparative items by sub-sectors. Based on this proposal, it is expected that IREDA will amend the list continuously to fit in the contest in India.

As for urban waste, the expectation from various parties in India is high toward Japan. Similarly to CCT, the ripple effect can be expected by realizing the successful model case by cooperating between the stakeholders in Japan as “all Japan”. At the current stage, it is important that how NEDO model project can be materialized quickly.

The table in the following page(Table 2-K) summarizes the 2nd mission findings of sub-sectors and the possible involvement of Japanese companies/technologies.
Issues are as follows:

(i) There are potential sub-projects eligible under TSL in each sub-sector.
(ii) The companies visited by the mission requested the lower interest rates in IREDA scheme.
(iii) Indian companies are interested in Japanese companies/technologies in general, but the information is not disseminated sufficiently.
(iv) European companies such as Germany and Chinese companies are already breaking into the market. It will be the effective approach that the results are obtained by

adjusting to the local context in India based on the technical information from NEDO model projects and this technical information is shared by cooperating as “all Japan” in order to spread/promote them.

(v) Considering vast and diverse characteristic of India, it will be desirable for NEDO model projects to demonstrate the same technology in various locations.

(vi) When the development is ongoing like in renewable energy field, it is necessary to consider the preferential treatment for development. For example, in India where has long sunlight duration and can use vast land, development of solar heat power generation technology can be promoted, since more equalization of the power supply and cost reduction can be expected by this technology.

(vii) In order to improve information exchange, it is essential to reinforce the communication with PCRA, NPC, CII and FICCI who have the bases in India and maintain PR activity continuously.

Table 2-K Potential Projects and expectation to Japanese Company in the visited companies in India

Site / Company visited	Suzlon Energy LTD.	Kotla Hydro Power PVT. LTD.	Selco Power Plant（RDF etc.）
Belong to	Ditto	Polyplex Hydro	Selco International LTD.
Sub-sector	Wind	Small Hydropower	Biomass (RDF)
Current Situation	**i)** The world 3rd in the wind power generation manufacturing now. Own 91% equity of Repower in Europe and 61.3% equity of Hansen (World 2nd, gearbox manufacturing). **ii)** Since Repower has joined to Suzlon group, the capacity which Suzlon can manufacture is increased from 600kW - 1.5MW to 600kW - 6.0MW, which is the size applied in offshore.	**i)** Along the 8 km long Kolta branch canal, it has three plants (tota capacity 3.75 MW) in the following order from upstream: Sahoke (head differential 5.27m), Killa (head differential 4.60m) and Babanpur (head differential 2.50m). **ii)** Since June 2004, Babanpur (1MW= 500kW x 2) 415V, Killa (1.75MW = 875kW x 2) 6.6kV in Oct 2005, and Sahoke (1MW) 6.6kW in Oct 2006 started to operate, respectively. The capital expenditure can be recovered in 3-4 years. **iii)** The generated power voltage is transformed to 11kV by transformer and the power is connected to the 66kVG/S/S grids of Punjab State Electricity Board at the sub-stations in Babanpur-Dhuri (4.97km away), Killa-Rangian (5.26 km away) and Sahoke-Ashpal Kalan (6.26km away).	**i)** The plant with RDF of MSW with the domestic technology in India was installed in 1999 and is located in 65km away from the power plant. (Survey No.43, Gandhamguda Village, Rajendra Nagar Mandal, R.R.Dist. A.P.-500 008). It is transported to the power plant by dump trucks. **ii)** 100-150t/D of RDF is produced from 700t/D MSW and 60t/D out of it is used to produce 40t/D of pellet (φ25-30mm x 30-40mm length), which are externally sold as compost. **iii)** Power consumption to manufacture RDF and pellet is 25kWh/t-RDF and 35kWh/t – pellet, respectively. **iv)** RDF(fluff) transported to the power plant is thrown into combustion boiler together with agro-residues and strip of cloth and produces 42kg/cm^2 steam (485℃). This steam will produce 5.6MW power. **v)** The generation capacity is 6.6MW, power externally sold is 5.9MW. **vi)** Deliverable materials such boiler ash and ESP fly ash are sold externally to brick manufacturers as bio-fertilizer and raw material, respectively.
Potential Project (MW)			
Wind Power (MW)			
Small Hydro Power (MW)		0.250−0.280	
Biomass(Agro Residues) (MW)			6.0
Biomass Cogeneration (MW)			
Biomass Gasifier (MW)			
Investment Amount (Rs. Crore/MW)	6	5−8	11.36
Generation cost (Rs./kWhr)	2	1−2	1.5−3.0
Sales price (Rs./kWhr)		3.65	
Years for recovery (Year)	1/4 − 1/2	3−4	
Technologies expected from Japanese Companies	As the total engineering company, the company is growing while it is involving in the sub-stations of grid-interactive. Therefore, it is the potential company to which Japanese technology for stabilization in grid-interactive is provided.	Using the new control technology, the company intends to implement the system (e.g. 50kW x 4 + 30kW x 1 + 20kW x 1) to adjust the output to 200 - 250 - 280 kW as the discharged water volume fluctuates from 200m^3 / sec to 547m^3/sec under the low head differential of 2.58m. In addition, it has the high interest in improving efficiency by integration.	The facilities are old fashioned and the control facilities are analog and limited, which is suitable for low cost production and labor. On the plant visit, a mask and dust-proof glasses are provided in addition to a helmet, which is rare in India. Surrounding environment is very different from Japan.
Key Person	Mr.Rohit Chauhan (Head-B.D.(North India))	Mr. Er.Amar Singh Walia (Plant Manager)	Dr.G.V.Ramakrishna (Chairman & M.D.)
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Contact Person	Mr.Vikas Sharma (Manager-Marketing)	Ditto	Mr.Ganesh
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Visited Companies	Auro Mira Bio Energy Madurai Limited	TNPL-Kagitapuram	DLF Gateway Tower
Parents company	Auro Mira Energy Company Private Limited	Tamil-Nadu Newsprint and Papers Limited	DLF Utilities Limited
Sub-sector	Biomass (Combustion Generation)	Biomass (Bagasse Paper Manufacturing)	Temperature Regulation System from Cogeneration
Current Situation	**i)** The 10MW plant just started to operate in May 2009 with the turbine, generator and ESP, which are made in China, and the cooling condenser made in India. (Plant Load Factor: 95%) **ii)** The budget of the new plant was 4.95 crore Rs./MW. **iii)** Consumed biomass is 300-350 t/day and the plant is operated for 350 days/year and closed for about 15 days (including the sub-stations) for maintenance. **iv)** The plant has 45 staffs (3 shifts, 10-12 staffs/shift). **v)** The planned plants are Kanyakumari, TN;15MW (Rs.5 crore/MW) and Tiunelveli,TN;15MW(Rs.4.9 crore/MW), are expected to be USD 15 million, approximately. **vi)** After the projects are commissioned by MNRE, Rs. 1.5 lakh/MW is provided as Government subsidy. **vii)** The investment amounts of the small hydropower project in Gulburga district in Karnataka State are: For those in construction phase (13.5MW (4.5 MW x 3), Rs. 4.75 crore/MW. For the ones waiting for MNRE approval (9MW (3MW x 3), Rs. 4.4-4.9 crore/MW. In total, about Rs. 108 crore. **viii)** By the end of 2012, RE generation capacity is planned to be increased to 1,300 MW. **ix)** The plan in viii) is expected to be achieved through: wind power generation to 1,000MW (none to date), the current 50MW biomass power generation to be increased to 150MW and the 13.5MW small hydropower generation under construction to be increased to 150MW.	**i)** 50-60kl water is generally consumed to produce 1 tons of paper. But this plant could reduce the water consumption to 30-40kl by reusing the water to rinse the material. **ii)** Daily water intake is 50,000kl/day and the daily output is 125-150 ton/day. **iii)** The paper is manufactured by blended pulp of bagasse (60%) and hard wood (40%). **iv)** 0.56 tons of pulp can be produced from 1 ton bagasse and 0.44 ton of pulp from 1 ton hard wood. The residuals are the materials for biomass-methanation of the bagasse plant. **v)** The outputs are mainly for domestic consumption (80%) and 20% are exported to Sri Land and Malaysia. **vi)** The production capacity is increased to 180,000 ton from 90,000 ton in 1995. **vii)** The generated methane gas (CH_4: 82-85%, CO_2: 15-18%, S< 1%) is 6,000kcal/Nm^3 in its calorie and is produced 23,000Nm^3 daily. After the expansion, it will be increased to 40,000Nm^3 and will cover 80% of the consumed material, lime kiln.	**i)** DLF Utilities Limited is the member of the building development group, DLF Building with more than 60 years of the history and it has been operating for 20 years. **ii)** As one of EEC activities, the own technical team is developing the regional temperature regulation system. **iii)** Under India's local condition such as more than 33% of the loss in distribution, the efficient regional temperature regulation system (4-40MW) is developed / operated. **iv)** The characteristic is that 1.0MkWhr/d will be produced (conversion of 2,202Kcal/kWhr) using 0.26Mm^3/D gas and it can be distributed with little loss in interconnection. **v)** 1.75MW can be effectively used using 1.4MW energy.
Potential Project (MW)			210
Wind Power (MW)	1,000	6.75/13.75	(Existing 350)
Small Hydro Power (MW)	136.5		
Biomass(Agro Residues) (MW)	100		
Biomass Cogeneration (MW)			
Biomass Gasifier (MW)			
Investment Amount (Rs. Crore/MW)	6/4.4 - 4.9/5	6/5	3.5/(6)
Generation cost (Rs./kWhr)		2 - 2.9	
Sales price (Rs./kWhr)			7
Years for recovery (Year)	3 − 5		
Technologies expected from Japanese Companies	**i)** Chinese companies export not only turbines and generators, but also ESP. **ii)** The team was told that the dust density after ESP made in China is 110mg/Nm^3 but could not confirm, since the meter is in the middle of chimney. **iii)** It was inexpensive equipment spec such as manual operation and with smoke vent unlike the ones in Japan. **iv)** It is worth keeping eyes on the future plan, since the renewable energy capacity is planned be increased to 1,300MW by 2012.	**i)** The plan to increase the capacity to 0.4 mil t/year is ongoing with USD 233 mil budget aiming at June 2010. **ii)** 20MW turbo generator using 1,300 t/d of black liquor dry solids recovery boiler seems to be installed. **iii)** European manufacturers such as Germany and Sweden are already operating, therefore it might be hard for Japanese companies to break in. **iv)** The company is promoting the aggressive plan such as the production increase and the introduction of new technology, and is the worth noteworthy company.	**i)** It is expected that the demand to replace emergency diesel using oil with the natural gas will increase in the future, since their system uses the natural gas. Therefore, the company can be expected to be the next user of the technology applied in the ongoing NEDO model project in TATA motors. **ii)** It has a possibility to apply EEC technology such as a heat pump.
Key Person		Mr.R.V.Krishnan (General Manager(Paper))	Mr.C.P.Poonacha (Executive Director)
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Contact Person	Ditto	Ditto	Mr.Ajay Kumar Gupta (Dy.General Manager)
Contact			g-ajay@dlf.in

Possible contribution of Japan

Site / Company visited	Suzlon Energy LTD.	Kotla Hydro Power PVT. LTD.	Selco Power Plant（RDF etc.）	Auro Mira Bio Energy Madurai Limited	TNPL-Kagitapuram	DLF Gateway Tower
Contribution type by Japan	Technical assistance (To provide information) / Two step loan	Research and development (To provide information) / Two step loan	NEDO model project		Technical assistance (To provide the information) / Two step loan	Dissemination of NEDO model project / Two step loan
Possible theme	To introduce the following technology: stabilization of grid-interactive and micro (<1kW) and small wind power (1kW≦SWT＜500kW)	Development of system configuration, which is the low head differential and wide control coverage	Power generation from incineration disposal using all RDF		Development of technology in paper manufacturing and introduction of EEC situation	Conversion of the fuel in the diesel power generation installations
Issues for the contribution	• The domestic companies in India cover the market of 225kW-2MW facilities for wind power generation in India. • Whether the demand of micro/small wind power, which is slight noise and small vibrancy, can be met?	• Whether the demand for hydropower generators to deal with low head differential and fluctuation of discharged water volume can be met?	• The collection system is not established. • The calorie of MSW is low (increase of calorie by cloth and agro-residues is necessary.) • The survey is essential regarding the possibility of the direct dissolution method in which the burned ash is effectively used. The ash is currently disposed. • The country is big and the climate greatly changes. Therefore, the several model projects are necessary.		• It is mainly baggasse (60%), in which Japanese companies do not have experience and wood pulp is only 40%. • European manufacturers are already in the market.	Waiting for the results of the model project in which the fuel is converted in the diesel power generation installations in TATA motors.

Chapter 3 Verification of potential to expand / adopt EEC projects in India

3-1 The current status and issues of energy efficiency and conservation

3-1-1 EEC promotion policy in India

The Energy Conservation Act, 2001 was promulgated by the Indian Government on 1st October 2001. The Energy Conservation Act is based on the Japanese Energy Conservation Act. It has adopted the Japanese Designated Energy Management Factories System and the Energy Manager System. The law contains the following provisions:

Provisions of the Energy Conservation Act

1. Bureau of Energy Efficiency (BEE)
   Establish the BEE in the Cabinet, thereby absorbing the Energy Management Center (EMC) which was established in 1989.
2. Governing Council
   Establish the Governing Council in order to manage the duties of the BEE.
   The Governing Council is chaired by Minister of Power, consisted of 20-26 members from following: Secretaries of Ministry or Department of the Central Government dealing with the Power, Petroleum and Natural Gas, Coal, Non-conventional Energy Sources, Atomic Energy and the representatives from energy consumers, equipment and appliance manufacturers and architects. Its Secretary is Director-General of BEE.
3. Scope of Energy: fossil fuel, nuclear substances, hydropower, renewable energy connected to the transmission grid, or biomass power generation
4. Energy Promotion Authority of the Government
   The BEE will perform the following duties, providing recommendation in relation to these authorities:
   - 4.1. Establishment of Energy Consumption Standards (for energy consumption, production, transmission and supply facilities)
   - 4.2. Prohibition of manufacture, importation, sales or purchase of equipment and electrical appliances that do not meet the Energy Consumption Standards
   - 4.3. Labeling of equipment and electrical appliances
   - 4.4. Designation and ranking of energy management factories, establishment of specific energy consumption
   - 4.5. Designation of Energy Intensive Industrial Sectors
   - 4.6. Establishment of Energy Consumption Standards for Designated Energy Management Factories

4.7. Instructions on Energy Conservation Audit for Energy intensive Industrial Sectors conducted by Certified Energy Auditor
4.8. Instructions on Energy Conservation Audit for Designated Energy Management Factories provided by Certified Energy Auditor
4.9. Conduct of Site Inspections in Designated Energy Management Factories
4.10. Instructions for reporting of the measures to guidance provided by Energy Auditors in Designated Energy Management Factories
4.11. Instructions for reporting the nominated Energy Manager in Designated Energy Management Factories and for submitting Annual Energy Consumption Reports at year end
4.12. Establishment of Certification scheme of Energy Managers
4.13. Instructions for Preparation of Energy Conservation Promotions Plan for Designated Energy Management factories not meeting the Standards
4.14. Establishment of Building Energy Conservation Standards (energy consumption standard per unit floor area). Buildings subject to this are those with equipment capacities of more than 500kW or with demand contract of more than 600kVA.
4.15. Energy Conservation publications (for information and education campaign)
4.16. Training on Energy Conservation Technology for officers and experts
4.17. Energy Conservation Consultations
4.18. Energy Conservation Research and Development
4.19. Development of testing and certification methods of equipment and electrical appliances and establishment of testing facility
4.20. Promotion of energy conservation model project
4.21. Promotion of adoption of energy conservation equipment and systems
4.22. Funding for energy conservation projects
4.23. Funding to assist energy conservation promoting organizations
4.24. Regulations on charges for services promoting energy conservation
4.25. List Management of Certified Energy Auditors
4.26. Energy Conservation Audit Method and Frequency
4.27. Establishment of Procedures for the Designation of Energy Managers in Designated Energy Management Factories
4.28. Preparation of Energy Conservation Education Curriculum for Educational Institutions, Universities and Local Government Units
4.29. Implementation of International Cooperation Program in Energy Conservation

5. Energy Conservation Fund

The Central Government will establish the Central Energy Conservation Fund. The funding

source will be the subsidy fund provided by the Central Government to the BEE and the fees received by BEE. These will be allocated to BEE officer payroll, business expenses, expenses required to implement the objectives of the Energy Conservation Act and administrative expenses of the Council. The State governments will establish State Energy Conservation Fund.

6. Penalties

3-1-2 System to Promote Energy Conservation in the Industrial Sector

Based on the Energy Conservation Act, the BEE will conduct the examination and certification for Energy Managers as well as Energy Auditors. The qualifications of an Energy Auditor may be conferred to a person who passes the written exams for a plant energy audit simulation and economic calculations in addition to the Energy Manager examinations and it ranks higher than that of the Energy Manager. As of 2008, 2,172 Energy Managers and 4,019 Energy Auditors have been certified. The total number of certifications for Energy Auditors number about 1000 auditors/year; however, since 2006 the number of certifications for Energy Managers has declined as the number of the exam takers decreases. Figure 3-A shows the number of certified Energy Managers and Energy Auditors.

Energy intensive factories and buildings are specified as Designated Energy Management Factories and they have the obligation to submit periodical reports and to conduct energy audit by an Energy Auditor. All energy audits are with fees, unlike in Japan where there are free energy audits for buildings and plants.

In order to raise the technical level of the Energy Managers and the Energy Auditors, the BEE is planning to set up five (5) Regional Energy Efficiency (REE) Training Centers nationwide. The first REE is planned for Chennai (formerly Madras), the Indian Government provides the land and the building for the Training Center and Japan is cooperating towards the provision of practice equipment and training course curriculum.

The BEE supports the energy conservation promotions of small and medium enterprises by means of providing financial and technical assistance.

Although BEE is merely one agency under the Ministry of Power, the industrial sector falls under the jurisdiction of many government agencies such as Ministry of Steel, Ministry of Textile, Ministry of Petroleum and natural Gas. The BEE has the duty to coordinate among these different ministries in promoting energy conservation.

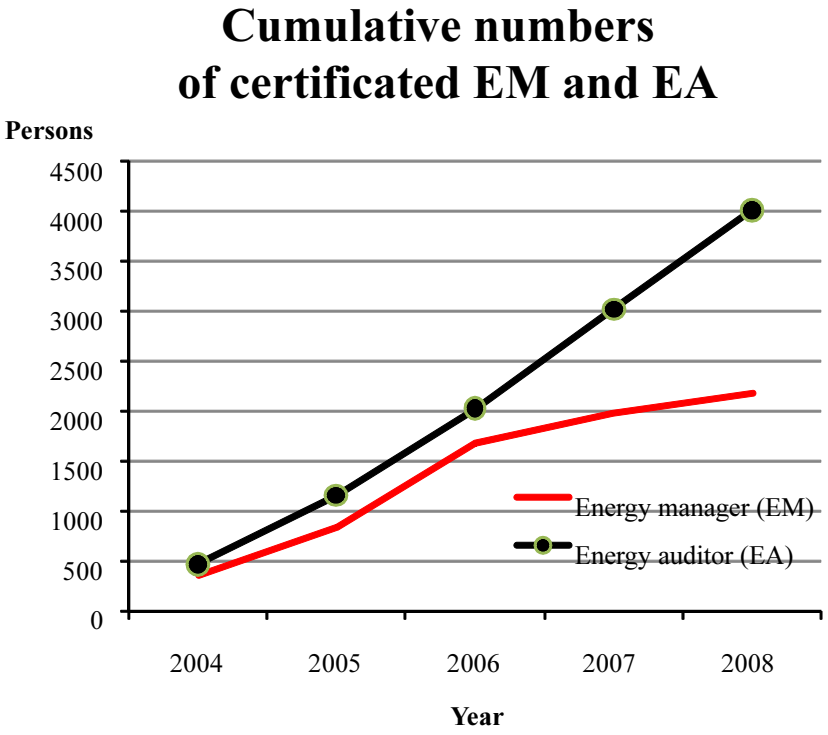


Figure 3-A Number of Certified Energy Managers and Energy Auditors

(Source: Website of BEE)

3-1-3 Promotion of Energy Conservation by ESCO Projects

For purposes of promoting energy conservation, the BEE has started a certification system for ESCO (Energy Service Company). Presently, there are 35 ESCOs certified, however, their main scope of work is to replace the street lamps commissioned by the local government units to energy conservation lamps. The ESCO projects have not yet covered factories and buildings. According to the Certification Sheet of the 35 ESCOs, there are the registered companies that have no experience with energy audits, and many of them are energy conservation lamps and equipment manufacturers. There is no ESCO that can provide a comprehensive ESCO project. It is estimated that the ESCO business market size in India is about USD 18 billion.

As shown in Figure 3-B, the contracts for ESCO Projects can be classified as Guaranteed Savings Contract and Shared Savings Contract. In Japan and USA, most contracts are the Shared Saving Contract type. However, in India, there are more of the Guaranteed Savings Contracts. For the development of ESCO projects, it is necessary that Shared Savings Contracts increase which gives more profit to ESCOs. The reason that Shared Savings Contracts does not

increase is that the management foundation of ESCOs is weak, and financial institutions are reluctant to finance small projects.

The market interest rate in India is more than 15%. In order to develop the ESCO business, it is necessary that government financial institutions provide assistance funding for ESCOs.

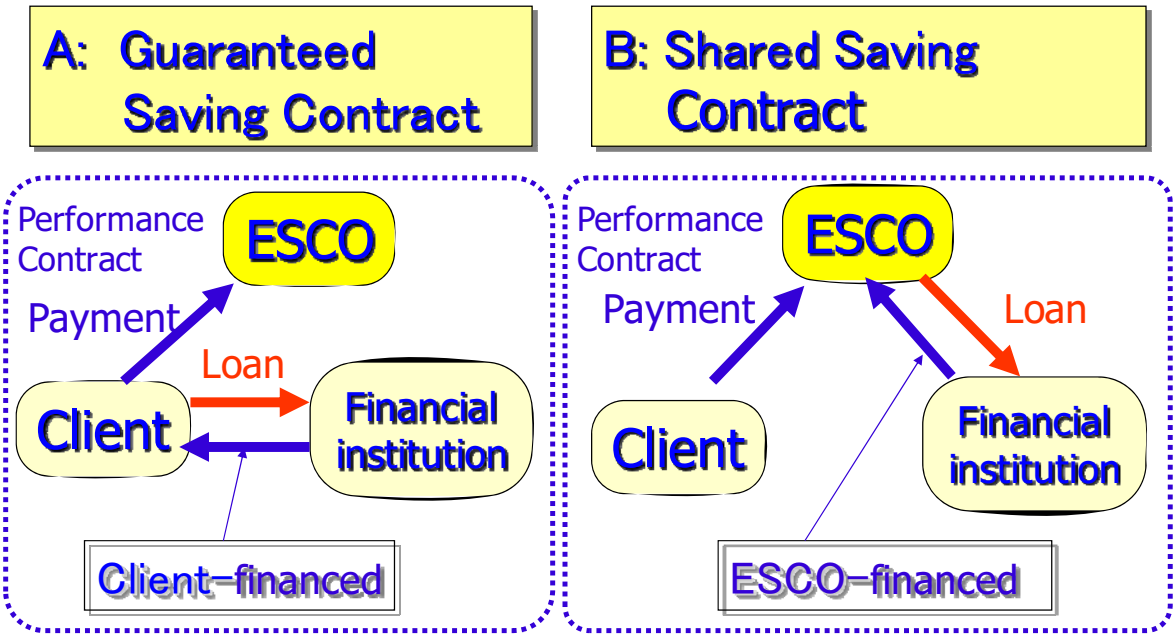


Figure 3-B ESCO Contracts

3-2 Status of Energy Consumption of Industrial Sector

3-2-1 Primary Energy Composition of India

The primary energy composition of India is shown in Table 3-A. The primary energy of India is composed of coal 39.4%, combustible renewable energy, 28.3%, crude oil 24.1%, natural gas 5.5%, hydropower 1.7% and others 1.0%. Coal accounts for almost 40% of the primary energy and plays an important role.

Table 3-A Primary Energy Composition (2006)

	India		Japan	
	10^3 toe	%	10^3 toe	%
Coal	222,772	39.4	112,410	21.3
Oil	136,080	24.1	240,580	45.6
Natural gas	31,395	5.5	77,440	14.7
Nuclear	4,849	0.9	79,070	15.0
Hydro	9,770	1.7	7,380	1.4
Solar & geothermal	796	0.1	3,570	0.7
Renewable energy	159,916	28.3	7,120	1.3
Electricity	242	0.0	0	0.0
Total	565,820	100.0	527,560	100.0

Source: IEA Energy balance 2008 Edition

3-2-2 Consumption of Primary Energy by Industrial Sector in India

Table 3-B shows how the primary energy described in section 3-2-1 is consumed by each industrial sector. India's primary energy shows which sector has consumed tons of oil equivalent (hereinafter referred to as 'toe') of 565,820toe in 2006. Consumption in the Energy Transformation Sector (187,332 toe) is mostly accounted for by the coal thermal power plant sector. Of the 159,319 toe consumption of the Residential Sector, 125,027 toe of which is combustible renewable energy such as wood and cow dung. This means that the Commercial Energy consumption of the Residential Sector is very small at 34,249 toe. The energy usage in Energy Transformation Sector (mainly coal thermal power plant) and the industrial sector is high.

Table 3-B Primary Energy Consumption by Sector (2006)

	India	
	10^3 toe	%
Energy transformation	187,332	33.1
Industry	109,048	19.3
Transportation	39,045	6.9
Residential	159,319	28.2
Common & Pub. Service	12,478	2.2
Agriculture/Fishing	14,271	2.5
Non-energy use	37,353	6.6
Others	6,975	1.2
Total	565,820	100.0

Source: IEA Energy balance, 2008 Edition

3-2-3 Energy Consumption per Subsector of the industrial Sector in India

Table 3-C shows the details of the 109,048 toe energy consumption of the industrial sector mentioned in section 3-2-2 per sub-sector. This data is cited from the IEA Energy balance; however, "Non-specified" sub-sector of the Indian industry is high at 57.2%. The reason behind this is thought to be because the energy balance reported by India to the IEA is not specific. Out of the energy used up by the industrial sector, the consumption of gas (6,162 toe), combustible renewable energy (27,596 toe) and electricity (19,620 toe) were not able to be classified by sub-sectors and they were aggregated this as "Non-specified".

However, out of the total consumption of the industrial sector (109,048 toe), coal (34,502 toe) and petroleum (21,167 toe) account for 51%. Based on the data classifying them by sub-sector, it can be determined that the highest and second sub-sectors are the iron and steel and the cement, respectively. This study focuses on and explores energy conservation projects in the iron and steel industry and the cement manufacturing industry.

(Notes) Even for coal and petroleum, 16.2% is classified as "Non-specified". The number of companies in the industrial sector is many and there are many companies who have not sought membership in their respective industry associations. In this regard, this figure cannot be classified into any sub-sector, therefore it is unavoidable to classify them as Non-specified.

Incidentally, in Japan, in the IEA Energy balance 2008 Edition, "Non-specified" is reported to be 18.4%.

Table 3-C Energy Consumption per Subsector of the Industrial Sector (2006)

	India	
	10^3 toe	%
Iron and steel	18,233	16.7
Cement	9,944	9.1
Food & tobacco	8,613	7.9
chemical	5,378	4.9
Machinery	*	
Paper & printing	1,309	1.2
Construction	*	

3-3 Status and Issues of EEC in the iron and Steel Industry

3-3-1 Iron and Steel Production and Sponge Iron Production in India

India produces coal and iron ores, thus the reduction process of iron ore is by blast furnace, COREX and direct reduction. Table 3-D shows the trend in crude steel production in India.

Table 3-D Trends in Crude Steel Production in India

Unit: 1,000ton

	SAIL Group			TATA Steel	VSP (RINL)	Total Main Producer	*Other Producer	Total India
	SAIL	ASP & VISL	Total					
2002-03	11,413	215	11,628	4,098	3,256	18,982	11,461	30,443
2003-04	12,129	256	12,385	4,224	3,402	20,011	18,715	38,726
2004-05	12,184	277	12,461	4,104	3,452	20,017	23,422	43,439
2005-06	13,179	292	13,471	4,731	3,494	21,696	24,766	46,462
2006-07	13,196	309	13,505	5,174	3,497	22,176	28640	50,816
2007-08(P)	13,647	315	13,962	5,014	3,129	22,105	31,800	53,905

Source: Steel Scenario Yearbook 2008

(Notes) In the reference material, it was written as “Major and Mini Steel Plant”. JSPL (Jindal Steel and Power Ltd) which produces pig iron using COREX method and sponge iron by directly reduction using the rotary kiln, falls under the “Major and Mini Steel Plant”.

Based on this table, the “Total Main Producer” refers to the companies that produce iron and steel by the blast furnace method. SAIL, Tata and RINL are India’s main integrated iron and steel companies, and in 2008, the crude steel produced amounted to 22.1million tons. Other Producer refers to companies producing steel using the direct reduction method – electric furnace or the induction furnace, however, this also includes companies using the COREX method and the mini blast furnace, and in 2008, the crude steel produced amounted to 31.8million tons.

As shown in Table 3-E, recently, the volume of sponge iron produced by direct reduction in 2007 has reached 20 million tons/year. Out of this, the coal based sponge iron that makes use of lignite as its reducing agent amounted to 14.1 million tons/year, while the gas based sponge iron which makes use of natural gas as its reducing agent amounted to 5.84 million tons.

Table 3-E Trend of Sponge Iron Production in India

Unit: 1,000ton

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Gas based sponge iron	3,624.6	3,975.8	4,643.1	4,542.5	5,264.8	5,845.3
Coal based sponge iron	3,283.9	4,109.3	5,420.1	7,278.5	11,012.3	14,142.4
Total	6,908.5	8,085.2	10,063.2	11,821.0	16,277.1	19,987.7

Source: Steel Scenario Yearbook 2008

Coal based sponge iron can use lignite instead of coking coal so it has the advantage of being able to produce using Indian raw material. Furthermore, the plants which own the processing technology have recently rapidly expanded their production. India is the world's number one direct reduced iron (DRI) producing country.

As stated above, other than the blast furnace method, the iron and steel production in India makes use of the direct reduction manufacturing, which accounts for a large part of the pie, and is an important subject for energy conservation.

Table 3-F World's DRI Producing Countries in 2008

Unit: Million ton

India	Iran	Venezuela	Mexico	Saudi Arabia	Others	World total
21.2	7.46	6.87	6.01	4.97	21.94	68.45

Source: Iron and Steel News newspaper (Japan) 7 Apr 2009

3-3-2 Status of Energy Conservation Initiatives of the Iron and Steel Industry of India

(1) Energy Conservation Potential of the Iron and Steel Industry of India

The task of Study Team is to find sub-projects from the various energy conservation themes in the iron and steel industry that may be subject for ODA financing. Therefore, as mentioned in section (2), we visited the SAIL Head Office and the sponge iron plant, and collected information regarding the status of adoption of energy conservation technologies, energy consumption intensity, operating conditions of energy conservation facilities, etc.

As a result of such visit, the energy conservation potential of the iron and steel industry in India is estimated as follows:

(a) Integrated Iron and Steel Works (SAIL, TATA and RINL)

The energy consumption intensity per ton of crude steel of SAIL was improved from 7.24Gcal/t-steel in 2005 to 6.76Gcal/t-steel in 2008. However, comparing this to the energy consumption intensity in Japan (4.8 Gcal/t), there is still a big difference. Other than there being a

difference in the raw materials used in manufacturing (coking coal and iron ore), there are no large-scale energy conservation measures being implemented. The introduction of energy conservation technologies is thought to be able to improve the energy consumption intensity by 15 - 20%.

(b) Direct Reduced Iron Manufacturing Plant with Sponge Iron making Process

As mentioned above, coal based sponge iron is mostly produced using the rotary kiln method. The rotary kiln sponge iron plants have energy consumption intensity of about 4,700Mcal/t-sponge iron, however it is estimated that this can be improved to 3,700Mcal/t-sponge iron, approximately 20% improvement by the application of waste heat recovery. Therefore, it is preferred that rotary kiln waste heat recovery power generation system be adopted as soon as possible.

(2) **Status of Adoption of EC Technologies in Iron and Steel Industry in India**

(a) Blast Furnace method

On the visit to Head Office of SAIL which is the largest crude steel producer of India, the status of adoption of energy conservation technologies was surveyed, and at the same time, the status of the adoption of the energy conservation technologies according to the NEDO plant survey report were also investigated, the result of which is shown in Table 3-G. According to Table 3-G, SAIL hardly has any large scale energy conservation equipment.

Table 3-G Status of the Adoption of Energy Conservation Technologies in the Iron and Steel Industry with blast furnace process in India

No.	EEC technology	SAIL	TATA	VIZAG
1	Coke oven: Coke dry quenching (CDQ)	Not yet	NEDO	Planning
2	Coke oven: Coal moisture control	Not yet	-	-
3	Sintering plant: Waste heat recovery	Not yet	Not yet	NEDO
4	Blast furnace: Top pressure recovery turbine (TRT)	Not yet	Planning	Planning
5	Blast furnace: HS waste heat recovery	Not yet	NEDO	Not yet
6	Blast furnace: BDC (BFG dry cleaner)	Not yet	-	Not yet
7	Blast furnace: Pulverizing coal injection (PCI)	Planning	-	-
8	Blast furnace: Waste plastics injection system	Not yet	-	Not yet
9	Steel-making: Converter gas recovery	Planning	Planning	Planning
10	Steel-making: Converter gas sensible heat recovery	Not yet	Not yet	Not yet
11	Rolling mill: RHF waste heat recovery boiler	Not yet	-	-
12	Rolling mill: RHF regenerative burner	Not yet	-	-
13	Rotary hearth furnace (RHF) for dust recycle	-	-	-
14	Motor: Variable speed driving (VSD) with inverter	Planning	-	-

Item of this table is made referring to Jase-World products & technology list.

Symbol: Already: Already introduced, Planning: Under planning, Not yet: Not yet introduced,

-: Not yet surveyed, NEDO: Introduced by NEDO Model project

To summarize the energy conservation information of SAIL obtained during the visit:

(i) India Iron and Steel Corporation (SAIL) steel plants

SAIL is composed of five steel plants namely BSP (Bhilai Steel Plant), DSP (Durgapur Steel Plant), RSP (Roukela Steel Plant), BSL (Bokaro Steel Plant) and ISP (Burnpur), with a crude steel production capacity of 14 million t/year, making it India's largest steel plant.

When installing additional facilities such as blast furnace or coke oven in the future, there are plans to install the following facilities:

- CDQ – additional Coke Oven for IISCO, BSP and RSP
- TRT – additional blast furnace of IISCO, BSP and DSP and Bokaro No. 2BF
  (Note) Bokaro No. 2BF is not an additional installation
- Blast Furnace Hot Stove Waste Heat Recovery – additional blast furnace for IISCO, BSP and RSP
- PCI – additional blast furnace for IISCO, BSP and RSP

PCI (Pulverized Coal Injection) is being implemented for 8 units of Blast Furnace.

The following information has been gathered from TATA and RINL.

(ii) TATA Steel

- Owns Jamshedpur Iron and Steel Works which have a crude steel production capacity of 5million t/year
- CDQ: under construction (NEDO Model Project)
- Of 8 blast furnaces, hot stove waste heat recovery system is installed in 2 units (Installed as NEDO Model project in G Blast Furnace).
- Of 8 blast furnaces, TRT is installed in 2 units
- As a policy, CDQ and TRT will not be installed on planned additional cokes oven and blast furnace due to financial constraints.

(iii) Visakhapatnam Steel plant of RINL

- Owns VIZAG Iron and Steel Works which have a crude steel production capacity 3.3 million tons/year (scheduled for additional installation to reach 6.30 million t/y by 2011)
- CDQ : installed on all cokes oven (made in Ukraine)
- TRT: installed on 3 units of blast furnace (Made in Russia but not performing well)
- Sintering cooler waste heat recovery: scheduled for installation (NEDO Model project)
- Blast Furnace volume: 2 units of 3,200m^3
- 1.2 BF top pressure: Max 2.5kg/cm^2, Nor. 2.0kg/cm^2

(b) Rotary Kiln Sponge Iron Plant (Direct Reduced Iron Manufacturing Plant)

As mentioned in 3-3-2-(1)-(b), the rotary kiln waste heat recovery power generation system has been introduced and is in the stage of adoption. The 3 plants that were surveyed all had rotary kiln waste heat recovery power generation systems.

These 3 plants own coal-fired in-house power plants and they have a waste heat boiler installed after the ABC (After Burning Chamber) of the rotary kiln. If the appropriate additional investment is made, the steam (67kg/cm^2, 490^{o}C) can be recovered as renewable energy at low cost.

The surveyed sponge iron plants are as follows:

- Vandana Global Ltd. Raipur factory: on 13th, July in 2009
- Mahendra Sponge & Power Ltd. Raipur factory: on 13th, July in 2009
- SHRI Venkateswa Sponge & Power Pvt. Ltd.: on 24th July in 2009

(3) **Issues on EEC in the Iron and Steel Industry of India**

(a) Promotion of Energy Conservation in the Integrated Iron and Steel Works

The iron and steel industry in India is promoting the improvement of raw material and is enhancing the operation performance, thereby improving energy consumption intensity. However, no large energy investments have been made. If these will be implemented, based on the Japanese experience, there is still room for 15% of improvement on energy consumption intensity. It is necessary to implement energy investments according to plans in the integrated iron and steel Works.

(b) Countermeasures for increase in CO_2 accompanying production increase of sponge iron

India is rich in iron ore and lignite, and this is why they are producing sponge iron using rotary kiln direct reduction method. Many of these facilities have a daily production capacity of 100t/day. The coal energy usage efficiency of a 100t/d class rotary kiln is estimated to be about 40% if a waste heat recovery power generation system is implemented and it will improve the efficiency by around 20%. Real demonstration of the effectiveness will promote waste heat technology in India.

In the future, if the rotary kiln is expanded to 1,000t/d, and the steam conditions of the steam generator is raised from the current 64kg/cm^2 x 480^{o}C (at Turbine inlet condition) to 102kg/cm^2 x 538^{o}C, the generated power per ton of sponge iron can be increased approximately by 30%. There is a high volume of waste heat in rotary kilns. There remains technical development challenge in the sponge manufacturing process to develop systems that can first use the waste heat for pre-heating of raw materials (iron ore) and then the remaining waste heat can be used for power generation.

(4) Possible EC Technologies/Facilities to introduce in Iron and Steel Industry in India

The following EEC technologies and equipments are selected due to its high energy saving effect based on Table 3-G in order to address the issues of the iron and steel industries in India mentioned above.

(a) Cokes oven: Coke Dry Quenching Equipment

(i) Outline of the System

CDQ is a system that makes use of circulating inert gas to extinguish and cool red hot cokes extruding from the coke oven, and at the same time, recovers steam (280^{o}C-545^{o}C) using the

waste heat boiler. The temperature of the red hot cokes is high at 1,000°C – 1,050°C, thus it is possible to recover high temperature and high pressure steam. This steam can be sent to the existing generator or another generator to be installed in the CDQ in order to recover power. The specific waste heat recovery per ton of coal is about 250Mcal/t. When a steam turbine with thermal efficiency of 36% is used, it is possible to recover 105kWh per ton of coal. However, since the power consumed in the auxiliary equipment of CDQ steam turbine is 10kWh/t-coal, the net power generated is 95kWh/t-coal. Figure 3-C shows the flow diagram of a CDQ system. (reference) There is abundant mid-temperature waste heat in a steel plant, and the steam recovery systems can be installed to any facility cheaply.

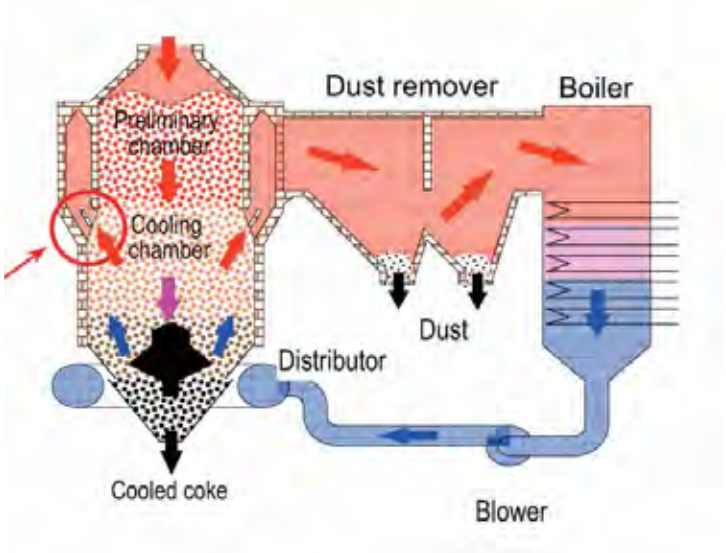


Figure 3-C CDQ Flow Diagram

(ii) Possibilities of Introduction to India

The steel plants in India have their own coal mines and are rich in energy resources. Therefore, the investment decisions for CDQ tends to be based on the comparison with coal fired thermal power plants. For this reason, there were no expressions of interest in the past. However, after the Jamshedpur steel plant of the TATA Steel Ltd. implemented a model project with NEDO, there is now a possibility that the biggest steel company SAIL will adopt this technology. During the visits of SAIL head office, conducted for the study, SAIL mentioned that IISCO, BSP and RSP will consider the installation of CDQ at the time of new installation of the cokes oven. This by itself is a change that was unimaginable in the past. If the CDQ of Jamshedpur will be able to perform the expected capacity, SAIL would decide favorably.

(iii) Possibility of Adoption in India and Forecast of Number of Installations

In India, a CDQ is presently under construction in the Jamshedpur steel plant of Tata as a

NEDO model project. Other than that, there is a Russian-made CDQ in operation at the BIZAG Steel Plant (RINL). But according to gathered information, the Russia-made CDQ has poor efficiency. It is only in the large steel company SAIL that CDQ has not been adopted, probably because of the following reasons:

- The steel plant of SAIL has in-house power plant, so it can be cheaper to just extract steam from the steam turbine and there is no benefit to introduce waste heat recovery. Moreover, if steam should be recovered, it is cheaper to recover steam from the sintering plant and the rolling mill rather than CDQ. However, it is still cheaper to extract from the steam turbine rather than recovered steam from these two facilities
- Although it is thought that they are interested in power recovery using CDQ, they consider the payback period is too long, and layout wise, it is difficult to install large CDQ in SAIL.
- Whether influenced by TATA's adoption of the CDQ or otherwise, SAIL is planning to install CDQ to the planned new cokes oven. The expected number of installations is 3 units (IISCO, BSP, RSP).
- TATA has no intentions of installing CDQ to the planned new cokes oven.

(iv) Possibility of Japanese Contribution

If the CDQ is for recovery of low pressure steam, it is difficult for Japanese companies to break into Indian market since India has already strong connections with Russia and Ukraine. Moreover, as mentioned earlier, low pressure steam (10-15kg/cm^{2}g) may be cheaply produced by other means within the steel plant other than CDQ. Therefore, Japan cannot contribute to low pressure steam recovery. For power recovery, there is a possibility for Japanese contribution for CDQ of 30MW class. The construction cost of CDQ with a 30MW power generator is JPY 800 to 900 million.

(b) Sintering Plant: Sinter Cooler Waste Heat Recovery System

(i) Outline of the Equipment

The main types of waste heat in a sintering plant are the main exhaust gas sensible heat and the sinter cooler sensible heat. The former recovers the waste gas sensible heat (250^{o}C - 400^{o}C) from the vicinity of the sintering ore discharge, while the latter recovers the high heat (250^{o}C - 400^{o}C) from the cooler waste gas. The former contains SO_3 resulting from the reaction occurring within the sintering machine, and compared to the latter, quantity is poorer.

When the sintering machine is big, for example the effective grate area is more than 400m^2, there is abundant waste heat. By recycling the boiler exhaust gas to the cooler, it is possible to

recover approximately 100kg/t-sinter of high temperature steam, which can be used for power generation. Figure 3-D shows the sintering cooler waste heat recovery system. This is an example of a straight-type cooler. In the case of an annular-type cooler, the cooler hood will have a circular shape.

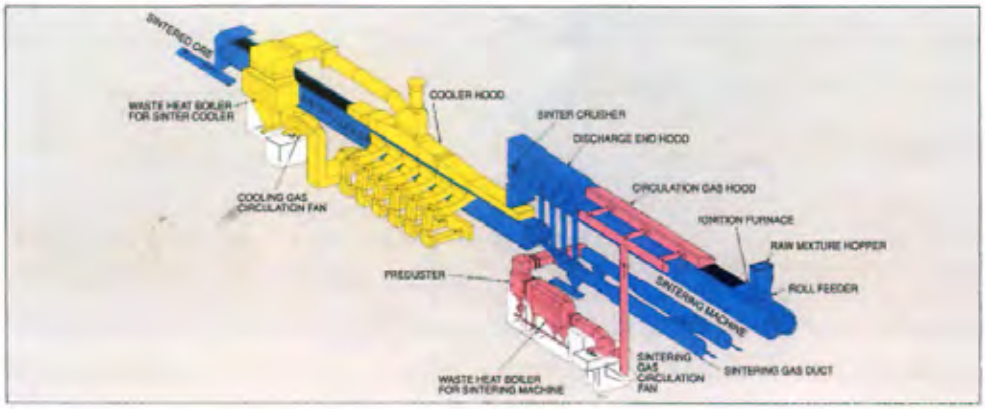


Figure 3-D Sintering Cooler Waste Heat Recovery System

(ii) Possibilities of Adoption in India

Presently, SAIL has no plans to install a sintering waste heat recovery system. However, RINL has decided to adopt a sintering waste heat recovery power generation system through NEDO Model project. It is thought that depending on the results of this model project, there is a possibility for SAIL to install this technology for the expansion of their sintering plant. SAIL's BSL (Bokaro) has 3 units of 275m^2, and if 2 units are made adjacent to each other, there is a possibility to be able to recover power. Steam recovery, although possible, is not appropriate for a sintering plant that has less that 200m^2/unit because investments efficiency for the power recovery is poor. Today, a sintering waste heat power recovery model project is in the planning stage. If this is successful, this construction cost per MW is cheaper than CDQ, thus has possibilities of implementation. In summary, if the planned NEDO Model project in RILN, (VIZAG) for a waste heat recovery power generation system is successful, 2 units may potentially be installed.

(iii) Possibilities of Japanese contribution

If sintering systems is large scale power recovery type, their investments efficiency is higher than CDQ in India and there is possibility for contribution from Japan. The blast furnace of the steel works of RINL has large inner volume (3,200m^3) x 2 units. Therefore, it is estimated that the sintering equipment is also large. Considering that RINL has TRT (Russia-made) and CDQ (Russia-made), if the power recovery system of the sintering plant produces the expected capacity, this sinter cooler waste heat recovery system might be installed to the entire sintering

system.

(c) Blast Furnace: Top Pressure Recovery Turbine (TRT)

(i) Outline of the Facility

In order to enhance the productivity of a blast furnace, a blast furnace is operated by squeezing the septum valve (valve to control the pressure) installed at the outlet of gas generated by a blast furnace and, through this, maintaining the inner pressure of the blast furnace at high. TRT is a system wherein the septum valve is by-passed, and a gas turbine generator is installed so the pressure energy can be recovered by the expansion turbine to generate power.

Blast Furnace top pressure is chosen between 1.2kg/cm^2 to 3.0kg/cm^2. This would increase required power of blast blowers, which assist reduction of the iron ores in the blast furnace. The installation of TRT makes it possible to recover 40-60% of the power consumed by the blast blower, thus TRT is considered to be equipment with high energy conservation effect. Figure 3-E shows the flow diagram. This diagram shows dry-type TRT. In the case of wet type TRT, there is no need for BDC (BFG Dry Cleaner).

(ii) Possibilities of Adoption in India

There are 2 units in TATA and 3 units in RINL. However, in the new additional blast furnace for TATA, because of funding reasons, TRT will not be installed. On the other hand, in the existing 22 units of blast furnace in SAIL, no TRT is installed. Of these, there are 5 units of 2,000m^3 blast furnace in BSP (Bokaro Works) with top pressure design value of 1.5kg/cm^2. From this it can be forecasted that the average power generation that may be attained is 4,900kW (max 5,500kW). The estimated construction cost is as follows:

- Large blast furnace with inner volume of more than 4,000m^3: 100,000 JPY/kW
- Small blast furnace with inner volume of less than 2,000m^3: 165,000 JPY/kW

The construction cost of TRT of 6,000kW for 2,000m^3 blast furnace is 1 billion JY, thus the investment in TRT is clearly a better investment condition than CDQ or sintering plant waste heat recovery power generation system. On the other hand, when we visited SAIL in 2009 May, they mentioned that they will be installing TRT to Bokaro No. 2BF, as well as to the new blast furnaces in IISCO, BSP and RSP, thus there is a possibility of adoption on these 4 units of blast furnaces. The additional blast furnace is expected to be of 3,200m^3 class, so, this is a very attractive proposal for SAIL. Since there are plans to install TRT on the additional blast furnace, a total of 4 units of TRT, i.e. 1 unit on the existing and 3 units for the additional blast furnace, are forecasted.

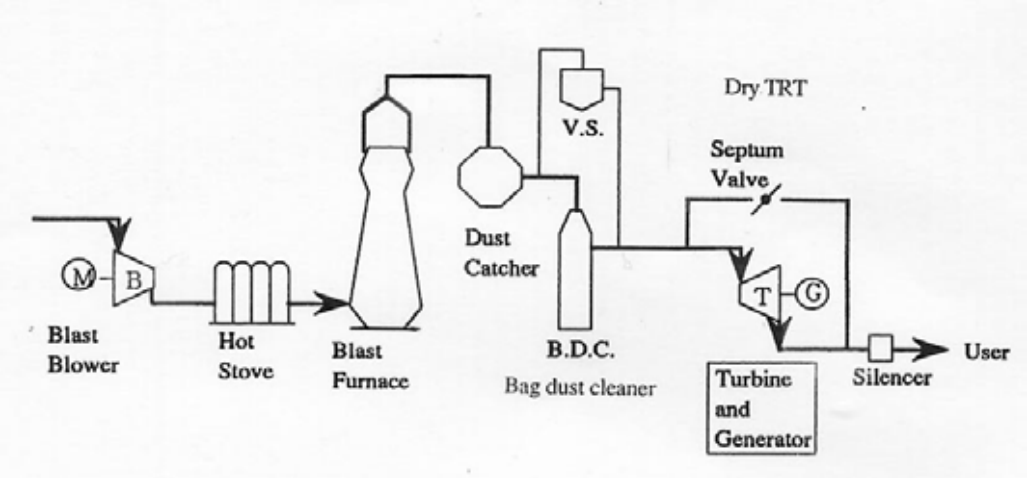


Figure 3-E TRT Flow Diagram

(iii) Possibility of Japanese Contribution

Bokaro 2BF was surveyed in an F/S Project of NEDO by the former Kawasaki Steel Corporation. China and Russia are competing with Japan. The Russian-made employs partial combustion of blast furnace gas (BFG), and gas temperature is increased at the inlet of the turbine up to 140°C, so on the surface, it seems that it has high output. However, since the dust in the BFG easily adheres to the impeller, a special know-how is required in order to efficiently, steadily operate this long term. (According to RINL, they have yet to reach the expected power.). Japanese innovation makes it possible for a sustained long-term performance, and Japan can make contributions with respect to large-scale facilities of more than 10MW.

(d) Blast Furnace: Hot Stove Waste Heat Recovery

(i) Outline of the Facility

The blast furnace hot stove waste gas has a temperature of 200 to 250°C and has huge volume. Therefore, recovering this waste heat for use in pre-heating of combustion air, or if the volume permits, for use in pre-heating air and fuel, the fuel consumption intensity of the hot stove may be improved by 20-40 Mcal/t-pig iron.

The thermal efficiency of hot stove, when air and fuel are not pre-heated, is about 80% in maximum, however, this can be increased to about 84% by recovering waste heat. The method to recover waste heat is by Ljungstrom type, shell and tube type heat exchanger or organic medium heat exchangers. When the waste gas temperature is more than 250°C, pre-heating of the air and fuel gas is possible. Figure 3-F shows the flow diagram of the hot stove waste heat recovery system using organic media. (This type is installed in the NEDO Model project in the G Blast Furnace of Jamshedpur of TATA.)

(ii) Possibilities of Adoption in India

In India, only Jamshedpur steel plant of TATA Steel has adopted this technology as a NEDO Model Project. Many of the Indian steel plants have the primary rolling but most do not have the secondary rolling. Furthermore, their in-house power plants use coal, so there is a slight surplus of by-product gas in the steel plant. Thus, there is no intention of installing air pre-heaters in the hot stove. Although we have received a response from SAIL that they will install this technology in IISCO, BSP and RSP at the time, which have additional blast furnace installations, this is low in their priority. The steel plants in India are interested in CCPP (gas turbine combined cycle power plant). However, they do no have sufficient by-product gas to constantly operate a 150MW CCPP at full load, so it can be considered that a hot stove air pre-heater will be installed to produce the by-product gas.

(iii) Possibilities of Japanese Contribution

The Ljungstrom type heat exchanger is being manufactured even in India for the coal fired power plants. If the basic design for the organic media heat exchanger and the water heat pipe heat exchanger is supervised by Japan, it is possible to have this locally fabricated. In this regard, there is little benefit for Japanese companies to participate.

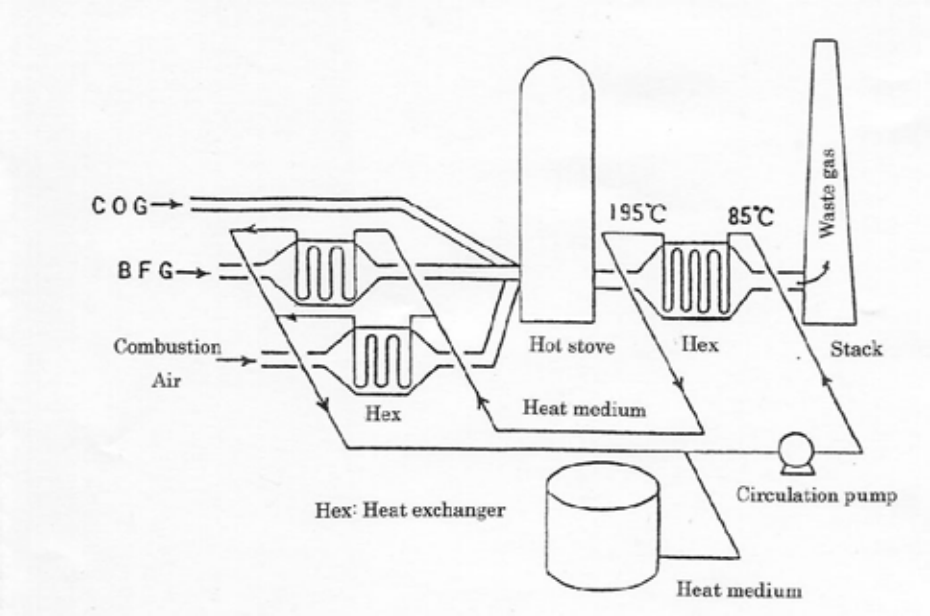


Figure 3-F Hot Stove Waste Heat Recovery System

(e) In-House Power Plant: Gas Turbine Combined Cycle Power Plant (CCPP)

The in-house power plant is thought to merely convert excess gas of the steel plant to power,

and in terms of management, not much attention has been paid to its thermal efficiency. However, due to the advancing sophistication of products and the need for pollution countermeasures, power consumption has been increasing and the cost of steel products are on the rise. As a countermeasure to this, it is necessary to increase generated power with the same excess gas volume. In order to dramatically increase the power plant thermal efficiency, a conventional power generator with net efficiency of 41% and a 145MW CCPP with net efficiency of 46% have been introduced.

(i) Outline of the Facility

This system is very compact, with the steam turbine, the generator and the gas turbine which are uni-axially arranged, and is connected to the Blast Furnace Gas (BFG) compressor via the accelerator. CCPP has high thermal efficiency, however, when the output declines, the thermal efficiency rapidly decrease. Therefore, it is preferred that by-product gas is kept in order to constantly operate the facility on full load. During scheduled stop of a blast furnace for maintenance when BFG significantly decreases, it is best to stop the facility. Figure 3-G shows the flow diagram of the CCPP.

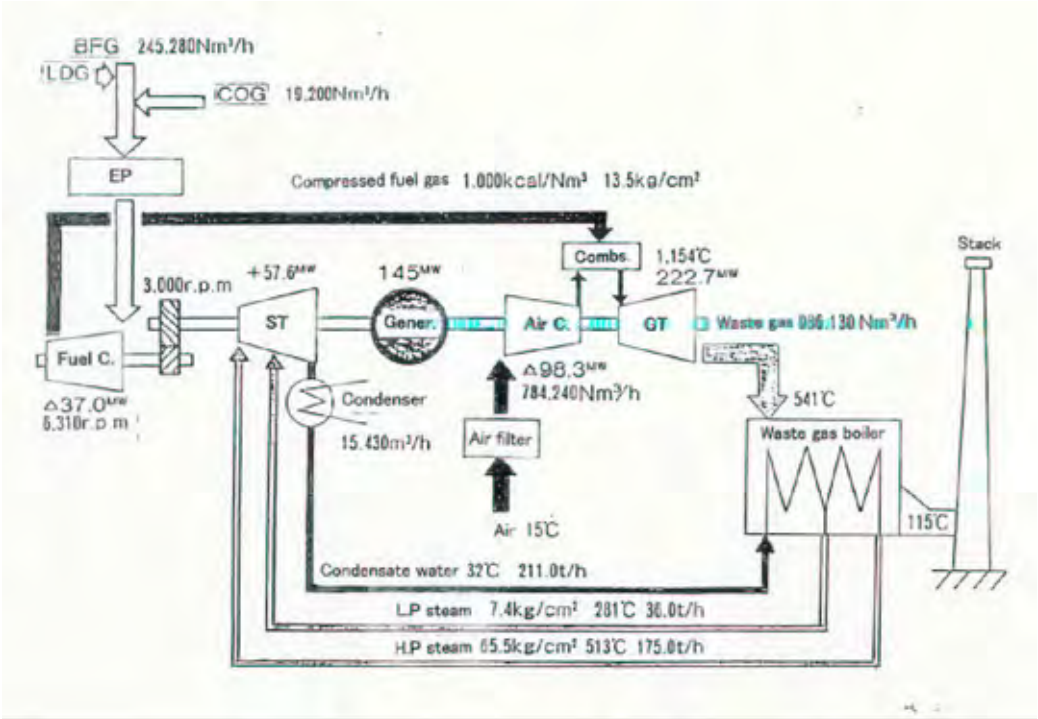


Figure 3-G 145MW CCPP Glow Diagram

(ii) Possibility of Adoption in India

This CCPP is the most important equipment for improvement of the energy intensity of

integrated iron and steel works, therefore there is strong desire for it due to its excellent efficiency despite rather expensive costs at JPY15-16 billion of 150MW. However, the fuel consumption intensity of each process in India is poor and its surplus by-product gas volume is low. Therefore, prior to recovering waste heat from the blast furnace hot stove, the improvement of thermal efficiency of the combustion furnace in each process must come first.

(iii) Possibility of Japanese contribution

Manufacturers for CCPP for natural gas are the ones such as General Electric (GE) and Alsthom (ABB). However, most of CCPP for low calorie gas are from Mitsubishi Heavy Industry (MHI) in the world.

(Notes) In order for gas turbine to operate at high temperatures of 1,150-1,500^{o}C, a big factor would be the improvement of cooling technology of the turbine blades, besides there is the development of the metal materials. BFG + COG contain dust as well as alkali metals such as K, Na, etc. This is too big risk for a manufacturer who has no experience with this technology, and a customer will be also exposed to high risk. Therefore, a Japanese company with delivery record would be of overwhelming advantage.

(f) Sponge Iron Manufacturing Facility: Sponge Iron Rotary Kiln Waste Heat recovery System

(i) Outline of the Facility

The waste gas of the rotary kiln type sponge iron manufacturing facility contains carbon monoxide, so, after it has burned at the ABC (After burning chamber) and cooled at the cooling chamber, it has passed through the electric dust collector and is discharged to the atmosphere. The waste gas at the output side of the ABC has a high temperature (950±50^{o}C). By installing a waste heat boiler to recover steam, the steam is conveyed to the in-house power plant to generate power via a steam turbine generator. With a 100t/d rotary kiln recovering 67kg/cm^{2} 490^{o}C steam, 2MW of power can be generated by the in-house power plant. Figure 3-H shows a flow diagram for rotary kiln waste heat recovery power generation system.

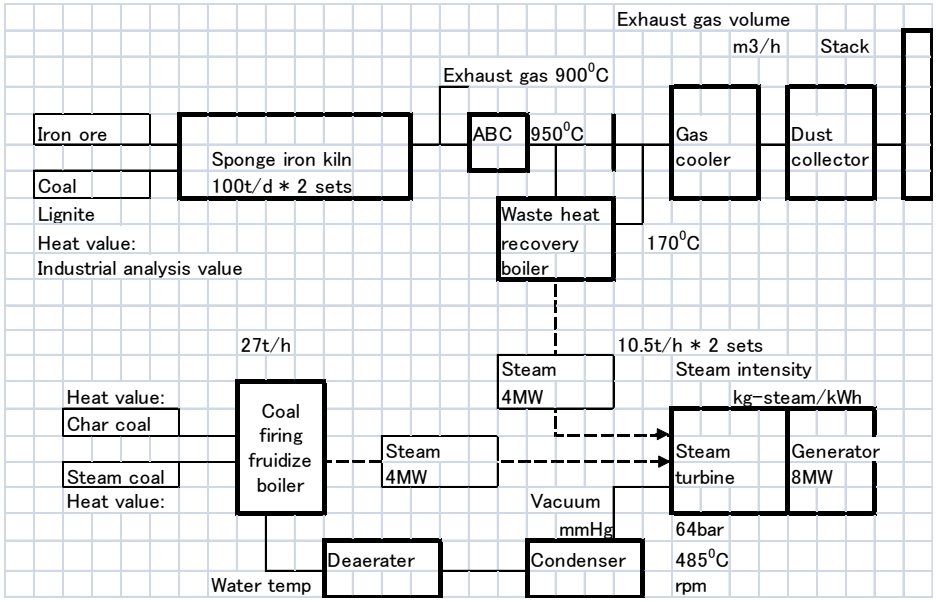


Figure 3-H Rotary Kiln Waste Heat Recovery Power Generation System Flow Diagram

(ii) Possibility of Adoption in India

There are more than 72 sponge iron manufacturing plants in India. These plants have been established near iron and/or coal mines, so many have constructed in-house power plants at the same time. The waste heat recovery system for rotary kilns is priced cheaply, and as long as there is an in-house power plant, waste heat recovery power generation is easy. Presently, this facility is in the adoption stage, and it is forecasted that these will be installed one after the other in different areas of India.

3-4 Status and Issues of EEC of the Cement Industry

3-4-1 Production of the Indian Cement Industry

(1) **Cement Production Volume of India**

The cement production volume of India in 2006 according to the Indian Cement Association (CMA) was 161.66 million tons. The production by CMA members amounted to 155.66million, while that of white and mini cement plants produced 6 million tons. The production volume of India is second to that of China worldwide, Figure 3-I shows the trend in cement production for the years 1970 – 2005.

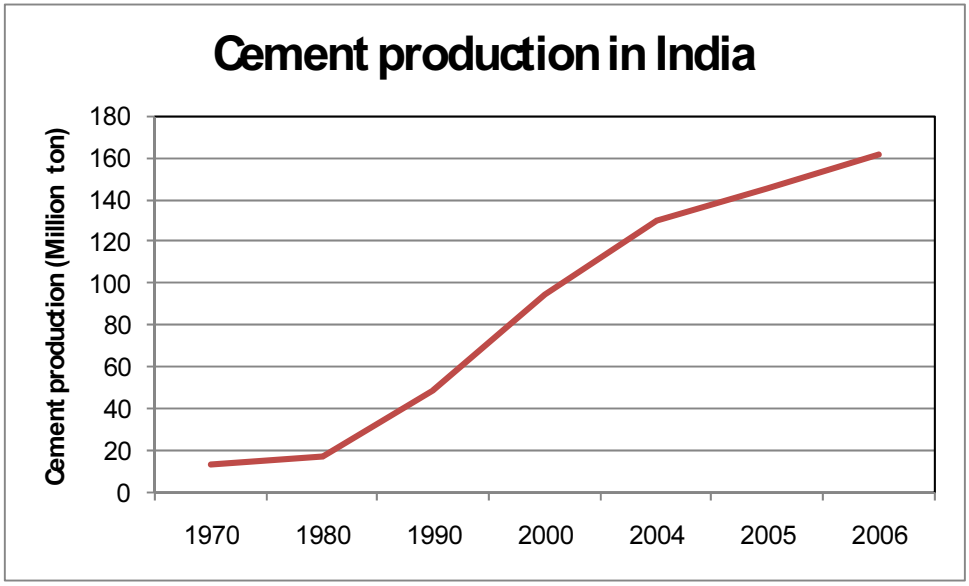


Figure 3-I Trends in Cement Production in India

(Source: 1970-2005: US Geological Survey, Mineral Yearbook 2006: CMA)

(2) **CMA and AIMCMA**

In India, there are two associations related to the cement industry – CMA (Cement Manufacturer's Association) and AIMCMA (All India Mini Cement Manufacturer's Association). The former is composed of 52 cement manufacturing companies which own large-scale kilns with capacity of 1,000 tons/day. As of 2009 May, there are 128 cement kiln plants and 44 grinding mill plants. The latter is composed of 16 mini cement companies. And as of 2009 July, there are 10 companies with rotary kilns, 4 companies with vertical shaft furnaces, and 2 companies with cement mill.

3-4-2 Status of Energy Conservation Initiatives in the Indian Cement Industry

(1) **Energy Conservation Potential of the Indian Cement Industry**

As can be estimated from Figure 3-I, the growth of production by the Indian cement industry is significantly high, seeing plants adopting new technologies and construction large-scale kilns. In the survey conducted by NEDO at the Shree Cement Ltd, Beawar Plant, and in the current survey, the fuel consumption intensity of the kilns with NSP hardly has any difference with the fuel consumption intensity of the average dry type kiln in Japan.

This survey also has the objective of identifying and evaluating proposals from the energy conservation themes of the cement industry that may be subject for ODA financing. The survey has been conducted focusing on the following two themes deemed to have high energy

conservation potentials.

(a) Conversion of Wet-Type Cement Kiln to Dry-Type Cement Kiln

Cement kilns may be divided into dry kiln (kiln with NSP and kiln with SP) and the wet-type cement kiln. There is a big difference between the fuel consumption intensity of these two methods. In Japan, until 1990, these wet kilns either have been stopped or have been remodeled to dry kilns. In India, just by converting the wet cement process to the dry process is by itself already a big energy conservation effects. (the difference between the specific fuel consumption of these two is as follows:)

- Dry type Kiln fuel consumption intensity: 836Mcal/t-clinker
- Wet type Kiln fuel consumption intensity: 1,481Mcal/t-clinker

(b) Cement Kiln Co-generation (Waste Heat Recovery Power generation) System

The heat balance of Japanese cement plants using waste heat power generation systems is shown in Figure 3-J. Strictly speaking, the recovered heating value shown here refers to the heating value of the recovered steam. The generated waste heat is from the kiln pre-heater waste heat and the clinker cooler waste heat, and this is being recovered as steam by the boiler, and is converted into power by a steam turbine generator.

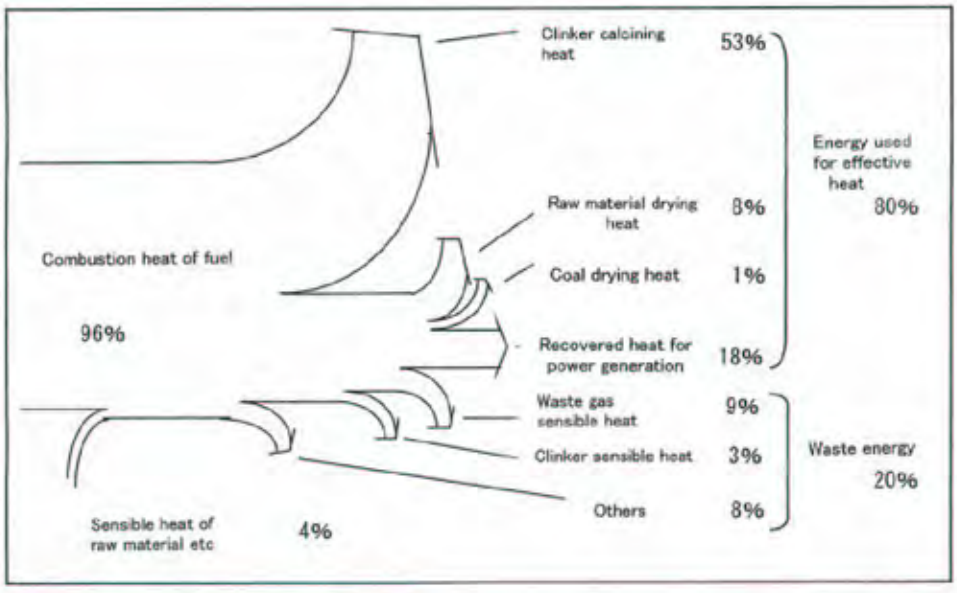


Figure 3-J Sample Heat Balance of Cement Kiln

Source: NEDO Basic Survey FY 2007

(2) **Status of Adoption of EE Technologies in the Indian Cement Industry**

A visit of the Indian cement plants was conducted to survey the status of adoption of energy conservation technologies. The results of this survey are shown in Table 3-H. Almost all plants have energy conservation measures in place. The new large-scale kilns have very good fuel and power consumption intensity thus construction works for the modernizing and upgrading of old kilns are in progress. After the upgrading works, the target of energy consumption intensity will be comparable to the intensity of Japan.

Table 3-H Status of Adoption of Energy Conservation Technologies by the Indian Cement Industry

No.	EEC technology		ACC Andhra Factory	ACC Wade Factory	India Cement Vishnupuram Factory
1	Material treatment: Vertical type roller mill		Not yet	Already	Already
2	Material pre-heater: NSP or SP		Already	Already	Already
3	Cement kiln: Pulverizing coal combustion		Already	Already	Already
4	Cement kiln: Waste material combustion		Not yet	Already	Already
5	Cement kiln: Waste heat recovery power generation		Not yet	Not yet	Partially
6	Finishing: Vertical type roller mill		Already	Already	Already
7	Finishing: Mixed cement or blended cement		Already	Already	Already
	Kiln capacity		*3,000t/d		*3,000t/d 4,000t/d
	Product mix	Ordinary Portland Cement	40	60 (Wadi-1)	30
		Portland Pozzolana Cement	60	40	70
		Ordinary Portland Cement		0 (Wadi)	
		Portland Pozzolana Cement		100	

Symbol: “Already”: Already introduced, “Partially”: Introduced in some plants

“Not yet”: Not yet introduced, “-” : Not yet surveyed

Summarizing the energy conservation data of the plants visited and surveyed:

(a) Andhra Cement Ltd. Durga Cement Plant, Date of Survey: 15th July 2009

(i) Remodeling 3,000t/d rotary kiln to 6,000t/d in progress. (after remodeling, kiln size will become 4.35m x 60m)

(ii) Energy consumption intensity

- Fuel: 720 kcal/kg-clinker
- Power: 72/kWh/t-cement

(iii) Kiln pre-heater outlet waste gas temperature is 373°C, oxygen concentration is 9.7%. (pre-heater has external air suction)

(iv) The clinker cooler waste heat temperature is 217°C as tertiary air temperature for calciner.

(v) The electric dust collector is being replaced with bag filters, target for dust concentration is less than 50mg/m^3.

(vi) After completing remodeling works on the rotary kiln, waste heat recovery power generation system is scheduled to be installed.

(vii) Power purchase cost 2.8Rs/kWh

(viii) Waste material is not yet used as fuel for the kiln

(ix) Lime stone mine is located 1km away.

(b) ACC (Associate Cement Company) Ltd Wade Cement Plant – 16th July 2009

(i) ACC was established in 1936, has plants in 14 locations, a company of the TATA Group.

(ii) ACC has Wadi-1 (3 kilns) that started operations in 1969 and Wadi-2 that started operations in 2001. One of the 3 kilns in Wadi-1 will be replaced with a new one (target 2012) and the new kiln is expected to have a capacity of 8,000t/d.

(iii) Energy consumption intensity of the new kiln

- Fuel: 710kcal/kg-clinker (presently: 830kcal/kg-clinker)
- Power: 90kWh/t-cement (presently: 120kWh/t-cement)

(iv) Actual energy consumption intensity is shown in Table 3-I.

Table 3-I Energy Consumption Intensity of Wadi plant of ACC

No.	Parameter	Unit	2007	2008	2009 (till June)
1	Clinker production	ton	2,074,593	2,078,377	999,489
2	Cement production	ton	2,649,384	2,749,208	1,404,005
3	Energy consumption up to clinkerisation	kWh/ton-cement	56.90	56.43	56.21
4	Grinding energy	kWh/ton-cement	32.83	32.47	34.14
5	Total energy	kWh/ton-cement	72.63	71.4	69.6
6	Thermal energy	Kcal/kg-clinker	710.52	711.77	712.06

(v) Waste Heat Recovery Power Generation System

- In the entire ACC, there are 5-6 plants with plans to install 7MW per unit, total 30MW.
- After installing the new type in Wadi-1, will consider installation.
- After start-up of Wadi-2, will consider installation.

(vi) Kiln waste gas via bag filter, has 30mg/ m^3N dust (State Standard: 50-150mg/ m^3N).

(vii) Has In-house power plant 75MW (Wadi Plant), consisting of fives boiler and 25MW×3 set of steam turbine generator with the steam condition of 63 kg/cm^2×485℃.

(c) India Cement Ltd Vishnupuram Plant, Survey Date: 15th July 2009

(i) India Cement Ltd. has always been a private company from the time of its establishment. It has cement plants in 7 areas and mill plants in 2 areas, manufactures 14million tons of cement a year.

(ii) Vishnupuram Plant started operations in 1980 and has 2 kilns.

- No.1 kiln : 3,000t/d, waste gas temperature is high.
- No.2 kiln : 4,000 t/d, waste heat recovery power generation system installed as NEDO model project, operating since 2004.

(iii) The company contacted Japanese cement factories in order to install a waste heat recovery power generation system to No.1 kiln, however was proposed to install the system to other plants of India Cement Ltd. Construction cost of power generation system is Rs. 15 crores/MW (300 million JY/MW), if just steam recovery, Rs. 4 crores/MW (80 million JY/MW).

(iv) Energy consumption intensity of cement kiln

- Fuel: 750kcal/kg-clinker
- Power: 90kWh/t-clinker

(v) Status of Operations of Waste Heat Recovery System

- Generated power: since start-up, sustains 8MW (at the survey 8.2MW)
- Annual operation days: 300 days
- Troubles: none
- The hammering device of the pre-heater waste heat boiler works effectively that there is no dust adherence; there is also no breakdown of the hammering device.
- Implements regular replacement of clinker cooler waste heat boiler heating pipes due to gall of the pipes.
- Pre-heater outlet waste gas temperature is 387℃, the waste gas temperature at the inlet of the clinker cooler waste heat boiler is 330℃.
- Turbine condenser pressure – 88.7kPa → degree of vacuum 95mmHg = 0.129kg/cm^{2}abs
- Turbine condenser vacuum (name plate) specifications: 0.01MPa abs = 75mmHg = 0.102 kg/cm^{2}abs
- Output indication: 8,219kW

India Cement have had no trouble for 5 years, highly commends Japanese technology.

(vi) Implements the use of agricultural wastes (biomass) as fuel in other plants. Used vehicle tires, after being recycled twice, are used in sandal processing, thus cannot be used as cement kiln fuel.

(d) Bheema Cement Ltd. Survey Date: 16th July 2009

(i) 2 units of Dry Type Rotary Kiln
2,000 t/d and 3,00t/d, 3,00t/d is new and just started operations.

(ii) Considered installing waste heat recovery power generation system to the 2,000t/d but cancelled. The Team proposed to use the steam from the 2 kilns in order to generate 8MW of power by explaining the temperature conditions using the flow diagram of the NEDO model project.

(iii) Asked whether they have any plant using wet cement kiln, the reply was that AIMCMA have no member company having wet kiln plant.
The data that there are 27 wet kiln plants is old information.

(3) **Wet Cement Kiln Survey**

(a) CMA (Cement manufacturer's Association)

Visited CMA on 4 May 2009, and obtained the following information.

(i) Cement processes in India in terms of production ratio is as follows:
- Dry process : 96%
- Semi-dry process: 1% (total 6 kilns)
- Wet process: 3%

(ii) There are a total of 300 units of wet kiln. 27 Kilns produce Portland cement, while the others are producing white cement. (Therefore, it is possible to convert 27 kilns to Dry Process).

(iii) CMA is composed of 52 member companies and they have completed the conversion from wet to dry process.

(b) AIMCMA (All India Cement Manufacturer's Association)

Visited in 2009 July 16, and obtained the information as per section 3-4-1-(2), and the members' list. On the same day, during the visit to Bheema Cement Ltd., we inquired after the use of the wet process and we received the reply as per 3-4-2-(2)-(d). That is, we found out that there are no companies possessing wet cement kiln in AIMCMA.

(c) Future Direction

According to the CMA, the cement production volume of Mini Cement is 6 million tons annually. The production volume of all the 14 AIMCMA member companies is estimated at more than 4million tons, and the cement being produced by wet process (except white cement) would be about 2million tons. This corresponds to less than 1% of the total cement production of India.

If the production volume is less than 1%, this will only negatively affect the energy consumption intensity of the entire Indian cement industry by 0.6%. The dry kilns have contributed to the increase in production and reduction of costs in the past 15 years that cement production grew, and for the factories that did not convert to the dry type and still maintain, they have no intention to convert.

(4) **Issues in EEC in the Indian Cement Industry**

(a) Waste heat recovery power generation system in Cement Plants

(i) In order for the Indian cement industry to respond to the rapid increase in demand for cement since 1995, they have adopted modern large-scale facilities, increased and improved the capacity of existing facilities. As a result, this energy consumption intensity of cement increase, and has approached global top level.

(ii) In order to further improve the energy consumption intensity of cement plants (specific consumption – specific recovery), there is a need to proceed with cement kiln waste heat recovery.

(iii) The cement kiln waste heat recovery power generation system can recover power of about 30-40 kWh/t-clinker, which would improve the energy consumption intensity of the cement plant by more than 7%.

(b) Contributions to the Material Recycling Society

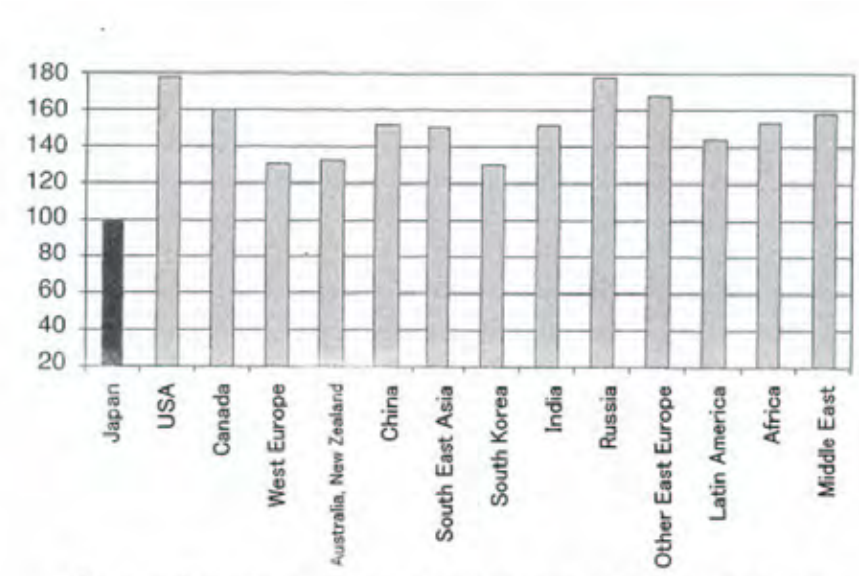
Activities that use wastes and biomass as heat energy in kilns have started in the Indian cement industry. Part of the issues on this matter includes the development of recycle routes as well as contributions to a material recycling society. This greatly contributes to the CO_2 emission reduction in the cement industry.

(c) Determining whether to modernize or stop operations of in-house power plant

On 2002 March, international comparisons of energy consumption intensity per ton of clinker was released in “Toward a Sustainable Cement Industry Substudy 8: Climate Change (March 2002)” (Battelle) as shown in Figure 3-K in the next page.

Basing comprehensively on the information obtained thus far, the energy consumption intensity of the Indian cement industry in 2000 can be estimated to be about 1.35-1.4 times that of Japan, which could mean that there are factors that caused this poor energy consumption intensity of the Indian cement industry.

Figure 3-K International Comparison of Energy Consumption Intensity per Ton of Clinker (year 2000, Japan=100)



Source : 「Toward a Sustainable Cement Industry Substudy 8: CLIMATE CHANGE (March 2002) 」 (Battelle)

Cement plants in India are constructed in the vicinity of limestone mine. Considering that the electricity transmission grid infrastructure in India was delayed, the area can be said to have poor conditions in terms of power supply, which could have lead the cement plants to construct in-house power plants. If the net thermal efficiency of the in-house power plants of the cement plants is poor, then this becomes a factor that would adversely affect the energy consumption intensity of the plant. Particularly, in modernizing the cement plants, keeping the power plants in a poor state would not improve the energy consumption intensity values of the cement plant, even if it is said that the energy consumption intensity of the cement kiln has reached global top level.

In 2007, according to the NEDO Survey Report, the Beawar Cement Plant of the Shree Group has been surveyed, and it is written that this plant has a 44MW in-house power plant. It has also been confirmed in this visit where 4-plants were surveyed, the Wadi Cement plant has a 75MW in-house power plant. (Not confirmed with other 3 plants)
(Note) The output of this two in-house power plants is much greater than the power consumption of the cement plant.

There is a power grid in the vicinity of the cement plant, and until power shortage is solved, in-house power plants are very important for the survival of the cement companies. However, it

will be the issues in the future that either this must be replaced with high-efficiency systems to lower the cost of fuel, or discard the whole idea of an in-house power plant and switch to purchasing power supply instead.

(5) **Energy Conservation technologies and Systems with possibilities for Adoption in the Indian Cement Industry**

(a) Cement Kiln: Waste Heat Recovery Power Generation System

(i) Outline of Facility

The main waste heat of the cement kiln is the waste gas from the pre-heater and from the clinker cooler. These two have different waste gas temperature and properties. By installing a pre-heater boiler (PH Boiler) and an air quenching boiler (AQ Boiler), the generated steam of different pressure and temperature can then be sent to one unit of steam turbine (strictly speaking Mixed Turbine) to recover as power.

The recovered power varies depending on the fuel consumption intensity of the cement kiln, but approximately it corresponds to 30% of the consumed power and the recovered energy intensity in 30-40 kWh/t-clinker. The conceptual diagram of the cement kiln waste heat recovery system is shown in Figure 3-L, a sample of specifications is in Table 3-Jwhile Picture 3-A and Picture 3-B show pictures of the system.

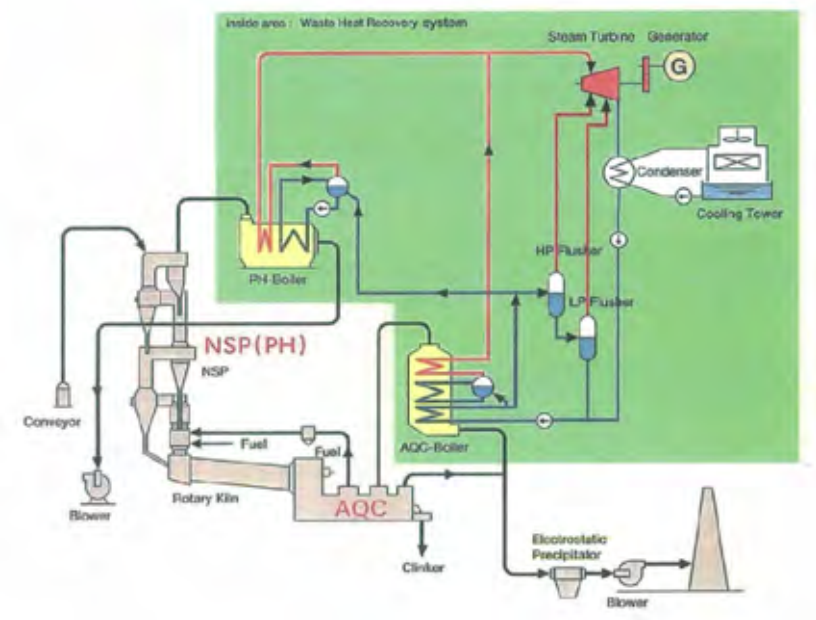


Figure 3-L Conceptual Diagram of Cement Kiln Waste Heat Recovery System

Table 3-J Sample Specifications of Waste Heat Recovery System

Kiln capacity		4,000t/d	Output of turbine generator	7,700kW
		Unit	PH boiler	AQC boiler
Specifications of waste heat boiler	Waste gas temperature at inlet	°C	340	360
	Evaporation	t/h	28	15
	Steam pressure	Bar	16	16
	Steam temperature	°C	315	345
	Feed water temperature	°C	200	56

Picture 3-A Cement Kiln Waste Heat Recovery System

Picture 3-B Cement Kiln Waste Heat Recovery System Generator

(ii) Possibilities of Adoption in India

In Japan, all companies have adopted the waste heat recovery power generation system, however in India, other than the 7.7MW waste heat recovery power generation system at the Vishnupuram Cement Plant under the NEDO Model Project, there are 6 units of independently developed systems. However, according to information obtained, these have poor working rate and there are many troubles with it.

The four companies surveyed during this visit, they all have plans to install this technology, and the possibility of its adoption in the future is very high.

For lowering the construction cost per MW, the waste heat recovery power generation system is recommended to be installed to a kiln of more than 4,000t/d capacity or 2 adjacent units with a total of 5,000t/d.

The 4 companies surveyed during the visit are all considering the installation of waste heat recovery power generation system.

- Andhra Cement Ltd., Durga Cement Plant: remodeling the 3,000t/d kiln to 6,200t/d kiln.
- ACC Wadi Cement Plant: remodeling 3,000t/d + 5,000t/d to 6,000t/d (in progress) + 5,000t/d
- India Cement Ltd. Vishnupuram Plant 3,000t/d + 4,000t/d

There is a request that because the waste gas temperature is high, they would like to install a waste heat recovery system to the 3,000t/d

- Bheema Cement Ltd. 2,000t/f + 3,000t/d, considering the installation of waste heat recovery power generation system.

It was learned that as a company, the ACC is in the planning stage for the installation of waste heat recovery power generation systems. Therefore, during this survey, it was learned that the direction for 1 company (ACC), 3 plants (except Wadi Cement Plant which is under ACC), 8-9 units is to install the waste heat recovery power generation system. Therefore, there is sufficient basis to believe that there is possibility for adoption.

<Forecast Number of Installations>

Table 3-K shows the companies in India with cement production capacity of more than 5million tons/year as of 31 Match 2007. Assuming that these companies will each install waste heat recovery power generation system of 4million tons per year, a total of 26 units will be installed,

which are shown in the column of Gene Estimation in Table 3-K. Therefore, even conservatively estimating, it can be said that there are 20 units of system for installation.

Table 3-K Companies with 5million t/year Production and Estimated Number of Waste Heat Recovery Power Generation Installation

Company	Capacity Mt/y	Gene. Estimation	Company	Capacity Mt/y	Gene Estimation
ACC Ltd.	19.91	5	JK Group	8.45	2
Ultra Tech Cmt. Ltd.	17.00	4	Century Textiles	6.30	1
Gujarat Ambuja Group	15.30	4	Birla Corp. Ltd.	5.78	1
Grasim Industries	14.12	3	Madras Cement	5.47	1
Jaypee Group	9.19	2	Lafarge India (P) Ltd.	5.00	1
India Cements	8.81	2	Other Companies	51.40	0
			Total	166.73	26

(iii) Possibility of Japanese Contribution

TSL is a possibility. It has been 5 years since the waste heat recovery power generation system at the Vishnupuram Cement Plant was installed as a NEDO Model project, and to date, it has not had any breakdowns, the hammering device is functioning effectively, and it has sustained its initial performance and efficiency with high reliability.

The product developed in Japan may be very expensive, however, it has an intangible advantage that “its maintenance is excellent and its availability very high”, thus, it can be said that the possibility of Japanese contribution is high. In order to lower the construction cost per MW, it is advantageous to offer to large scale kilns.

Chapter 4 Confirmation of Status of Initiatives towards Efficient Use of Coal in India

4-1 Status of the Sector

4-1-1 Coal consumption in India

Table 4-A shows the actual consumption of coal in India. According to Table 4-A, 70.9% of the coal usage in India in 2007-2008 is accounted for by the power industry, followed by the in-house power plant consumption 6.2%, sponge iron 4.6%, iron and steel 3.7%, cement 3.3% and others at 11.2%.

The industry that has a high consumption of coal other than the power sector is the iron and steel (including the sponge iron, 8.3%) and the cement industry. Thus, a survey was conducted on the status of initiatives towards the effective use of coal in the power, iron and steel and the cement industries.

Table 4-A Actual Consumption of Coal by Sector in India

Unit: Million ton, (%)

	Power (Utility)	Power (Captive)	Steel	Cement	Sponge iron	Others	Total
2005-06	286.8	19.2	19.7	15.0	14.6	41.4	396.7
2006-07	298.1	23.7	17.3	14.8	17.5	49.4	420.8
2007-08	322.2	28.3	17.0	15.0	20.9	51.1	454.5
2007-08(Share)	(70.9%)	(6.2)	(3.7)	(3.3)	(4.6)	(11.2)	(100.0)

Source: Coal Directory of India, Section I, PI.12

4-1-2 Supply condition of coal

(1) Ministry of Coal (MOC) Organization and its Jurisdiction

Companies and public corporations under the MOC umbrella are as follows:

MOC
- COAL INDIA LIMITED (CIL) AND ITS SUBSIDIARIES
  - Coal production: 400 million t/y
  - Manpower: 430,000 persons
- NEYVELI LIGNITE CORPORATION (NLC)
  - Production of 3 Lignite Mines: 22 million t/y
  - Generated Power Output of 3 Thermal Power Plants: 2,490MW
- SINGRAENI COLLIERY COMPANY LIMITED (SCCL)
  - Joint venture Company: Capitalization Share: Indian Government 49% and Andhra Pradesh State Government 51%
  - Hard coal production: 37 million t/y
- COAL MINES PROVIDENT FUND ORGANISATION (CMPFO)
- COAL CONTROLLER

MOC has a supply contract with the thermal power industry and the cement industry, wherein it has a 60% supply obligation to the cement industry.

(2) Coal Reserves and Production

Coal accounts for 55% of commercial energy. According to Eleventh Five year Plan, coal reserve data are as flows:

(i) Coal estimated reserve: 264.5 billion ton

(ii) Coal proven reserve: 102 billion ton

(iii) Coal recovery reserve: 52 billion ton

(iv) Coal production plan: 680 million ton

(3) Coal Preparation Facility

(a) Thermal Coal

Presently, coal preparation facilities have 103 million tons/year capacity and will be expanded to 250million tons/year in 5 years from now. 37 projects have expansion plan of 108 million tons.

(b) Coking coal

Coal India Ltd. (CIL) has 11 coal preparation facilities, with a capacity of 19.86 million tons. This is an old system. The expansion plan for 31million tons/year has 7 projects. 101million tons/year is being planned by Coal India. The plant facilities have a 40 million ton and 50 million ton system in series.

4-1-3 Electric power industry

(1) **Coal consumption of coal fired thermal power plants**

The coal consumption intensity of the coal fired power plants of the Indian power industry is 320.6 kgoe /kWh in oil equivalent according to the Energy Balance of Non-OECD countries, IEA 2008 Edition. According to the Energy Balance of OECD countries, IEA 2008 Edition, the coal consumption intensity in oil equivalent of the coal fired power plants in Japan is 205.0 kgoe /kWh. Comparing the coal consumption of the Indian coal fired power plants to that of Japan, the former is worse by 56%.

(2) **Evaluation of thermal efficiency of coal fired power plants**

(a) International comparison of coal consumption of coal fired power plants (commercial use)

Figure 4-A shows the trends of coal intensity ton/GWh of the power plant by country. In India coal consumption of coal fired power plant in latest year is about the same as in 1990.

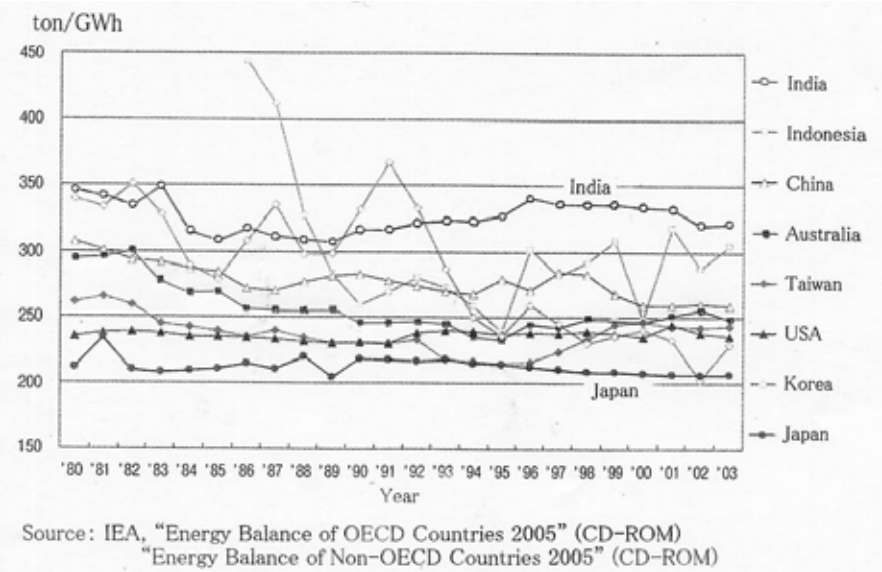


Figure 4-A Trend of coal consumption per GWh

(b) Trends in the total output of coal fired thermal power plants

Table 4-B shows trends of installed capacity by each unit size from 1966 to 2005. According to this table, as of the end of 2005 these power plants had a total capacity of 68GW, and 200 to 250MW unit were the leading units, accounting for 53.4% of the total capacity. Next were the 500MW unit with 23.4%, the 100 to 150MW unit with 15.2%, and the under 100MW unit with 7.9%. (The majority of the boilers are the pulverized coal firing type.)

The installed capacity of coal fired power plants in Japan at the end of 2005 was 35GW, 50% of

the figure for India, but the leading units were the 700 to 1,000MW.

Table 4-B Size and vintage of coal-based units in India

Age	Installed Capacity (up to end of 2005)					Installation Year
Unit Size	<100	100/110/120/ 140/150	200/210/250	500	Total	
< 5 years		490	3165	4500	8155	2001–2005
5–10 years	75	740	5280	2000	8095	1996–2000
10–14 years	205	120	8060	3500	11885	1991–1995
15–19 years	332	890	8370	5500	15092	1986–1990
20–24 years	540	1670	8270	500	10980	1981–1985
25–29 years	120	2640	3290		6050	1976–1980
30–34 years	460	2710			3170	1971–1975
35–39 years	2210	720			2930	1966–1970
40+ years	1466	430			1896	< 1965
Total	5408	10410	36435	16000	68253	

The unit size and vintage of current installed capacity of Indian coal and lignite power plants up to the end of 2005 is shown in five-year periods.

Source: Chikkatur and Sagar, 2007.

Source: A Resource and Technology Assessment of Coal Utilization in India

Ananth P. Chikkatur, Kennedy School of Government, Harvard University, Cambridge, MA

October 2008

(c) The thermal efficiency of coal fired power plants

The thermal efficiency of existing power plants by capacity is shown in Table 4-C. The annual average net efficiency of existing plants is 29%.

Table 4-C Efficiency of existing power plants

Unit Size (MW)	Total units operating*	Units considered for data*	Avg. Gross eff. (Actual)	Avg. Gross efficiency (Design)	Percent Variation**	Avg. Net efficiency (Actual)	CERC norms	PLF
500	18	18	35.7%	38.1%	6.9%	33.3%	35.1%	81.9%
200/210/250 (KWU)^	154	48	35.0%	37.7%	7.6%	32.0%	34.4%	86.6%
200/210 (LMZ)^		37	34.6%	36.2%	4.7%	31.7%	34.4%	78.0%
100 to 200	84	32	27.6%	34.9%	26.6%	24.2%	—	66.5%
Less than 100	67	32	25.8%	31.2%	21.1%	22.8%	—	57.7%

Source: Chikkatur, 2005. Calculations based on CEA data (CEA, 2005c).
Average efficiency is calculated based on operation data for the period April 2000 to December 2003, as collected by the CEA.
* Units operating on Lignite and those installed after 2000 are not included here.
** Percent Variation is defined as (Design eff—Actual eff)/Actual eff.
^ Design efficiency varies with technology—KWU units are based on Siemens technology and LMZ units on Russian technology.

Source: A Resource and Technology Assessment of Coal Utilization in India

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(d) Reasons for the poor thermal efficiency of coal fired thermal power plants

1) Non-adoption of SC (super critical steam condition)

Over the 36 years from 1970 to 2006 India's GDP grew at an average annual rate of 7.8%. Coal fired thermal power plants increased their capacity at an annual average rate of 7.9% but power generation capacity could not keep up with the growth in electricity consumption, so it was necessary to give more priority to the construction costs per kW than thermal efficiency improvement. Therefore, SC (super critical steam condition – for example, 24.1MP, 538^{o}C/566^{o}C) was not adopted, to say nothing of USC (ultra super critical steam condition).

2) Outdated small and medium-sized power plants are still in operation

Old units with a capacity of less than 200MW are inefficient but their depreciation is finished so there is no fixed cost burden. This means a low power generation unit cost and so measures are still being taken to extend their lives and keep them operating.

3) Operation with worse thermal efficiency, under the design thermal efficiency

Plants are being operated with a worse thermal efficiency than their design thermal efficiency. The thermal efficiency of units with a capacity of 200MW or less is particularly bad. At the time of power plant construction an annual average thermal efficiency target should be established, and the equipment necessary to enable the maintenance for keeping it should be installed.

(1) **Characteristics of coal**

Table 4-D shows the characteristics of the coal being used in Indian power plants. The impact of 46% ash on the thermal efficiency of power plants changes depending on the exhaust gas temperature of the air preheater outlet of the boilers. If it is assumed that this temperature is 300^{0}C, in case of coal ash being of 46%, and coal higher heat value being of 2,800kcal/kg, theoretically the thermal efficiency of the power plant will decline by a relative value of 0.9%. However, manufacturers take this into account when calculating the design efficiency of power plants.

Table 4-D Typical coal characteristics in Indian power plants

Details, %	Kahalgaon	Simhadri	Sipat	US (Ohio)	China (Long Kou)
Carbon	25.07	29.00	30.72	64.2	62.8
Hydrogen	2.95	1.88	2.30	5.0	5.6
Nitrogen	0.50	0.52	0.60	1.3	1.4
Oxygen	6.71	6.96	5.35	11.8	21.7
Moisture	18.5	15.0	15.0	2.8	11.0
Sulphur	0.17	0.25	0.40	1.8	0.9
Ash	46.0	46.0	45.0	16.0	7.7
Calorific Value, kcal/kg	2450	2800	3000	6378	6087

Ultimate analysis of non-coking (thermal) coal from three power stations (Kahalgaon, Simhadri, and Sipat) is shown along with analysis of Ohio coal of the United States and Long Kou coal from China

Source: Visuvasam *et al.*, 2005

Source: A Resource and Technology Assessment of Coal Utilization in India

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(Additional information) Table 4-B, Table 4-C, and Table 4-D are quoted from "A Resource and Technology Assessment of Coal Utilization in India" published by the Pew Center on Global Climate Change. On Page 33, it contains the following statement which says that improvements by coal washing technologies would improve thermal efficiency by 1%. In this case we can interpret from the context that this means the relative value of the thermal efficiency will improve 1%. We can infer that this 1% improvement includes experimental effects such as a reduction in the heat transfer amount due to dirt on the heat-transfer surface. Furthermore, the figures 33.3% and 35.1% quoted below are net efficiency on an HHV basis.

> "According to a recent Nexant (2003) study, supercritical PC technologies, including flue gas desulfurizers (FGD), would be at least 5% more efficient (35.1%) than current 500MW sub-critical units (33.3%), and the use of washed coal would increase the efficiency by another 1%"

4-1-4 The iron and steel industry and the cement industry

(1) **The iron and steel industry**

(a) The blast furnace method and the COREX method

The majority of coal is consumed for the reduction reaction of iron ore, but the specific consumption of coking coal is good, if one takes into account the quality of the raw materials. However, if the byproduct gases and waste energy produced in iron and steel works were used effectively by installing energy conservation equipment, it would no longer be necessary to use coal in-house power plants, and electricity purchases could be reduced to almost zero. Refer to 3-3-2-(3).

(b) Rotary kiln method

Sponge iron is being produced using innumerable (approximately 500) inefficient rotary kilns and inefficient small (5 to 10MW) coal-fired power plants. It is estimated that the real net thermal efficiency of small capacity coal-fired in-house power generation units is 22% or less. Refer to the EE & C issue in 3-3-2-(3).

(2) **Cement Industry**

Coal is being used in cement kilns and coal-fired power plants. The conversion of cement kilns to dry systems has been almost completed so the fuel specific consumption of kilns has greatly improved, and there are many plants that have achieved world-class standards. However, the cement industry also appears to have a large number of inefficient, coal-fired, small power generation units.

Just as in the case of coal-fired in-house power plants installed in rotary kiln plants, the electricity supply network is poor, so in-house power plants are necessary and essential plants for the continuation of productive activities under conditions in which there is not a stable supply of electricity. However, on the other hand, it is estimated that even if small power units were to adopt high temperature and high pressure steam conditions, their power generation efficiency would be low, and as a result a large number of small power units with poor thermal efficiency have been constructed. Refer to 3-4-2-(4).

4-2 Status of initiatives to improve the efficiency of coal use in India

(1) **Potential for energy-saving through the effective use of coal**

In India the electricity sector (utilities) and captive power sector account for 77.1% of total coal use. As stated in section 4-1-3, if a simple comparison of the coal consumption rate per kWh in Japan and India is made using the IEA energy balance, the result for India is (320.6-205.0)/320.6=115.6/320.6=0.36. In other words, there is the potential for 36% energy-saving. It is estimated that even taking into account the geophysical disadvantages faced by India, including a high cooling water temperature of turbine condensers and the large number of impurities in the coal, there is room for a 20% (64kgoe/kWh) improvement in coal consumption.

We surveyed the literature in order to estimate the causes of this and analyzed the background of the data shown in Table 4-B, Table 4-C and Table 4-D. Then we counted the conclusion as described in section 4-1-3-(2)-(d).

Therefore, if we make a situation in which all of India has adopted SC (super critical steam condition), the target value will be of net efficiency 35.7% (on an HHV basis) under the conditions of 24.1Mpa. 538/566 ^{o}C. The potential of energy-saving relative to current conditions is (35.7-29)/29=0.23. In other words, it can be estimated that there is the potential for 23% energy-saving.

(Additional information) Net thermal efficiency under SC conditions (24.1Mpa, 538/566^{o}C) is approximately 40.5%, but we made it 35.4% taking into account the fact that the actual net thermal efficiency of sub-super critical steam condition 500MW units under current conditions is 33.3%, and in addition assumed the improvement effect of coal washing technologies has a relative value of 1%, giving a target value of 35.7%.

If we assume that the above estimate results are the same for captive power as well and we set the other sectors (100-77.1=22.9) to 0 (zero), the potential of energy saving of coal use in India is approximately 18%.

(2) **Introduction status of clean coal technology in India**

Fifteen themes related to energy-saving and environmental improvement in the power generation, iron and steel, and cement sectors were selected from NEDO's Clean Coal Technology Journal, and the introduction and dissemination status of these themes was surveyed in the literature and through factory visits. The results are shown in Table 4-E.

Table 4-E Introduction status of clean coal technology in India

No	Clean Coal Technology	Status Of introduction	Note
1	Coal Preparation and reforming technology	Planning by NEDO Model	
2	Pulverized Coal-fired Power Generation Technology USC (Ultra Super Critical Steam Condition)	Sub-critical steam condition	Note 1
3	CFBC (Circulating Fluidized-bad Combustion Tec)	Already introduced	Note 2
4	ICFBC (Internal circulating FBC)	Not yet surveyed	
5	PFBC (Pressurized FBC)	Not yet introduced	Note 3
6	IGCC (Integrated Coal Gasification Combined Cycle)	Pilot test finished	Note 4
7	PCI (Pulverized Coal Injection for Blast Furnace)	Already introduced	
8	DIOS (Direct Iron Ore Smelting Reduction Process)	Not yet introduced	Note 5
9	CDQ (Coal Dry Quenching Technology)	Planning by NEDO model	Note 6
10	CO_2 Recovery and Sequestration Technology	Researching	
11	SOX Reduction Technology	Already introduced	Note 7
12	NOX Reduction technology	Pilot test finished	Note 8
13	Particulate Treatment Technology	Already introduced	Note 9
14	Effective Use of Ash	Already introduced	Note 10
15	Combustion Technology for Low Now Emission	Already introduced	

(Note 1) As of 2005, 25 units with a capacity of 500MW are operating and they have adopted the sub-critical steam condition. Therefore, the gross efficiency of the state-of-the-art designs is 38% and the net efficiency is 33.3%. (Refer to Table 4-C.)

Currently two SC (super critical steam condition) power plants are under construction using the technologies of Russia and South Korea in Sipat and Barh and they are scheduled for completion in 2009.

The Indian Government has been implementing the UMPP (Ultra Mega Power Project) since 2007 in order to solve the electricity shortage. The UMPP includes plans to construct at least seven coal fired power plants that have the total capacity of 4,000 MW each site, and the plans are being carried out by a private contractor using the Build-Own-Operate (BOO) method. It is mandatory for the private contractor to adopt SC (super critical steam condition) when constructing the plants. The private contractor can adopt USC, but the company which can achieve the lower unit cost of power generation will be able to win the tender for the project so it can be concluded that SC will be adopted.

(Note 2) BHEL (Bharat Heavy Electrical Limited) is carrying out the development and manufacturing. For example, in 2000 this company delivered the CFBC boilers (2×125MW) of the Surat Lignite Power Plant.
CFCB boilers are mainly used as combustion boilers for lignite, waste coal, etc.

(Note 3) Believing that PFBC is good for combusting the high-ash and high-moisture content Indian lignite in a low SOX and low NOX condition, BHEL has proposed demonstration tests of 60MW PFBC to the government.

(Note 4) BHEL performed pilot tests in the second half of 1990 aimed at the development of technologies for fluidized-bed gasification combined power generation. We have information that BHEL is currently searching for a sponsor for 100MW class demonstration tests.

(Note 5) In India the COREX method has been adopted.

(Note 6) They are planning to install CDQ in Tata's Jamshedpur. (NEDO model project)
A large number of outdated, Russian-made, small CDQs are operating in the VIZAG steel plant.

(Note 7) Refer to 4-2-(3)-(c).

(Note 8) A pilot test of the selective catalytic reduction process was carried out in NTPC's Badapur power plant in 1988-1989.

(Note 9) The ESP (Electrostatic precipitator) has already been widely adopted. However, the volume of coal ash is large and its electrical resistance is high, so its particulate collection effect is poor and therefore some companies have replaced it with a bag filter.

(Note 10) We have information that 30% of all of the coal ash being used as raw material for cement, etc. is being used effectively.

(3) **Issues on efficient use of coal in India**

(a) Improvement of the net efficiency of commercial-use power plants

1) Adoption of SC (super critical steam condition)

Under current conditions the net efficiency of commercial-use power plants is extremely low at approximately 29%. This is due to the fact that when the power plants were constructed the reheating and steam conditions deemed to be appropriate for their unit size were not used.

India plans to install a large number of power generation units with a unit size from 500 to 1,000MW in order to meet the energy requirements of its increasing GDP, so it should achieve a net efficiency of 39% or more by adopting SC (or USC).

2) Improve efficiency by upgrading old power plants

By 2015 there will be power generation units that are 40 years old or older generating a total of 10,996MW. It is necessary to replace them because they all have a unit size of 150MW or less and therefore have poor efficiency. It is thought that the power plants constructed at that time will be comparatively near to urban areas and factory zones, so desulphurization and denitration equipments will be necessary.

(b) Feasibility study on IGCC (Integrated Coal Gasification Combined Cycle) and coal gasification technologies

IGCC technologies are getting a lot of attention as measures for tackling global warming and other environmental issues. These technologies have a target of a net efficiency of 48% or higher in the future, and demonstration tests are currently being carried out in Japan as well. A capacity of 250MW has been selected for the capacity of the demonstration equipment based on the assumption that the capacity of the commercial equipment will be 500MW or more. Last year the demonstration plant achieved continuous operation of over 2,000 hours. So now, it gives bright future of practice use.

Therefore, IGCC is hopeful clean coal technologies as next-generation technologies in succession to USC technologies, but as we stated in section (a)-2) they are one option when replacing old power plants. However, the types of coal are different to those in India so it might be necessary to implement feasibility studies of coal gasification technologies, and to carry out demonstration tests if necessary.

(Note) Technology for more improvement of coal- fired power plant thermal efficiency

It is thought that there are two means of more improving the thermal efficiency of coal-fired power plants.

- Adopt A-USC (Advanced USC), which is higher ranked than USC (for example, 24.5MP, 600^{o}C/600^{o}C), as the steam condition for the power plant steam turbine. For example, if steam conditions of 35Mpa and 700^{o}C/720^{o}C/720^{o}C are achieved, net efficiency will improve from 42% (USC) to 46% (A-USC).

  In this case, the development and application of Nickel base alloy with an even higher

strength at elevated temperature than austenitic steel will be essential.

- If IGCC is adopted and 1,500°C-grade gas turbines are used, net efficiency will improve to 46% and in addition if a dry gas purification system can be developed net efficiency will improve to 48%. Methods using oxygen in gasification equipment consume electricity for manufacturing the oxygen, so there is a high likelihood that net efficiency cannot exceed A-USC. For this reason Japan does not use oxygen in coal gasification, and is carrying out demonstration test using air, with which gasification is thought to be difficult.

Comparing these two approaches, under current conditions IGCC is more effective for not only thermal efficiency but also pollution control.

(c) Promotion of pollution control measures

The sulphur content of Indian coal is low at a weighted average of 0.59% but the annual volume of coal consumption is large so an enormous amount of sulphur is emitted into the atmosphere. (In a one year period from 2007 to 2008, the amount of SO_2 emitted by power plants alone was 4.1 million tons/year.)

Therefore, it is thought that the installation of desulphurization equipment in power plants near to urban areas and factory zones will be necessary.

We have information that an FGD (flue gas desulphurizer) is actually installed in the Trombay thermal power station in the Mumbai suburbs, and that Reliance Energy Limited has decided to install an FDG in its Dahanu power plant.

On the other hand, we have not received any information that denitration plants have been installed, but it is thought that as India's GDP grows resulting in greater industrial activity, in the near future it will be necessary to introduce denitration plants in addition to low NOx combustion technologies for boilers.

(4) **Possible clean coal technology for introduction in India**

In order to solve the challenges to overcome to improve the efficiency of coal use in India stated in section (3) above, we selected two kinds of technologies: the technologies that Japan can contribute and the technologies that India needs.

(a) Coal preparation technologies

1) Overview of the plants

Demonstration projects are being carried out for this technology in Monnet Ispat & Energy Ltd.

under the “Clean Coal Technology Dissemination Project (Coal Washing Model Project)” for which the Indian Government [the Ministry of Coal] and NEDO concluded a basic agreement in October 2008.

Indian coal has a low sulphur content of 0.1% to 0.8% (an average of 0.59%) but it has the characteristic that the ash (40 to 50%) does not separate out easily. For this reason, for power generation coal washing processing is not carried out and the raw coal is used unaltered. For this reason, naturally the thermal efficiency of power plants decreases if the ash content increases. In addition, it needs more transportation capacity and more location for storage of fly-ash. And it causes atmospheric pollution by transportation of coal and storage of fly-ash, water pollution near storage of fly ash.

With the objectives of reducing the severity of these problems and maintaining the average ash content of the clean coal at 34% while improving the clean coal yield ratio (=100 × clean coal amount/raw coal amount), we utilized coal preparation technologies developed in Japan to carry out demonstration projects involving the washing of Indian coal with a high ash content. India forecasts that if the ash content of the coal is reduced to 34%, the thermal efficiency of the power plants will improve by 1%. (Refer to 4-1-3-(3)-Additional Information.)

This process flow is shown in Figure 4-B.

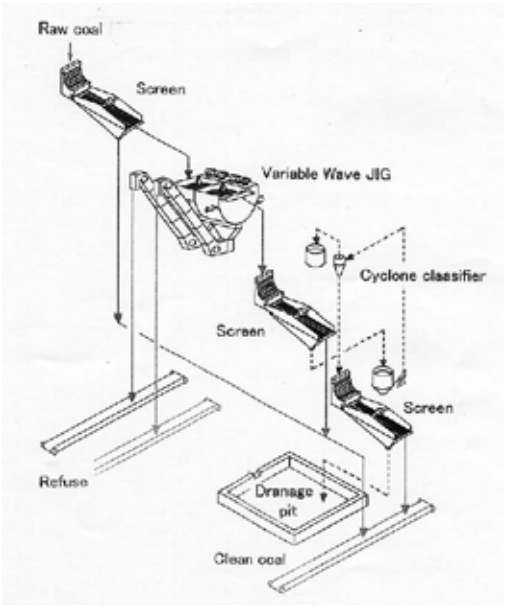


Figure 4-B Process flow of Coal Preparation Facility

- Raw coal that has undergone the first crushing process (50mm or less) is fed into the equipment and passes through the screen and hopper before being injected into the variable wave jig.
- Inside the variable wave jig, the ash and charcoal are separated by the difference in their specific gravities by forcing the surface of the water to pulsate up and down. The waveform of this jig is basically a trapezoidal wave, and the separation performance can be improved by subtly adjusting the waveform in accordance with the characteristics of the raw coal.
- In order to avoid remixing the separated coal layer and ash layer, the equipment has automatic controls to detect the boundary position and remove only the ash.

2) Potential for introduction of the technologies

These technologies can improve the clean coal yield ratio and reduce the ash content so India has high expectations of them.

The Ministry of Coal also has stated that if the demonstration projects produce good results other coal companies will introduce the technologies. In 2006 NEDO conducted a site survey of factories and the following five factories were the leading candidates for the introduction of the technologies.

* Monnet Daniels Coal Preparation factory, Monnet Daniels Coal Washery Pvt. Ltd.
* Piparwar Coal Preparation factory, Central Coalfields Ltd.
* Rajrappa Coal Preparation factory, Central Coalfields Ltd.
* Gidi Coal Preparation factory, Central Coalfields Ltd.
* Madhuband Coal Preparation factory, Bharat Coking Coal Ltd.

3) Potential contribution by Japan

Japan has a strong enough technological capacity to determine the specifications of plants in accordance with the characteristics of the coal in each region of India, and guarantee these specifications. Therefore, Japan and India could cooperate to spread these technologies throughout India. For example, Japan could be in charge of the basic engineering, the cooperating companies in India could carry out the local production and installation, and Japan could carry out the final adjustment operation, etc. Regarding this matter, Japan must continue making a contribution until these technologies are disseminated.

(b) Joint research and development on Coal gasification and purification for IGCC technology (NEDO joint R&D project)

250MW IGCC demonstration tests are currently being carried out in Japan as well, with a

target of a net efficiency of 48% or higher in the future.

Figure 4-C shows the process flow of the 250MW demonstration plant and Table 4-F shows the specifications and target values of the plant.

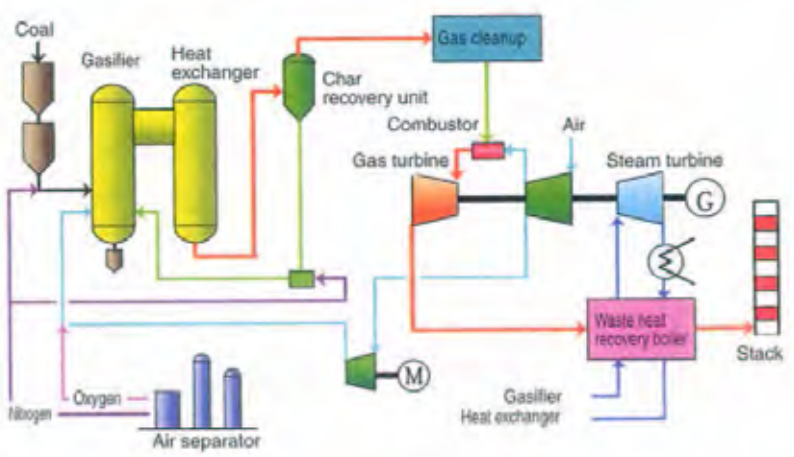


Figure 4-C Process flow of IGCC demonstration plant

Table 4-F Main specifications of IGCC demonstration plant

Output	250 MW class	
Coal feed rate	Approximately 1,700 t/d	
Type	Gasifier	Dry-coal-fed, air-blown, Pressurized, two-stage entrained beds
	Gas cleanup	Wet gas cleanup (MDEA) + gypsum recovery
	Gas turbine	1200°C-class
Target thermal efficiency (LHV)	Gross efficiency	48%
	Net efficiency	42%
Environmental characteristics (target values)	SOx emission concentration	8 ppm (O2 conversion: 16%)
	NOx emission concentration	5 ppm (O2 conversion: 16%)
	Dust emission concentration	4 mg/Nm^3 (O2 conversion: 16%)

1) Joint R&D projects on coal gasification technologies and the purification technologies (proposal of the NEDO joint R&D project)

The important technologies constituting IGCC are coal gasification and purification, and the low-calorie dirty gas stable operating performance of the gas turbines. Japan has a strong track record with blast furnace gas (low-calorie dirty gas) fired gas turbines so for gas turbines development has been completed. Therefore, if Japanese stakeholder consider introduction of the gasification and gas purification equipment, they shouldcarry out an F/S to determine whether or not the equipment which Japan is using for the demonstration test is suitable for Indian coal, and if necessary they should also determine what pilot tests and / or demonstration

tests are necessary and implement them.

2) The potential in India

- Demand for energy is rapidly increasing in India due to that country's economic growth, and the energy source that is supporting the increased demand for energy is coal. Therefore, the introduction of clean coal technology is essential in order to maintain economic development in harmony with the environment. The key clean coal technology is IGCC.
- On October 26-27, 2006 scientists and technologists debated a CTT road map in a workshop held by the Department of Science and Technology (DST) and BHEL. In the workshop demonstration test on IGCC were included as one of the items on the list of themes to work on within the next five years.
- According to table 4-B, next year, total capacity of one group will be of 4,826MW, constructed before 40 years or more, and the other group, 3,170MW, before 35 years to 40 years. Both groups have extremely poor net thermal efficiency of 25% or less and will require upgrading soon.

3) The contribution of Japan

- Japan is currently establishing IGCC technologies, which are highly efficient and highly reliable technologies.
- When developing IGCC, in order to develop fluidized-bed coal gasification combined power generation technologies, from 1981 to 1987 Japan used 40 tons/day pilot plants to develop an air-blown pressurized two-stage fluidized-bed gasification furnace, dry gas purification (fluidized-bed desulphurization, moving-bed dust removal), etc. Subsequently with the 200t/d pilot plants Japan succeeded in the development of the air-blown pressurized two-stage entrained bed method for gasification plants and dry gas purification as a gas purification method, and all of these technologies have been accumulated in the current 250MW demonstration plant. Therefore, Japan can engineer coal gasification and gas purification equipment suitable for Indian coal that has high ash content.
- Japan also has a strong track record of designing and producing gas turbines capable of stable combustion of low-calorie dirty gas and operation over a long time.

Chapter 5 Overall Picture for the Prospect Loan

5-1 Project costs

IREDA prepared the roadmap for lending from FY2007 to FY2011. This is based on the Eleventh Five Year Plan and is the plan to support the utilization of unused energy and promotion of EEC, as a policy based financial institution specializing in energy. According to this, the lending target amounts are Rs. 8,145 crore and Rs. 5,700 crore for sanction and disbursement, respectively. These targets assume that the lending will be higher than the actual lending amounts in the past. Compared with these targets, the actual amounts in FY 2007-08 (2 fiscal years) are Rs. 2,317 crore and Rs. 1,325 crore for sanction and disbursement, respectively and the lending amounts are gradually increased following the growing economy.

Table 5-A

Road Map of IREDA for 5 Years

	Loan Sanction	Disbursement
11th Plan Taget (2007-2012)	8145	5700
Achievement in 07-08	826	554
Achievement in 08-09	1491	771
Planed in 09-10	1350	800
Planed in 10-11	2000	1500
Planed in 11-12	2450	2100

Resource: IREDA document

In FY 2009, the demand for finance to IREDA is strong and the financial plan in the beginning of the fiscal year (as of 11 May 2009) is Rs. 1,250 crore for disbursement while it was Rs. 770.95 crore in the previous year. Out of the pipeline list (Table 5-E) prepared in the beginning of FY 2009, the number of projects in "physical status: agreement to be executed"[19] are 30 and their total project costs and expected loan amounts are Rs. 2,178 crore and Rs. 1,375 crore, respectively. When these amounts are compared with the amounts for FY 2009 in the roadmap plan mentioned above (sanction Rs. 1,350 crore and disbursement Rs. 800 crore), the sanction amount reached the plan and the disbursement greatly exceeded the plan. This disbursement amount as of now almost reached the expected one in the financial plan of this FY. In conclusion, the demand for finance to IREDA is strong and it can be assumed that the financial

[19] The projects in this status are the ones which are sanctioned and the contracts for them are not signed, but the disbursement is expected within 90 days.

needs from the end users are also high in terms of the expected loans to IREDA from JICA aiming to promote new/EEC energy.

The number of the pipeline projects categorized in EEC (excluding bagasse cogeneration) is only 3 and the expected loan is Rs. 40 crore. (It will be 7 if bagasse cogeneration projects are included.) This is because IREDA has been working as an institution which mainly aims to finance the renewable energy related projects, since its establishment. As a result, IREDA is not widely recognized by users as an institution to cover the EEC projects and IREDA was not active in its promotion and finance, since its expertise and experience in EEC are limited compared with the ones in the renewable energy sector.

However, IREDA recently started to put on strong focus on the lending for EEC projects to reflect the government's policy. The potential list[20] for the EEC related projects by IREDA is listed below.

According to the project list obtained in the first mission, the sanctioned but not disbursed projects and their expected amounts are 5 and Rs. 95 crore, respectively and each project size was small (Table 5-B). However, according to the list obtained in the second mission, the projects (including the projects for which the borrowers expect loans and IREDA positively considers the lending.) are 9 and the expected loan is Rs. 720 crore (excluding the projects for which the expected amounts are not determined). (Table 5-C, including cogeneration projects by bagasse) The pipeline list in the second mission includes the district heat supply projects which IREDA did not finance in the past and the loans to ESCO operators in addition to waste heat recovery systems in steel plants. Therefore, it can be inferred that IREDA started to focus on EEC sector through the loan preparation with JICA.

[20] Obtained by JERI team in two field missions.

Table 5-B

Potential EEC Pipeline Project in EEC Sector in IREDA (I)

Lakhs

No.	Name of the Company	Project Description	Project Cost	Loan expected from IREDA
1	M/s Noble Distilleries Ltd	8 MW captive power plant utilizing Waste Heat Recovery and Fluidized Bed Combustion, Karnataka	3044.00	2130.00
2	M/s Padmavati Fferrous Ltd.	12 MW Captive Power Plant utilizing Waste Heat Recovery Boiler (WHRB) and Fluidized Bed Combustion Boiler (FBC), Karnataka	4872.00	3358.00
3	M/s C.P Sponge Iron Pvt. LTD.	8 MW captive power plant utilizing Waste Heat Recovery and Fluidized Bed Combustion, West Bengal	4872.00	2350.00
4	M/s Gopal Sponge & POWER Pvt. Ltd.	4.5 MW Power Plant utilizing Waste Heat Recovery Boiler, Chattisgarh	3415.00	1602.00
5	M/s Pranat Engineers Pvt. Ltd.	Implementaion of Energy Efficiency Measures in the Street Lighting of HUDA, Haryana	155.00	86.00

Table 5-C

Potential EEC Pipeline Project in EEC Sector in IREDA (II)

Crores

No.	Name of the Company	Project Description	Project Cost	Loan expected from IREDA
1	M/s DLF Utilities Ltd.	234 MW Co-Generation project at 11 locations across the country (Union Bank of Idia & PFC have sanctioned balance loans)	1126.00	104.00
2	M/s Shri Mahavir Ferro Alloys Pvt. Ltd., Orissa	27 MW Coal Washrey rejects based power plant at Sundergarh, Orissa	148.80	104.16
3	M/s Shyam Steel Industries Ltd, Kolkata	4 MW Waste Heat Recivery Boiler (WHRB) Captive Power Plant in Integrated Steel Complex at Angadpur Unit, Durgapur	17.00	12.00
4	M/s N.R. Sponge	12 MWCPP [7.5 MW from Fuel gases, Char and Dolachar. Balance power from the Linked Coal and Coal fines , enerated during Sponge Manufacturing]	58.00	16.80
5	M/s Savitar Sol Energy Efficiency Pvt. Ltd.	Proposal for Installation of Energy Cost saving for Hotel (two in numbers)	50.00	24.00
6	M/s NELCO Ltd, Navi Mumbai.	Medium VOLTAGE Variable Freqency Drives (VFD) OF 25 MW capacity for irculationg Water Pumps for Units 1&2 for M/s Coatal Gujrat Power Ltd.(CGPL) 5800 MW Ultra Mega POWER Project, Mumbai	350.00	245.00
7	Dharani Sugar and Chemical Limited	22 MW bagasse based cogeneration project at their proposed integrated sugar comples consisting of 5000TCD sugar mill and 100 KLPD distillery at Sankarpuram, Tamil Nadu	113.56	77.95
8	SHREE RENUKA ENERGY LIMITED	30 MW bagasse based cogeneration project on boot at 6000 TCD co-operative sugar mil of DRKPSSKL at Ichalkaranji, Kolhapur, Maharashtra	120.00	84.00
9	The Seksaria Biwan Sugar Factory Ltd.	60.9 MW bagasse based cogeneration project	200.00	150.00

Furthermore, JERI technical team visited the project sites and collected information through the hearings to the companies[21] regarding the expected borrowing from IREDA as below. (Table 5-D) From this site visit, 8 projects with Rs. 694-705 crore of the financial needs are identified. These projects include the ones currently under planning and some depend on the financing norms. The feasibility of the borrowing for these projects needs to be increased by the measures such as promotion of IREDA afterward. However, considering that the information for the investment in facilities and expectation of borrowing in next 2-3 years is collected to a certain degree during about 3 week field trip, the potential financial demand to IREDA is strong even in

[21] From the hearing during the field trip in the second mission

EEC sector.

Table 5-D

Potential EEC Project List by JERI Technical Team

(Rs. in Crores)

No.	Name of the Company	Date of Visit	Project Description	Project Cost	Loan Expected	Note
1	Vandana Global Ltd.	07/13/09	Modification of existing Plant at Raipur with EE Equipment for Refuction in Shell Heat Radiation	-	-	planed targeting at 2012
2	Mahendra Sponge & Power Pvt. Ltd.	07/13/09	Expansion plan at Raipur plant with EE equipment	-	-	planed targeting at 2012 & 2014 with total budget of Rs 450 Crores
3	The Indian Cements Limited	07/15/09	Improvement of 2nd kiln of Andhra Pradesh plant (in case of WHR)	90	63	under consideration of two options
			Inprovement of 2nd kiln of Andhra Pradesh plant (in case of Thermal Power)	24	16.8	
4	Andhra Cement Limted	07/15/09	Waste Heat Recovery System (WHR) - 8MW to Target: 30% of energy to be full-filled by WHR Budget: 4.5 crores/MW	50	35	planed after current upgradation
5	ACC C ement Limited	07/16/09	Waste Heat Recovery System (WHR) - 30MW (6 Target: 23% power from wasted heat power Budget: 13 crores/MW	350	245	planed at 6 different plants
6	ACC C ement Limited	07/16/09	Wadi Plant Kiln Replacement: replacing the 3 existing kilns by 1 new energy efficient kiln	568	397	planed for 2012
7	Shri Venkateswara Sponge & Power Pvt. Ltd.	07/24/09	2 step expansion plan at Andhra Pradesh Construction of a Rolling Shop & SMS with 2 additional kilns (1,700 tons/day in total capacity)	-	-	planed targeting at 2012 & 2015
8	Shri Venkateswara Sponge & Power Pvt. Ltd.	07/24/09	Waste Heat Recovery System (WHR) for 2 plans in Rmgarth and Jharkhand	90	63	
			1) Total (if WHR case of No3.)	1006	705	
			2) Total (if Thermal Power case of No.3)	992	693.8	

From the analysis above, it is expected that the loan amount (USD 200 million (≒Rs. 1,000 crore)) under discussion between JICA and IREDA is possible to be disbursed in approximately 3 years after its launching. Furthermore, assuming the loan amount of USD 200 million, there are sufficient financial needs for 20% of the loan from EEC projects, provided that the rebate system under discussion with JICA is introduced and the appropriate promotion is conducted. These EEC projects include cogeneration, waste heat recovery facilities, district heat supply and ESCO and they are considered as new sectors by IREDA.

Table 5-E

Projects Sanctioned

lakh

State Located	Sector	Name of the Borrower	Project No	Physical Status	MW Sanctioned	Taluk	District	Sanction Capacity	Project Cost	Date of Sanction	Sanction Year	Project Description	Project Location	Total Loan	Loan Sanction
Uttarakhand	Small Hydro	Himalaya Hydro Pvt Ltd	1714	Additional Sanction	2	Munjiyan	Pithorgarh	2 MW	1805.95	31-Jul-08	2008-09	5.00 MW Tanga SHP Project at Tanga Village, Munjiyan Taluq, Pithoragarh Distt.	Tanga Villag	2300	1280
Uttarakhand	Small Hydro	Himalaya Hydro Pvt Ltd	1715	Additional Sanction	2	Munsiyar	Pithorgarh	2 MW	1861.83	31-Jul-08	2008-09	capacity form 3 MW to 5 MW Motighat SHP Project at Lodi Village, Munsiyari Taluq, Pithorgarh Distt. Uttarakhend	Lodi Village	1391.6	1391.6
Uttarakhand	Small Hydro	Him Urja Private Ltd	1777	Agreement to be Executed	0	Nandpray ag	Chamoli	0	10077.12	5-Dec-08	2008-09	MW (2X7500 kw) Vanala Small Hydro Project at Vanala Village, Nandprayag Tehsil, Chamoli Distt., Uttarakhend	Nandakani River, Vanala Village	7000	1225
Himachal Pradesh	Small Hydro	Siri Ram Syal Hydro Power Pvt.Ltd	1780	Agreemen t to be Executed	0	Sainj Tehsi	Kullu	0	234	24-Dec-08	2008-09	MW (2X900 kw) Kothi Small Hydro Power Project being set up at Nevli Village, Sainj Tehsil, Kullu District, Himachal Pradesh	Nevli Village	138	138
Karnataka	Small Hydro	South West Hydro Power Pvt Ltd	1824	Additional Sanction	0	Shorapur	Gulbarga	0	2942.5	31-Jul-08	2008-09	SHP -III on Devapur Nalla (Tributory to Krishna River) at Gonal Village, Shorapur Tq., Gulbarga Distt. Karnataka	Gonal Village	2029	913
Gujarat & Karnataka	Wind	Tata Power Company	1838	Agreemen t to be Executed	100.8			100.8 MW	51840	30-May-08	2008-09	100.80 MW Wind Farm Project in Gujarat and Karnataka		36200	36200
Maharashtra	Wind	PTC India Ltd	1839	Agreemen t to be Executed	6	Sinnar	Nasik	6 MW	3677	30-May-08	2008-09	6.0 MW Wind farm project in Survey No.968, Vill.Konambe, Taluk Sinnar, Distt. Nasik, Maharashtra	Survey No.968, Vill.Konambe	3125.45	3125.45
Madhya Pradesh	Wind	Magma Shrachi Finance Ltd	1840	Commissi oned	3.6	Dewas	Dewas	3.6 MW	1836	30-May-08	2008-09	3.6 MW Wind Farm Project at Nagda Hills range, Nagda Village, Dewas Taluk, Distt. Dewas, Madhya Pradesh	Nagda Hills range, Nagda Village	1222	1222

Projects Sanctioned

Maharashtra	Small Hydro	Tembu Power Pvt Ltd	1841	Agreement to be Executed	4.5	Karad	Satara	4.5 MW	2669	30-May-08	2008-09	Tembhu Barrage Hydro Project on Krishna River at Tembhu Village, Karad Taluka, Satara Distt. of Maharashtra	Barrage Hydro Project on Krishna River at	1865	1865
Karnataka	Wind	Texmo Precision Castings	1842	Commissioned	1.6	Chikkamayakmahalli	Tumkur	1.6 MW	790	17-Jun-08	2008-09	1.6 MW Windfarm project at Vill.Gamtamahalli, Taluk Chikkamayakmahalli, Distt. Tumkur, Karnataka	Vill.Gamtamahalli	553	553
Rajasthan	Wind	Khanna Industrial Pipes Pvt Ltd	1843	Commissioned	1.5		Shergarh	1.5 MW	916	14-Jul-08	2008-09	1.5 MW Windfarm project at Village Deriya, Dist. Shergargh, Jodhpur, Rajasthan	Village Deriya,	641.2	641.2
Uttarakhand	Small Hydro	Chamoli Hydro Power Pvt Ltd	1844	Commissioned	5	Narian Bagar Tehsi	Chamoli	5 MW	3268.6	31-Jul-08	2008-09	SHP in Debal Village, Narian Bagar Tehsil, Chamoli District, Uttarakhand (Take over loan)	Debal Village	2200	2200
Tamil Nadu	Bagasse Cogeneration	Dhanalakshmi Srinivasan Sugar Pvt Ltd	1845	Agreement to be Executed	23	Veppanthattai Taluq	Perambalur	23 MW	11400	31-Jul-08	2008-09	Cogeneration Project to be set up in their new Sugar Complex including Sugar Mill capacity of 3500 TCDC expandable to (5000 TRD)	Udumbiyan Village	7980	7980
Karnataka	Bagasse Cogeneration	Nirani Sugar Ltd	1846	Agreement to be Executed	24	Mudhol	Bagalkot	24 MW	8764	31-Jul-08	2008-09	Cogeneration Plant (in addition to existing 16 MW Cogen Plant) in their 6250 TCD Sugar Mill (Under expansion from 1250 TCD)	Mudhol Village	7900	7900
Himachal Pradesh	Small Hydro	Shakti Hydroelectric Co. Pvt Ltd	1847	Agreement to be Executed	2.4	Chouri Tehsil,	Chamba	2.4 MW	1554	31-Jul-08	2008-09	2.4 MW Ubhara SHP at Chanri and Khari Village, Chouri Tehsil, Chamba Distt. Himachal Pradesh	Chanri and Khari Village	1050	1050
Karnataka	Small Hydro	SM Hydro Power Pvt Ltd	1848	Agreement to be Executed	10	Malavalli	Mandhya	10 MW	5402.8	31-Jul-08	2008-09	Setting up of 10 MW SHP at Shivasmudram Village, Malavalli Tq., Mandhya Distt, Karnataka on River Cauvery	Shivasmudram Villag	3775	3775
Maharashtra	Small Hydro	DLI Power India Pvt Ltd	1849	Disbursement Yet to Commence	4.9	Igatpuri	Nasik	4.9 MW	2852	31-Jul-08	2008-09	Setting up of 4.9 MW Dharna Dam Foot Hydro Electric Project at Aswali Village, Igatpuri Taluk, Nasik District, Maharashtra	Aswali Village	1996	1996
Himachal Pradesh	Small Hydro	Raghupreet Hydro Project PVT Ltd	1850	Agreement to be Executed	2.4	Banjar Tehsil	Kullu	2.4 MW	1655.71	31-Jul-08	2008-09	Setting up of 2.4 MW Kartaul SHP Project at Nevli Village, Banjar Tehsil, Kullu District, Himachal Pradesh	Nevli Village,	1152	1152

Projects Sanctioned

Gujarat	Wind	Decolight Ceramics Ltd	1851	Commissioned	1.25		Kutch	1.25 MW	637.5	13-Aug-08	2008-09	Setting up of 1.25 MW Wind Farm Project at Vill. Kadoli, Distt. Kutch, Gujarat	Vill. Kadoli,	446	446
Tamil Nadu	Wind	Bhagwati Oxygen Ltd	1852	Commissioned	0.75		Tirunelveli	0.75 MW	379.7	14-Aug-08	2008-09	Setting up of 0.75 MW Wind Farm Project at Village Aiyakudi Region Kodaikurichi Distt. Tirunelveli, Tamil Nadu	Village Aiyakudi Region	265	265
Karnataka	Solar Thermal	Elpro Energy Dimension Pvt. Ltd	1853	Agreement to be Executed			Bangalore	23000 LPD	23.4	8-Sep-08	2008-09	23000 LPD / 460 Sq.m. Collector Area Solar Thermal Intermediary Project		19.89	19.89
Karnataka	Solar Thermal	Velnet Non-Conventional Energy Systems P Ltd	1854	Agreement to be Executed			Bangalore	50900 LPD	86.46	6-Oct-08	2008-09	50900 LPD / 1018 Sq.m. Collector Area Solar Thermal Intermediary Project		50	50
Gujarat	Wind	Dharmanand Diamonds Pvt Ltd	1855	Agreement to be Executed	2.4	Bharuch	Kutch	2.4 MW	1196	13-Oct-08	2008-09	Setting up 2.4 MW (4X600 kw WEG) at Village Suraj Bari, Taluk Bharuch, Distt. Kutch, Gujarat	Village Suraj Bari	837	837
Maharashtra	Wind	Tanaaya Gems & Jewellery Exports Ltd	1856	Agreement to be Executed	2.4	Patanda	Beed	2.4 MW	1196	13-Oct-08	2008-09	Setting up Wind farm of 2.4 MW (4x600 kw WEG) at Village Sanctanda, Taluk Patanda, Distt. Beed, Maharashtra	Village Sanctanda	837	837
Himachal Pradesh	Small Hydro	Ravipati Venkateswara Rao Power Pvt Ltd	1857	Agreement to be Executed	2.5	Chingaon	Shimla	2.5 MW	1739.5	13-Oct-08	2008-09	Setting up of 2.50 MW Gumma-II SHP at Gharsari Village, Chingaon Tk., Shimla Distt., Himachal Pradesh	Gharsari Village	1200	1200
Andhra Pradesh	Small Hydro	SLS Power Corporation Ltd	1858	Agreement to be Executed	21	Dummaruden	Khammam	21 MW	15581	13-Oct-08	2008-09	Dummaruden Mini Hydel Project at Dummaruden Village, Dummaruden Taluk, Khammam Distt., Andhra Pradesh	Dummaruden Village	10500	10500
Karnataka	Wind	Indowind Energy Ltd	1859	Agreement to be Executed	18		Chitradurga	18 MW	10860	13-Oct-08	2008-09	Setting up 18.00 MW (12x1500 KW WEG Suzlon make) Windfarm project at Chitradurga, Karnataka		7602	7602
Gujarat	Wind	Energy Infratech Pvt Ltd	1860	Agreement to be Executed	10.5		Kutch	10.5 MW	6407.79	5-Dec-08	2008-09	10.5 MW (7 No. 1500 KW WEG) Capacity Wind Farm Project at Village Jangi, Distt.Kutch, Gujarat	Vill.Jangi	4227	4227

Projects Sanctioned

Karnataka	Wind	Nuziveedu Seeds	1861	Agreement to be Executed	49.5	Holalkere	Chitradurga	49.5 MW	34000	5-Dec-08	2008-09	KW Wind Electric Generators) wind farm project at Bhimasamudra, Holakere Taluk, Chitradurga Distt., Karnataka	Bhimasamudra	25500	9700
Karnataka	Wind	Super Wind Project Pvt Ltd	1862	Agreement to be Executed	12		Gadag & Chitradurga	12 MW	7123.6	5-Dec-08	2008-09	capacity Wind Electric Generators) wind farm project at Gadag and Chitradurga District, Karnataka	adi, Jalwadgi, Chaginakeri, Elakurnah	3917	3917
Maharashtra	Biomass Power	A A Energy Ltd	1863	Agreement to be Executed	10	Wadsa	Gadchiroli	10 MW	4650	5-Dec-08	2008-09	Setting up of 10 MW Biomass Power Project as an IPP Project at Desaiganj, Wadsa Tk, Gadchiroli Distt., Maharashtra	Desaiganj	3250	1625
Rajasthan	Wind	Paranjape Autocast Pvt Ltd	1864	Agreement to be Executed	3.2		Jodhpur	3.20 MW	1720	24-Dec-08	2008-09	Setting up of 3.20 MW Capacity Wind Farm Project consisting of 4 No. 800 KW WEG at site Tiwari, Distt.Jodhpur, Rajasthan	site Tiwar	1204	1204
Tamil Nadu	Wind	National Enterprises	1865	Agreement to be Executed	3.3	Taluk Radhapuram	Tirunelvel	3.3 MW	2190	24-Dec-08	2008-09	nos. of 1650 KW Wind Electric Generator) capacity wind farm project at Village Samugaregapuram Taluk Radhapuram, Distt.	Village Samugaragapuram	1533	1533
Karnataka	Bagasse Cogeneration	Athani Farmers Sugar Factory Ltd	1866	Agreement to be Executed	23	Tehsil Athani	Belgaum	23 MW	9868	24-Dec-08	2008-09	Cogeneration project to be set up in the existing integrated sugar complex consisting of sugar mill with an installed capacity of 5000	Vill. Vishnuanna Nagar, Post Navalihal	8419	8419
West Bengal	Energy Conservation	C P Sponge Iron Pvt.Ltd	1867	Agreement to be Executed	8	Angadpur Industrial Area	Durgapur	8 MW	3460	24-Dec-08	2008-09	Power Plant utilizing Waste Heat Recovery Boiler and Fludized Bed Combustion (FBC) Boilet at Raturia, Angadpur Industrial Area,	Raturia	2350	2350
Chattisgarh	Energy Conservation	Gopal Sponge & Power P. Ltd	1868	Agreement to be Executed	4.5		Raipur	4.5 MW	2264	24-Dec-08	2008-09	Plant utilizing Waste Heat Recovery Boiler at P.H.90, Industrial Growth Centre, Phase II, Village Siltara, Raipur - 493 111,	Industrial Growth Centre, Phase II, Village	1584	1584
Karnataka	Solar Thermal	Nucifera Renewable Energy Systems	1869	Agreement to be Executed			Bangalore	19200 LPD	35.31	7-Jan-09	2008-09	Solar Thermal Intermediary Project LPD 19200 (Approx.) Collector Area 384 sq.m. (Approx.), Bangalore, Karnataka		29.95	29.95
Maharashtra	Wind	Transpor Corporation of India Ltd	1870	Agreement to be Executed	1.5	Targan	Sangli	1.5 MW	906.36	23-Jan-09	2008-09	1.5 MW Wind Farm Project at site Village Jarandi, Taluk Targan, Distt. Sangli, Maharashtra	Village Jarand	577	577

Projects Sanctioned

Karnataka	Bagasse Cogeneration	Godavari Sugar Mills Ltd	1871	Agreement to be Executed	20	Mudhol	Bagalkot	20 MW	8540	28-Jan-09	2008-09	Cogen Project (expansion of existing 24 MW to 44 MW) to be set up in their existing integrated sugar complex consisting of sugar mill with		7686	7686
Haryana	Energy Efficiency	Pranat Engineers Pvt Ltd	1872	Agreement to be Executed			Panchkula		123.5	2-Feb-09	2008-09	Efficiency measures in the Street Lights of Haryana Urban Development Authority (HUDA) at Distt. Panchkula, Haryana		86	86
Andhra Pradesh	Small Hydro	Ananthapuram Power Projects Ltd	1873	Agreement to be Executed	2	Kudcru Mandal	Anantapur	2 MW	1352	28-Jan-09	2008-09	Hydel Power Project at South Canal, Mid Pennar Reservoir at Marutla Village Kudcru Mandal, Anantapur Distt., Andhra Pradesh	Marutla Village	941	941
Karnataka	Small Hydro	Bhoruka Power Corporation Ltd	1874	Agreement to be Executed	4.5		Bellary	4.5 MW	2020.5	28-Jan-09	2008-09	4.50 MW Sugur SHP in Bellary Distt., Karnataka (Take over project)		1357.62	1357.62
Karnataka	Small Hydro	Bhoruka Power Corporation Ltd	1875	Agreement to be Executed	6.25		Chamaraj nagar	6.25 MW	4920	28-Jan-09	2008-09	6.25 MW Sattegala SHP in Chamarajnagar Distt. of Karnataka (Take over project)		2817.24	2817.24
Karnataka	Solar Manu	Emmvee Toughened Glass & Photovoltaic Pvt.Ltd	1876	Agreement to be Executed			Bangalore		4170	28-Jan-09	2008-09	Expansion of capacity of SPV unit from 15 MW to 65 MW		3336	3336
Karnataka	Small Hydro	Saroj Energy Co. Pvt.Ltd.	1877	Agreement to be Executed	1.5	Channapu tna	Bangalore Rural	1.5 MW	961.47	10-Feb-09	2008-09	Iggalur SHP Project on Iggalur Barrage at Iggalur Village, Channapatna Taluk, Bangalore Rural District, Karnataka	Iggalur Village	640	640

5-2 Project Scheme

The prospected Japanese ODA Loan scheme is depicted as in the following figure.

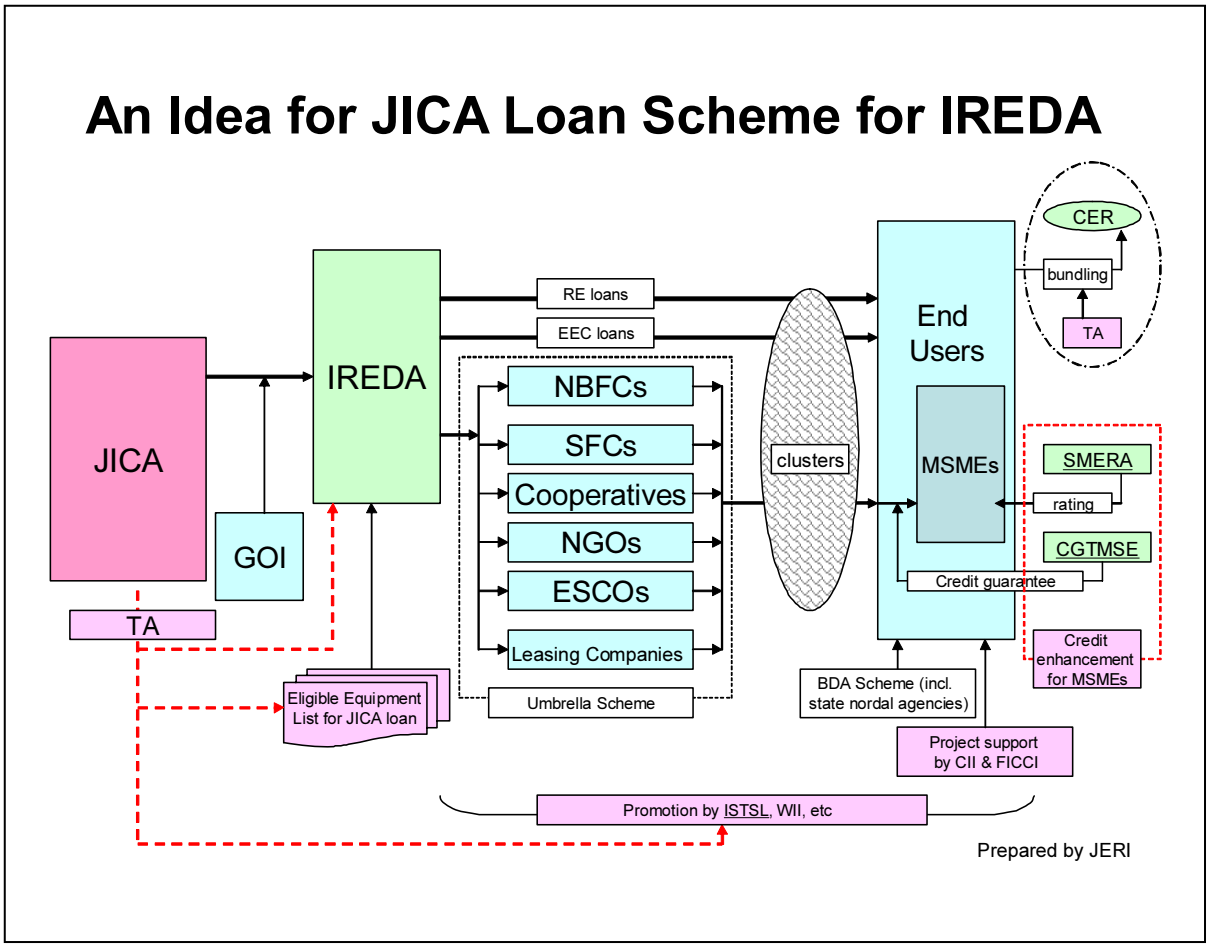


Figure 5-A

5-2-1 Utilization of Eligible Equipment List

For the selection of energy efficiency and conservation (EEC) eligible projects under the prospective Japanese ODA Loan scheme, it would be deemed appropriate to apply the "systemic approach to EEC (EEC process method)" through conducting energy audit to attain efficiency of energy use, and reduce energy waste through energy audit systematically, as well as applying the "list method", which allows the end users to acquire and install the equipments which are included in the pre-determined list of eligible equipments. The former is the effective method to attain EEC systematically at the project or entity bases. However, for the small and medium enterprises or small sized projects, it takes too much time and costs to grasp the energy usage amount, and to plan and manage the EEC activities. Considering this shortcomings, it might be deemed appropriate to use the former and the latter method (the list method), which

incorporates the required knowledge regarding the EEC, and applicable for the entities facing cost restriction problem, to promote the EEC.

Other merits of the "list method" include 1) the loan officer could assess the loan qualification by referring the list which clearly specifies the eligible equipments without having sufficient knowledge on EEC, and the loan officers' arbitrariness could be excluded, 2) it would enable to omit the task to calculate the effectiveness of EEC in advance by projects to be funded, and 3) it would not be necessary to measure the effect of the project individually if the equipments are confirmed to get installed and started working as planned, as the list incorporates the equipments which EEC effects are already accredited of.

It would be appropriate to finalize the eligible equipment list for this project based on the list[22] which JICA made for the "SIDBI Financing Scheme for Energy Saving Projects in MSME Sector"[23] which in operation. The list, currently employed by SIDBI, was finalized by incorporating the list determined under "Revised Guidelines on Credit Linked Capital Subsidy Scheme (CLCSS)" conducted by Ministry of Small Scale Industries, and by receiving supports from TERI, CII, and NEDO which brought into knowledge and experiences of Japan which is one of the leading countries in the energy efficiency and conservation context. However, this list targets only for micro, small and medium enterprises, needed to be revised according to the IREDA's targeting sector and the size of the targeted companies (to be applicable to bigger companies).

5-2-2 Outreach of IREDA -1（Umbrella Financing Scheme[24]）

IREDA has a head office in New Delhi, and two small branches in Chennai and Hyderabad (plans to set up new offices in Kolkata and Ahmadabad). Because of this, IREDA has limited access to the entities located in the whole country. IREDA is not defined as a bank based on the Government of India's definition, and does not conduct any apex banking activities which enables IREDA to further extend Japanese ODA Loans to the commercial banks. In order to make up for this weak outreach, IREDA operates the "Umbrella Financing Scheme" to improve access to the individuals and micro and small enterprises all over in India, by allocating funds from IREDA to intermediate financial institutions including 1) State Financial Corporations (SFCs), 2) Industrial Development Corporations (IDCs), 3) Technical Consultancy Organisations (TCOs), 4) Non Banking Financing Companies (NBFCs), 5) State Nodal Agencies (SNAs), 6)Business Development Associates (BDAs) , 7) Scheduled banks and 8)

[22] http://www.sidbi.in/notices/Copy%20of%20Energy.xls
[23] http://www.sidbi.in/energysaving.asp
[24] http://www.ireda.in/homepage1.asp?parent_category=2&sub_category=24&category=37

Non-Governmental Organisations (NGOs). Under the "Umbrella Financing Scheme", the amount of the loan extended ranges from Rs. 25.00 lakhs to Rs.1 crores, and the tenor is maximum 10 years including 2-year grace period with the interest rate of 13.75% p.a..[25] The on-lending terms and conditions[26] are determined by the borrowers (i.e. intermediate financial institutions mentioned above). Leasing companies, including SREI, one of the largest financial institutes in India, are also be able to serve as the intermediately.

IREDA has been mainly conducting on-lending activities, for the borrowers which are mostly medium-sized entities. In this prospective Japanese ODA Loan scheme, IREDA is considered to concentrate on on-lending activities as well considering the lending amount. However, from the policy aspect to promote and disseminate the RE and EEC activities in India, it is crucial for small-sized enterprises to raise awareness through executing the loan especially for EEC activities, so that the utilization of the channel for extending small credit under Umbrella Financing Scheme would also be regarded very important. The number of the actual loans sanctioned/disbursed is not disclosed, but according to Mr. Reddi (Director of Finance in IREDA), its number through this scheme is limited so far. The reason behind is IREDA's limited experience of the lending to SMEs, thus the expertise to appraise SMEs is not accumulated.

SREI, one of the leading leasing companies in India, occasionally procures street lights and traffic lights to lease out for the private companies commissioned from local governments and traffic polices. SREI bundles the credit obligations (accumulating the small amount of credit obligations) of the IREDA's EE eligible projects, and sell them for IREDA. Even though the size of the project is small (around Rs. 20M – 30M per year), it will produce a beneficial effects for EEC education because this kind of experience gives people opportunity to understand the idea and concept of how they can save energy.

In addition to that, ESCO companies could also be served as intermediately entities under the "Umbrella Financing Scheme". However, as ESCOs are generally facing unfavorable business conditions as SMEs, the potential customers of ESCOs, have no legal obligation to conduct EEC by having ESCO's guidance, and besides ESCO companies which are affiliate of big manufacturing companies etc, independent ESCO companies are the micro and small-sized companies, which hampers IREDA from extending credits. Because of these reasons, IREDA has traded only 3 to 4 ESCO companies so far. In order to address this issue, use of CGTMSE

[25] Source: "Renewable Energy & Energy Efficiency Financing Guidelines, Internal Manual" (p.65) issued by IREDA dated 31 December 2008. For North Eastern Region and Sikkim, the interest rate is 5% p.a.
[26] Source: IREDA website (http://www.ireda.in/homepage1.asp?parent_category=2&sub_category=24&category=37)

(Credit Guarantee Fund Trust for Micro and Small Enterprises) for ESCO's credit enhancement could be the option.[27]

Without enough creditworthiness from financial institutes, ESCOs, categorized into vender type and service type based on the collection of the fund from end-users, should face difficulties for the business development to pursue the EEC projects as both categories of ESCOs should make the initial investments. Obtaining creditworthiness is the problem not only to ESCOs but also for micro, small and medium-enterprises to begin with, and it is more severe problem at this moment as the those sectors are affected more severely due to the global financial crisis. The credit enhancement method for the said companies will be discussed later.

5-2-3 Outreach of IREDA - 2（BDA Scheme[28], etc）

In order to make up for the weakness of IREDA's network, IREDA signed business contracts with 53 institutions nationwide, including Technical Consultancy Organizations (TCOs)、State Nodal Agencies (SNAs), Local Productivity Councils (LPCs)/National Productivity Councils(NPCs), Private Consultancy Organizations (PCOs), National Governmental Organizations (NGOs), Technical Institutions and Agencies registered under Societies Act (TI&A)）. The contracts are to pay the commission by the area of the project (e.g. energy efficiency and conservation 0.05%, ethanol 0.05%, solar photovoltaic 0.5%) for above 53 agencies, in exchange for the provision of information which are used and actually led to IREDA's new lending activities.

These 53 institutions, dealing with investment promotion and energy consultation, provide consulting activities to formulate investment projects and fund raising activities. Even they provide relevant information also to the commercial banks, they have incentives to introduce the possible projects to IREDA as IREDA is able to provide effective support to end-users through expert know-how in the field of RE/EEC and long-term finance which the commercial banks cannot provide.

However, it seems that the number of the projects under this scheme is still limited according to Mr. Reddi (Director of Finance). As one of the measures to increase the projects, IREDA is now considering approaching to the end users through the industrial clusters. The industrial clusters is the area where the small and medium-sized enterprises, engaging the business which are

[27] The details for CGTMSE are in 6th paragraph onward of 5-2-5 in this report (Credit Enhancement for the Eligible Project/Borrower) and the section of "Loans to ESCOs" in 6-2 of this report.
[28] http://www.ireda.in/homepage1.asp?parent_category=1&category=18

mutually complement are accumulated in a local area (for example, a leather industry cluster is an area where the small and medium-sized enterprises such as leather tanning units, leather finishing units, leather goods producers, leather garment manufacturers, designers, sub-contractors, merchant buyers, exporters, etc, are gathered).

IREDA has the bank accounts at the leading banks in the region (including State Bank of Hyderabad、Punjab National Bank). IREDA intends to collaborate with these local banks to finance equipments while those commercial banks will provide operating fund to the clusters by obtaining detailed information from the commercial banks.

5-2-4 Promotion for the End Users

In order for IREDA to increase the lending activities for EEC which was not IREDA's main focus, it is crucial to raise the awareness for EEC, economic effectiveness, and realization approach of EEC for potential users besides accumulation of know-how and knowledge within IREDA. As IREDA does not have sufficient contents on EEC, nor widespread network for the PR activities, it is required to spur the awareness to the end users by mobilizing experts from external organizations, such as India SME Technology Services Ltd.(ISTSL) [29], an affiliate of SIDBI, having experiences for the dissemination of new technologies using clusters and energy related knowledge, Winrock International India (WII) who complied and finalized the eligible equipment list for existing Japanese ODA Loan to SIDBI.

In addition to that, it would also be important to formulate the system to obtain cooperation from industrial association, such as Confederation of Indian Industries (CII) and Federation of India Chambers of Commerce and Industry (FICCI) in order to promote EEC and RE for the end-user companies and to discover the possible projects.

CII is the largest industrial association in India, with around 7500 direct member companies and organizations (of which, around 80% are small and medium-sized enterprises), and having network with about 83,000 companies nationwide which are affiliated to the CII members such as local organizations and independent industrial associations. CII operates Green Business Center[30] and CII-ITC Center of Excellence for Sustainable Development[31], to promote EEC or to provide technical supports in EEC and environment related area for its member companies.
FICCI also intends to promote EEC and environmental related business activities, such as the

[29] http://www.techsmall.com/company.htm
[30] http://greenbusinesscentre.com/
[31] http://www.sustainabledevelopment.in/

promotion activities to support EEC industry, such as compiling the "Green Pages" [32] which is the directory to introduce the producers or service providers of EEC and environmental related business equipments or services. FICCI also accumulated investment related information of the member companies; through the interview in this study, the team was introduced a project - a cement kiln west heat recovery equipment by Associated Cement Companies Limited (ACC).

Being non-profit and self-supporting organizations, the objectives of both CII and FICCI are to conduct activities to improve the benefit of the member companies, through the revenues received in exchange for the services provided for the member companies. It is impossible to expect CII and FICCI to participate this JICA ODA scheme on a non-fee basis. However, consigning a part of TA activities such as EEC promotion / campaign for private companies would enable for IREDA / JICA to secure the effective information sources on relevant investment of the private companies through those entities.

In India, most of the people has not yet well understand the meanings and implication of EEC on their business. It is not so easy to make them realize the merit of investment for EEC to save energy and to use it efficiently. Therefore successful cases of EEC in Japan as a leading country in this area will bring positive incentive to Indian businesses to improve their use of energy. Explanation of economics of EEC by use of investment recovery calculation model and/or examples of real business projects will help Indian companies to grasp concretely the importance of EEC activities in their business. On the other hand, in the last spring, JASE-World sent to India the EEC promotion mission of its member companies and Japan Machinery Center for Trade and Investment（JMC）also came to this country to make a field research of potential EEC and environmental related markets. Japanese EEC sectors showed interested in India.

From this viewpoint, IREDA should ask Japanese EEC related organizations including The Energy Conservation Center, Japan(ECCJ) and Japanese Business Alliance for Smart Energy Worldwide（JASE-World）to send energy expertise as lecturers to their EEC promotion events in order to make explanation about Japanese experience and know-how in this field. For Japanese organizations, this kind of events offers good marketing opportunities to show Japanese technologies and products in front of potential business counterparts.

Furthermore, Japanese companies such as Mayekawa Mfg. Co. Ltd, Kawasaki Plant Systems Co. Ltd and Toshiba Co. Ltd are already engaged in promotion of their EEC products in this

[32] http://www.ficci.com/general/greenpages/greenpages.htm

country and want to have a chance to exhibit their competency in EEC technology. They may have interest in participation of EEC awareness campaign by IREDA. If need of both side meet each other, win-win situation can be realized.

5-2-5 Credit Enhancement for the Eligible Project / Borrower

It is said that IREDA's loan assessment is said to be taking up times compared with the commercial banks, as the applicants of the IREDA loan are micro, small and medium-sized companies which generally having funding problems because 1) those companies cannot provide sufficient company information required to conduct credit analysis by the financial institutions including IREDA, and 2) those companies cannot provide sufficient collaterals to cover the credits to the financial institutions. For the entities with small scales of operations, the EEC and RE are new investment areas and most investments are not for the green fields but for upgrading of equipments or supplementary investment to increase the existing capacity, those companies may face more difficulties to provide sufficient information for IREDA to evaluate the credit of the companies than obtaining loans from commercial banks for the conventional investment projects. In order to solve those problems above, utilization of SMERA (SME Rating Agency of India)[33] and CGTMSE[34] for the credit enhancement for the borrowing companies could be considered.

SMERA is the only rating agency focusing primarily on the SME companies among the existing 5 rating companies. It was established in September, 2005, by SIDBI (holding 22% of shares), Dun & Bradstreet Information Services India Private Limited (D&B), and several leading banks in India. SMERA signed MOUs with 23 institutions including shareholding companies on rating services. So far, SMERA assigned ratings for approximately 4,000 companies.

The internal rating assigned by the financial institutions are placing too much emphasis on quantitative analysis including financial assessment, and those financial institutions don't recognize SME as a sector that has its own peculiar characteristics, so that they are not able to fairly evaluate the credit capacity of SMEs. SMERA, on the other hand, conducts company site survey to grasp the equipment, technology and performance of the companies, and also do the sector analysis of the sector to which the companies belong, to supplement the insufficient information (such as finance) and to improve the accuracy for the rating assignment.

In order for the micro, small and medium companies to have ratings more easily, Ministry of

[33] http://www.smera.in/
[34] http://www.cgtmse.in/

Micro, Small and Medium Enterprises (MSME) has a scheme to subsidize 75% of the rating cost per company, which never obtained the rating, to support the fund raising activities of micro, small and medium companies. This subsidy is not only for refinancing the costs from IREDA but any rating companies, however, most of the micro, small and medium companies obtain ratings from SMERA considering the company's strengths.

IREDA hasn't entered into MOU with SMERA – however, through the cooperation with SMERA, which shows positive stance to cooperating with IREDA to support credit enhancement through SME ratings, IREDA could expect more accuracy in credit analysis of the borrowers, leading to more efficient loan judgment through SMERA's ratings. According to SMERA, they have assigned a rating to a company which operates wind power generation business which obtained finance from IREDA.

CGTMSE was set up to strengthen credit delivery system and facilitate flow of credit to the micro, small and medium-sized enterprises with the authorized capital of USD 500 million and paid-in capital of USD 360 million. MSME holds 80% of its shares, and remaining shares are owned by SIDBI. The debtors are micro, small and medium-sized companies defined by the MSME act, in the manufacturing and service sectors. So far, CGTMSE's guarantee provisions are mainly to food processing, garment, and wooden furniture industries. The number of Member Lending Institutions (MLIs) that the CGTMSE signed MOUs on credit guarantee partnership agreement is 90.

The maximum cap for the guarantee amount is USD 200,000 - the guarantee coverage is 75% to 85% for the debt amount of up to USD 100,000, and 50% for the debt amount up to USD 200,000. The guarantee period is set to match the tenor of the loan for the medium- and long-term projects, while the guarantees for short-term projects are reviewed by every 5 years.

The MLIs are able to bring in the debt to be guaranteed. In addition to that, non-bank institutions such as State Financial Corporations (SFCs) will also be admitted as members if they could obtain the special permissions from MSME and SIDBI, which might take 1 to 2 months. IREDA is neither a member of MLIS nor that of CGTMSE; it would require obtaining special permissions to cooperate with CGTMSE's activities. According to Mr. O.S. Vinod, the CEO of CGTMSE, CGTMSE will be interested in having IREDA as a member if IREDA wishes, as it helps diversify CGTMSE's portfolio. Mr. Vinod also suggested JICA to consider extending finances, so that CGTMSE is able to make CGTMSE increase in capital, by earmarking this increased funds exclusively for the guarantees for RE or EEC related projects

under the prospective Japanese ODA Loans, and set the different guarantee conditions such as relaxing the cap or guarantee rate as the World Bank did for the different project before.

For IREDA which extends finances mainly to micro, small and medium-sized enterprises than to bigger companies, and the companies with weak management such as Independent Power Producer (IPP), supplementing borrowers' credit capacities by using credit enhancement instruments from CGTMSE which lead to facilitate RE and EEC related investment to attain the political significance.

5-3 Monitoring

The appropriate monitoring is necessary in order to ensure the following: i) IREDA's funding is used for the target projects which were declared upon application for finance and ii) the projects are operated as initially assumed in the appraisal for the lending. The monitoring during the project implementation and after the project completion is explained below.

During the project implementation, monitoring is generally supposed to be conducted on disbursement of the funding and completion of construction. For "after the project completion", it is desirable for the monitoring to be conducted after about one year of construction completion, completion of account processing and commencement of steady operation. "Steady operation" here is that the facilities financed are in the status of operation, which is assumed in the project plan. In addition, if there are any changes (e.g. loss of capacity, abolishment, transfer and disposal by sales) for the funded projects by the end of the loan period, it is necessary for a borrower to report such a fact even after the completion report of the funded project.

Before the disbursement of funding, the construction progress report and project completion report will be submitted by a borrower. In this report, the construction progress status (%) and the payment progress status (payment to constructors) are described. The balance between the construction costs and the disbursement amounts will be checked.

Immediately upon the completion of a project, IREDA will ask a borrower to report the project completion. For this, the invoice of the construction costs, their receipts and a copy of the section concerned in property ledgers are required to be submitted. By these documents, approximately 60-80% of the total project cost is the appropriate volume to be covered. One of the critical issues is that IREDA will be able to check the ledger for the main part of the construction (the essential equipment for the project operation). The balance between the construction costs and lending amounts is also confirmed.

After the completion report, IREDA will conduct a site visit for the construction completion and facility's operation. It will confirm in terms of installation of equipment and its use and check whether the policy effects initially expected upon the lending are satisfied. The policy effect evaluation reports are prepared based on the site visit. If there are any changes in a targeted project after the appraisal for lending, IREDA will confirm there are no large discrepancies in the content of a targeted project and the policy effects after the changes. The lender will decide the penalty such as prepayment in case of any significant discrepancies.

The above are the monitoring process assumed for the fund management and confirmation of the policy effects.

5-4 Project Selection Criteria

5-4-1 Selection Criteria for equipment

(1) **Coke oven: CDQ (Coke Dry Quenching equipment)**

(a) Components

This facility consists of the following component equipment:

(i) Coke transportation equipment
(ii) Cooling chamber
(iii) Waste heat boiler
(iv) Steam turbine and generator
(v) Cooling tower
(vi) Circulating fan
(vii) De-mineralizer, deaerator, feed water heater
(viii) Dust collector
(ix) Electrical and instrumentation equipment
(x) Piping and dust valves

(b) Consideration on CDQ process design

There is no problem with waste heat recovery equipments for recovering steam of up to 300℃. However, for recovering waste heat of more than 350℃, steel becomes highly corrosive due to the Sulfur component of coal, and a study on experiences of manufacturers for the performance of CDQ under these circumstances becomes necessary.

There is a need to cool cokes of approximately 1,000℃ to less than 170℃, thus the height of the cooling chamber and measures on preventing cooling gas drift within the cooling chamber

must be suitably determined.

(2) **Cement Kiln Waste Heat Recovery Power Generation System**

(a) Components

This facility consists of the following component equipment:

(i) Pre heater waste heat recovery boiler & Air quenching cooler waste heat recovery boiler

(ii) Steam turbine, Reduction gear & Condenser

(iii) Generator & Exiter

(iv) Cooling tower and Water supply & treatment equipment

(v) Pumps, Duct, Piping and Valves

(vi) Electrical & Instrumentation equipment including Process control devices

(vii) Others (Dust Collector, etc.)

(b) Cement Kiln Heat Balance

The clinker burning process utilizes high temperature of more than 1,450℃, consuming a lot of heat. Analyzing the input heat and the output heat of the kiln, we get the graph as shown in Figure 3-I. Of these, the heat required for the clinker burning (theoretical required heat) is the clinker burning heat, and accounts for 53% of the total heat supplied to the kiln.

The remaining 47% are emitted as pre-heater waste gas sensible heat, cooler waste gas sensible heat, clinker sensible heat and dissipated heat. Of these, 11% comes from radiation heat loss of 8% and clinker dissipated heat of 3%. Thus, the remaining 47-11=36 % is the amount of waste heat from the pre-heater outlet and the clinker cooler. From Figure 3-I, it can be deduced that 9% of heat (the raw material drying heat 8% and the coal drying heat 1%) utilizes the waste heat from the pre-heater and the clinker cooler outlets. The waste gas sensible heat which can be actually used for waste heat recovery power generation is 36%-9% = 27%. On the other hand, the waste gas used to dry raw material and coal is low temperature gas. Therefore, after the waste gas sensible heat from the pre-heater waste gas is made to be absorbed by the pre-heater boiler, the remaining waste gas sensible heat can then be used for the raw material and the coal drying. The waste gas temperature at the outlet of the PH boiler is determined based on the required heating value for raw material and coal drying.

As can be understood from this explanation, the poorer the fuel consumption intensity of the kiln, the more recovery amount of waste heat increases. The same trend can be seen in CDQ, sintering plant waste heat recovery systems and blast furnace hot stove waste heat recovery systems.

With this reason, when being asked to ensure the output of the waste heat recovery system, the operation conditions of the plant must be clearly specified. When the preset conditions are off the mark, it is necessary to determine in advance the steps to compensate for the discrepancy. However, if giving a guarantee for the maximum capacity of a waste heat recovery system, it is possible to verify that the waste heat recovery system can operate at the maximum output by temporarily changing the operation conditions of the kiln.

(c) Consideration on design of the waste heat recovery power generation system

<Getting the Waste Gas Sensible Heat Volume>

Study the flow rate and temperature of the waste gas at the outlet of the pre-heater and the clinker cooler as well as the gas components, or by finding out the required waste gas temperature t if the present (before waste heat recovery) pre-heater waste gas is being used for the drying of the raw material, it is possible to calculate for the sensible heat of the waste gas that can be used.

Using this information, take the boiler steam generation condition as a parameter, simulate the flow diagram to get the maximum power generation, and determine the pressure and temperature of the main part. In this case, the boiler efficiency and the turbine generator efficiency may be defined as follows:

Boiler efficiency = 100{Gp (i1p－i2p) ＋Ga (i1a－i2a)} /{Qp (i3p－i4p) ＋Qa (i3a－i4a)}..(Eq. 1)

Turbine Generator Efficiency = 100×N×860 / {Gp（i1p－i2p）＋Ga（i1a－i2a）… (Eq. 2)

Here,

G: steam generation rate [kg/h]

Q: waste gas flow rate [m3N/h]

N: power output [kWh/h]

i1: boiler outlet steam enthalpy [kcal/kg]

i2: boiler economizer inlet water enthalpy [kcal/kg]

i3: Waste gas enthalpy at the inlet of boiler [kcal/ m^3N]

i4: Waste gas enthalpy at the outlet of boiler [kcal/ m^3N]

The suffixes a, b represent the pre-heater waste gas and the clinker waste gas, respectively.

Compared to approximately 95% of boiler heat efficiency, the turbine generator efficiency is only about 20-25%. Similar to cement kiln waste gas, when the waste gas temperature is low, it

is necessary to have a system design that will specifically result in maximum steam turbine generator efficiency. This system design capability may be used as criteria to evaluate the manufacturer's technical ability.

(d) Estimate amount of waste heat recovery power

Although this varies depending on the heat consumption intensity of the kiln, a 4,000t-clinker/day plant can generate approximately 7,000kW (net) while a 5,000t-clinker/day can generate approximately 8,800kW (net).

(Note) When a bank receives a loan application that has a discrepancy of more than ±500kW from this value, ask for the reason from the loan applicant.

5-4-2 Consideration of Specifications of the Equipment to be Financed

An eligible equipment list in cement industry and iron & steel industry for energy conservation loan is shown in Table 5-F, which includes objective equipment name and production capacity having profitability. This eligible equipment list is prepared based on equipment list for small and medium size enterprises loan by SIDBIC.

Table 5-F Eligible equipment list in cement industry and iron & steel industry for energy conservation loan

Energy Saving Equipment List for Cement and Steel industry							
Sl.No	**Eligible Equipment/Technology**	**Advantages**	**Expected Effects of Energy Conservation (Bench Mark)**	**Specifications**	**Note**	**Reference**	**Remarks**
23	**Cement Industry**					CII	
	# High efficiency Dynamic Separator for Raw Mill	Increased output				CII	
	# Air lift to Bucket Elevator					CII	
	# Low Pressure drop Cyclone	Increase of output				CII	
	# Use alternative fuel storage, conveying & firings system as supplement to coal in Calciner Firing					CII	Fuel substitution
	# VFDs for Cooler Fans	Avoid damper loss				CII	
	# Low pressure Air Burner					CII	
	# High efficiency Crusher	Increase in capacity				CII	
	# Cogeneration from Kiln Preheater and Cooler Exhaust					CII	
	# Pre-Grinder						
	# Waste Heat Recovery Power Generation from Kiln Exhaust gases	Utilisation of waste heat					
	# Power Generation from Kiln Exhaust gases	Waste heat recovery for power generation	Power recovery ratio: 25% or more of power consumption in the plant	Generated power: 6MW or more	India	NEDO Model project	
	# Slip Power Recovery System						
	# Soft Starters for Motors						
	# Energy efficient Fans						
	# Vertical Roller Mill						
	# Pre-Grinder / Roller Press						
	# Multi-channel Burner						
	# Fuzzy Logic/Expert Kiln Control System						
	# Improved Ball Mill Internals						
	# High Efficiency Grate Cooler						
27	Steel Plants						
	# Blast furnace Top pressure Recovery Turbine Generator (TRT)	Waste heat recovery for power generation	Turbine generater efficiency: more than 80%	Generated power: 5MW or more			
	# Coal Moisture Control System				China	NEDO Model	
	# Power Generation from Blast Furnace Exhaust gases				China	NEDO Model	
	# Sinter Cooler Waste Heat Recovery for power generation	Waste heat recovery for power generation	Net recovery power is more than 20kWh/t sinter	Generated power: 10MW or more	China, India	NEDO Model	
	# Sinter Cooler Waste Heat Recovery for steam generation						
	# Coke Dry Quenching process for power generation	Waste heat recovery for power generation	Net recovery power is more than 55kWh/t coke	Generated power: 20MW or more	China, India	NEDO Model	
	# Waste Gas Recovery from Oxygen Converter				China	NEDO Model	
	# High efficiency Combustion Control System in Pre-Heating Furnace				China	NEDO Model	
	# Regenetive burner unit of steel billet reheating furnace	Fuel consumption reduction: 20% to30%			Thailand, Indonesia	NEDO Model	
	# Regenetive burner unit for ladle preheating						
	# Heat Recovery from Blast Furnace Hot Stove Waste Gases				India	NEDO Model	
28	Metal Industry					NEDO Model	
	# High efficiency Industrial Furnace in Aluminum Factory				Thailand	NEDO Model	
	Source: Energy Saving Equipment List (Revision 2.0), Released on : 12th Feb, 2009, SIDBIC						

5-5 Guidelines for loan condition

5-5-1 Coke Dry Quenching Equipment (CDQ)

Loan criteria for CDQ include the following:

(i) Working rate of coke oven at present and coal consumption(t/d) or cokes production (t/d) when working rate is 100%

(ii) Payback period

(iii) Construction cost

Here, we enumerate the important factors of investment recovery period.

(1) Recovered power volume

Calculations for recovered power (to be attached to loan application) and the required elements

(i) Heat released by cokes at the cooling chamber during coke cooling. But combustion of cokes as well as combustion of hydrogen adhering to the cokes must also be clearly noted.

(ii) Heat absorbed by boiler

(iii) Power generated by steam turbine generator

(iv) Auxiliary power volume

(v) Cooled cokes volume

(2) Calculation of 180t/h CDQ Payback period

The specifications of the additional coke oven in iron and steel plants in India are unknown. Therefore, the team arbitrarily selected the 180t/h coke oven, which is commonly used worldwide, as basis for the calculations of the payback period, resulting in a payback period of 5.8 years. Six years is the limit allowed for strategic investment.

5-5-2 Sintering plant waste heat recovery power generation system

(1) **Features of the System**

This equipment recovers the sensible heat of the sintering ore. A hood is installed in the existing sintering cooler to recover the waste heat. The important items for design considerations are the following:

(i) Since the sintered ore and its supporting parts are moving, the seals between the movable parts and the stationary parts should be strengthened. This matter influences the heat recovery rate.

(ii) The cooler equipment should not be easily deformed by the heat to prevent decrease in sintering production.

(2) **Cautions on Designing Waste Heat Recovery System**

Comparing the waste heat recovery power generation system to a thermal power plant, generally, the steam conditions are low, and the capacity is less, thus this technology is being lightly taken. When companies having no experience of waste heat recovery system participate in this endeavor, a severe price war may result. However, the waste heat which is the input for the waste heat recovery system, is highly influenced by the operations of the process (in this example, sintering plant). Purchasing imitation equipment, operating it without receiving proper operation instructions, could lead to unexpected pitfalls, resulting in system troubles spelling continuous poor operability, giving rise to possibilities of major opportunity loss. Presently, according to information at hand, many problems are being experienced with the cement waste heat recovery system developed in India.

(3) **Estimate of waste heat recovery power**

Although largely affected by the coke consumption intensity of the sintering plant, there is about 18-22kWh/t-sinter of power that may be recovered.

5-5-3 Blast furnace top-pressure recovery turbine (TRT)

(1) **Features of the System**

(i) This system recovers the pressure of the blast furnace gas as power, and the main equipment is the gas turbine generator. However, even if it is referred to as gas turbine, it makes use of low temperature 40-140℃ of blast furnace gas (BFG).

(ii) The gas contains dust of about 5-10mg/m3N, moisture 10g/ m3N so, dust easily adheres to the impeller which will eventually cause deterioration of performance, thus cleaning equipment is required.

(iii) In Japan, in order to maximize the recovered power from TRT, there are many plants wherein all BFG is made to pass through the TRT, and the top pressure is controlled with the TRT (during this time, the septum valve is full close).

(iv) For this purpose, the angle of the stator blade of gas turbine must be adjustable, to minimize all forms of possible losses during power recovery.

(2) **Estimate of Recovered Power**

(i) 40-60% of blast blower output (kW) can be recovered.

(ii) Blast furnace with an internal volume of 2,000m^3, recoverable power is about 5,000kW; with 5,000m^3, approximately 26,000kW.

(iii) This system has few auxiliaries so auxiliary power may be ignored.

(3) **Conditions for loan decision**

The conditions for loan decision to TRT are as follows:

(i) Blast furnace inner volume, top pressure, production volume, and working rate

(ii) Payback period

(iii) Construction cost

(iv) Calculation equation for generated power

Particularly of concern is the working rate of the TRT and the blast furnace. It is necessary to request a survey of the working rate and the generated power of the TRT delivered by the manufacturer.

Furthermore, in order to sustain efficiency, it is necessary to confirm what kind of devices are installed, and what kind of instructions are given to the users with the operation and maintenance manual.

(4) **Calculation for payback period of TRT of 6,000kW**

The payback period in terms of number of years is about 3.6 years. For a blast furnace of 3,200m^3, the payback period is 2.7 years.

5-5-4 Sponge Iron Rotary Kiln Waste Heat Recovery Power Generation System

Sponge iron kiln waste heat recovery power generation system has entered the period of dissemination in India, and India is disseminating sponge iron kiln waste heat recovery power generation system using Indian technology. IREDA pipeline list related to EEC is shown in Table 5-G, accepted during 2008-2009.

Table 5-G IREDA pipeline list of EE&C (2008-2009)

Project name	Sector	Company	Specification		Construc-tion Cost	Loan (Lakhs)	Receipt	Sanction	Completion	State	Project No.
			Capacity	Unit							
Sponge iron WHR power generation	EE&C	Shri Mahavir Ferro Alloys Pvt Ltd	27	MW		10416	2-Feb-09		2008—2009		
Sponge iron WHR power generation	EE&C	Shri Mahavir Ferro Alloys Pvt Ltd	27	MW		10406	24-Sep-08		2008—2009	Orissa	
Sponge iron WHR power generation	EE&C	CP sponge iron Pvt. Ltd.	8	MW	3,460	2,350		24-Dec.-08	2008—2009	West Bengal	1867
Sponge iron WHR power generation	EE&C	Gopal Sponge & Power P. Ltd.	4.5	MW	2,264	1584		24-Dec.-08	2008—2009	Chattisgarh	1868
Street lights	EE&C	Planat Engineers Pvt Ltd.			123.5	86		02-Feb.-09	2008—2009	Haryana	1872

(1) **Loan decision conditions**

(i) Nominal capacity (t/d) of the rotary kiln concerned and the rotary kiln working rate in the latest 1 year

(ii) Coal consumption of the rotary kiln concerned: Mcal/t-sponge iron

(iii) Heat consumption of existing generator turbine: kcal/ kWh

(iv) Expected working rate of the waste heat recovery boiler to be newly installed:

= 100 x waste heat recovery boiler operation time / rotary kiln operation time

5-5-5 Cement kiln waste heat recovery power generation system

(1) **The loan conditions for cement kiln waste heat recovery power generation system are as follows:**

(i) Cement kiln production capacity (t/d) and the average actual production (t/d) in the annual operating days for the last 3 years.

(ii) Cement kiln fuel consumption intensity (kcal/kg-clinker)

(iii) Payback period

(iv) Construction cost

(2) **The factors critical to the payback period are as follows:**

(a) Waste heat recovery power volume

The waste heat recovery power volume:

= (Specific generated power – specific auxiliary power) [kWh/t] x production volume [t/yr] x Waste Heat Recovery System working rate ….(Eq. 3)

Or

= (Generated power – auxiliary power) [kWh/h] x kiln operation time [h/yr] x Waste Heat Recovery System working rate … (Eq. 4)

Normally (Eq. 4) is used. In this case, the basis for the calculated equation of recovered power volume and the working rate of the waste heat recovery system must be given attention when evaluating loan conditions.

The factors used in the following parameters are as follows:

(i) Heat emitted by waste gas of the subject process: H_1 [Mcal/h]

(ii) Heat absorbed by the boiler: H_2 [Mcal/h] …. refer to (Eq. 1)

(iii) Power generated by steam turbine generator: P_3 [kWh/h]

(iv) Auxiliary Power: A_3 [kWh/h]

Based on the above information, the following parameters can be computed.

(i) Boiler efficiency = 100 x H_2/H_1

(ii) Turbine Generator Efficiency = 100 x P_3 x 0.86 [Mcal/kWh] / H_2[Mcal/h]

(iii) Auxiliary Rate = A_3/P_3

(iv) Specific generated power = P_3 x 24 [h] / average daily clinker production

(v) Boiler recovered waste heat per ton of clinker = H_2 x 24[h] / average daily clinker production

(b) Working rate of waste heat recovery system

There is no problem regarding the kiln operation time as the cement plants have actual records. It is necessary for a bank to require a loan applicant to submit the manufacturer report including the actual performance values of the plant with regard to the working rate of the waste heat recovery system (with the assumption that operation hours is 100).

(c) Factors critical to Payback Period

(i) Generated power

(ii) Does the waste heat recover system proposed by the manufacturer have actual applications?

(iii) Efficiency of turbine generator

If high temperature and high pressure steam is used, the efficiency of the turbine generator is good, however, in the case when the waste gas temperature is low, like in the cement kiln waste heat recovery system, the efficiency of the turbine generator drops, thus, design capabilities for waste heat recovery system becomes important, and should be subject for validation.

(d) Payback Period

The payback period may be calculated with the following equation. In the case of energy conservation investment, the energy conservation effects can be directly calculated (profit before depreciation) without taking into account the depreciation value.

(Normally, in the case of production process,

Profit = sales – manufacturing cost, and

Profit becomes profit after depreciation, so the depreciation value must be added to the denominator of the payback period).

(i) Payback Period = construction cost/ (saved energy cost – service cost – maintenance cost – labor cost – interest on borrowing) … (Eq. 5)

When there is an actual accomplishment with regards to waste heat recovery power generation system, use the proportional ratio of the maintenance cost to the construction cost; in the case of no accomplishment, use 1.5% of the construction cost.

(ii) Service cost is calculated from the necessary expense for make-up water and water treatment of industrial water etc.

(iii) Labor cost is calculated from the labor cost for operation and maintenance of power generation plant

(3) **Calculation for the payback period of 6,000t/d kiln**

Calculating for the kiln waste heat recover in India, the result of payback period is 5 years. Taking into consideration that the power shortage befalling the country will continue for the time being, and the rising purchase price of power, this equipment must be treated as a strategic investment like production equipment and that Payback period of 6 years or less should have positive investment possibilities.

(i) The prerequisites are shown in Table 5-H.

Table 5-H Prerequisites for the Calculation of Payback Period

Item	Description
Kiln capacity	6,000t/d
Annual operation days	330 days/y=7,920 hours/y
Rated power out put	10,000kW
Construction cost	2,500,000 kilo yen
Generated power	10,000kW
Aux. equipment power consumption	850kW
Annual net generated power	9.15MW×330×24=72,468MWh/y
Purchased power tariff	3.8 Rs×2.2 yen/Rs=8.36 yen/kWh
Power cost reduction	72,468×8.36=605,832 kilo yen
Operation and maintenance cost	Construction cost×1.0%=25,000 kilo yen
Utility cost	Construction cost×0.5%=12,500 kilo yen
Interest rate	5%/y
Repayment period	10 years
Average interest rate	2.75%/y
Average interest during repayment p.	68,750,000 yen

(ii) Computation results

Payback Period = construction cost / (reduce in power consumption – service cost – maintenance cost – labor cost – interest on borrowings)

= 2,500,000 / (605,832 – 12,500 – 25,000 – 68,750) = 2,500,000 / 499.582

= 5.0 years

(unit: 1000 Japanese Yen)

(Notes) This survey mission found out that companies are looking into the installations of waste heat recovery system as a means to effect cost reductions. However, it remains a fact that they have not yet crossed over to implementation. There is also the problem that the companies cannot raise capital to fund this project, and that interest rates are high which makes the payback period longer.

Thus, in order to promote energy conservation, supporting policies are required such as special depreciation system or low interest loans / interest subsidy etc.

In India, depreciation takes 19 years making depreciation value small. So, when companies invest in energy conservation, there is a need to pay 33% tax of the profits, so in practice, payback period is 6.6 years. Deducting depreciation 131,579 from the above profit, the taxable amount becomes 499,852 – 131,579 = 368,003. Further deducting 33% the profit after taxes before depreciation becomes 499,852 – 121,440 = 378,142, so 2,500,000 / 378,142 = 6.6 years, which should entice managers to invest.

Chapter 6 Project Implementation Structure

6-1 Overview

Indian Renewable Energy Development Agency Limited (IREDA) was established under the supervision of Ministry of Non-conventional Energy Sources (MNES) (Current Ministry of New and Renewable Energy (MNRE)) on 11th March, 1987 as a Public limited Government Company under the Companies Act, 1956 and it promotes Renewable Energy technology and projects through loans. It is "Public Financial Institution" under Companies Act and registered as "Non-Banking Financial Company" (NBFC) with Reserve Bank of India (RBI). Therefore, it is not a bank but is required to follow prudential norms. Furthermore, it is not an Apex Banking Institution, thus in principle, it is not allowed to grant loans to commercial banks. However, Parliament currently discusses the possibility to include IREDA in Apex Banking Institutions in order to reinforce its function to channel the donor funds. IREDA does not receive deposits at the low interest rates following RBI directive, unlike Small Industries Development Bank of India (SIDBI) and Rural Electrification Corporation Limited (REC). IREDA provides loan, whereas doesn't provide other financial measures as equity or guarantee.

6-1-1 Governing law of incorporation, Registered Capital, History, Shareholders and Mission

The governing law of incorporation is Companies Act, 1956. According to this law, IREDA was established as a Public limited Government Company to promote renewable energy projects.

In the end of March 2005, the authorized capital and paid-up capital were Rs. 400 crore and Rs. 375.35 crore, respectively. In the fiscal year 2005-06, Rs. 24.65 crore was paid up and the authorized capital reached the upper limit, Rs. 400 crore. On April 1, 2007, the authorized capital was increased to Rs. 1,000 crore and in the fiscal year 2007-08, Rs. 90 crore (0.9 million share) was paid up. As a result, the paid-up capital reached Rs. 490 crore (Issued share 4.9 million, 1 share = Rs. 1,000) in the end of March 2008. In addition to the capital injection and increase in capital described above, the supports by MNRE include the receipt of the comfort letter issuance (not credit guarantee) and designation of IREDA as an implementation institution for Capital Subsidy Scheme/ Interest Rate Subsidy Scheme. However, MNRE does not intervene in IREDA's credit decision.

As the company's history, IREDA has been leading expansion of loans for renewable energy projects as a recipient institution of donor funds. From around 2000, it started to loan energy efficiency related projects and currently promotes renewable energy use and energy efficiency

for sustainable economic development under the motto of "Energy for Ever". IREDA's corporate profile (as of April 17, 2009) and the organizational chart are listed in Table 6-A and Figure 6-A, respectively.

The mission is as follows:

(1) To operate a revolving fund for development and deployment of New and Renewable Sources of Energy (NRSE),
(2) To give financial supports to specific projects and schemes for generating electricity and/or energy through new and renewable sources and conserving energy through energy efficiency,
(3) To bring down the cost of Renewable power,
(4) To assist in upgrade of technologies in the country through New and Renewable Sources of Energy (NRSE),
(5) To develop criteria/systems/concepts for financing projects based on New & Renewable sources of Energy and Energy Efficiency/Conservation,
(6) To strive for improvement in customer satisfaction.

At present, IREDA is greatly expanding its operation under the five year plan (2007-2011). According to the latest management plan, its operation is: in 2007 sanctions Rs. 826 crore, disbursements Rs. 554 crore (actual), in 2008 sanctions 1,491 crore, disbursements 771 crore (actual), in 2009 sanctions 1,350 crore, disbursements 800 crore (plan), in 2010 sanctions 2,000 crore, disbursements 1,500 crore (plan) and in 2011 sanctions 2,450, disbursements 2,100 (plan). Inflow and outflow of the cash flow in 2009 are planned both Rs. 1,500 crore. They are expected to be financed by commercial banks 600 crore, bond issuance 150 crore, donors 260 crore (KfW 2nd phase 100 crore, KfW biomass 60 crore, NIB 100 crore) and collection 300 crore. The new Japanese ODA Loan is not included in this figure. After its disbursement (In total Rs. 500 crore, among which 200 for 2009, 200 for 2010 and 100 for 2011), it will be possible to reduce the expensive commercial bank loan, but its allocation is under discussion. The loan provision is increased in the five year plan, since the request for energy diversification and clean energy is high while the central government policy emphasizes energy supply increase in order to meet the great electricity demand.

6-1-2 Board meeting and Board of directors

The current Chairman/Managing Director, Mr. (Shri) Debashish Majumdar, had been Managing Director by the end of March 2007, and has continued to serve as Chairman concurrently since the fiscal year 2008. He joined IREDA 13 years ago after his career in the private sector

(conglomerate (Zaibatsu)) and the government (BHEL).

He is assisted by two directors, who manage the main two departments, Technical and Finance (finance and risk management) departments, respectively. These two Directors plus Chairman and other two are Executive Directors (5 in total). In addition, there are three part-time Executive Directors who are deployed from the supervisory authority: MNRE, and an academic entity: IIT.

6-1-3 Head Quarter, Branches and Employees

The total employees in Head Quarter (in Delhi, relocated for space expansion within the city in the end of April 2009) are 120. Out of them, Technical Services Dept and Finance & Accounts Dept have 40 and 40, respectively. The remaining 40 are assigned to Chairman & Managing Director's cell, Human Resource Dept, Legal Dept, Vigilance Dept and other sections. There are no branch but are camp offices (no authority for loan decision), which function as a contact point. They are located in Industrial and Technical Organization of Tamil Nadu Limited in Chennai and The Federation of Andhra Pradesh Chambers of Commerce and Industry (FAPCCI) in Hyderabad and each have a representative. The organizational chart is listed in Figure 6-A. There are no affiliate companies (but it is allowed to incorporate them).

The general academic background of the employees is master or bachelor degree holders and their majority is engineering major, but recently the management major has been increased. For human resource development, both are trained in the internal trainings. For the same purpose, the employees are internally transferred among groups (such as among the groups of wind, solar photovoltaic, waste to power and EEC in Technical Services Dept) and among other departments. However, internal trainings and transfer are not necessarily implemented in a systematic manner and IREDA recognizes that it is not sufficient to deal especially with the future demand increase and operation expansion. The average salaries (gross, per head) are approximately Rs. 40-50 thousands for the entry level and Rs. 60 thousands for the mid-career in thirties. RBI has the authority to decide the salary for the policy financial institutions such as SIDBI, the policy NBFC such as IREDA, PFC, REC and state-owned commercial banks. The salaries are decided based on financial soundness and IREDA and PFC/REC are categorized in C and B, respectively (B is higher than C).

IREDA is increasing the employees following the five year plan. The current employees are 121 as of July 2009, but planned to be increased to 175 in the maximum in 2011. For this reason, the office space was expanded along with the HQ's relocation. In 2009, hiring maximum of 30

employees is under discussion and 4-6 and more than 20 are expected to be allocated to Finance & Accounts Dept and Technical Services Dept, respectively. In Technical Services Dept, 3-4 are planned for the group for waste to power and EEC. The new recruits are new graduates from master or bachelor courses mainly in engineering or partly in management majors. The newcomers during April and July 2009 are in management major and graduates from International Management Institute, Management Development Institute and Institute of Cost, Works and Accounting in India. Since IREDA has had a small number of employees and started around 20 years ago, it has not developed a periodic hiring system. But recently, it started the steady hiring for operational expansion and the net increase in personnel cost is estimated for Rs.1.5 crore p.a. on average.

Employee increase is expected to bring the total number of employees, from 112 employees as of March 2009, 121 employees as of July 2009, 135 employees as of September 2009, reaching to 175 employees as of March 2011. However it is up to the work demand how much the net increase is realized in the months and years ahead. In terms of the group for EEC and waste to power, number of appraised and sanctioned projects was zero as of 2008, 3-4 as of 2009 (expected). In terms of the group for cogeneration it was 4 projects as of 2008, 7-8 projects as of 2009. Therefore it is an investment for the future demands to increase employees.

According to the latest MOU (annual business plan) agreed between MNRE and IREDA, it was decided to additionally establish camp offices in Kolkata and Ahmadabad. They are aimed to be the sites to monitor already disbursed loan projects as well as to collect information on expected future projects. IREDA annually exchanges MOU with MNRE regarding the overall management policy such as an annual business plan.

Table 6-A Corporate Profile

Governing Law of Incorporation

IREDA (Indian Renewable Energy Development Agency, Ltd.) was incorporated on 11th March, 1987, as a Public limited Government Company to promote renewable energy projects under the Companies Act, 1956. It is "Public Financial Institution" defined in Section 4 'A' of the Companies Act, 1956 and registered as "Non-Banking Financial Company" in RBI.

History

1987 – On 11th March, incorporated as a Public Limited Government Company to promote renewable energy projects according to Companies Act, 1956.
2000 – Started to work for energy efficiency projects.
2001 – IREDA hosts the India secretariat of UNF/UNEP/WB Three Country Energy Efficiency (3CEE), "developing and financing energy efficiency and conservation projects", which is the capacity development project to promote loans for energy conservation by financial institutions in India and started in June 2001.
2003 – Issued "Investors Manual for Energy Efficiency" together with CII.
2006 – Issued the Best Practice manual for energy efficiency together with BEE.
2007 – The cabinet approved to increase IREDA's authorized capital from Rs. 400 crore to Rs 1,000 crore on 1st March.
2009 – Moved the office to the new HQ (relocation for office expansion n Delhi)

Registered Capital

In the end of March 2005, the authorized capital and paid-up capital were Rs.400 crore and 375.35 crore, respectively. In FY 2005-06, the capital was increased by 24.65 crore and the authorized capital reached the upper limit. On April 1st, 2007, the authorized capital was increased to Rs. 1,000 crore. In FY2007-08, the capital was increased by 90 crore and the paid-in capital was Rs. 490 crore and the total share was 4.9 million as of the end of March in 2008 (Rs. 1,000 per share, 1 crore=10,000,000).

Shareholders

100% owned by MNRE. (MNRE is a main supervisory authority.)

Missions

As follows: (1) to operate a revolving fund for development and deployment of New and Renewable Sources of Energy (NRSE), (2) to give financial supports to specific projects and schemes for generating electricity and/or energy through new and renewable sources and conserving energy through energy efficiency, (3) to bring down the cost of Renewable power, (4) to assist in upgrade of technologies in the country through New and Renewable Sources of Energy (NRSE), (5) to develop criteria/systems/concepts for financing projects based on New & Renewable sources of Energy and Energy Efficiency/Conservation, (6) to strive for improvement in customer satisfaction.

Board of Directors and Board Meeting (Mar 31, 2008)

- Out of 8 Directors, five Directors including the Chairman and Managing Director (Mr. Shri Debashish Majumdar), the Director of Finance (Mr.(Shri) S P Reddi) and the Director of Technical (Mr.(Shri) K. S. Popli), serve on a full time basis. Other three are part-time and two out of these three works for MNRE, which is the supervisory authority of IREDA, and IIT Bangalore.
- The Chairman and Managing Director, Mr. Shri Debashish Majumdar, was the Managing Director till the end of March in 2007, but he doubles as Chairman since FY2008.

Head Quarter / Branches / Employees (Mar 31, 2008)

- HQ address: August Kranti Bhawan, II Floor, Bhikaji Cama Place, New Delhi – 100 066 (After HQ relocation in April 2009)
- Branches: 2 (Contact points in Industrial and Technical Organization of Tamil Nadu Limited and The Federation of Andhra Pradesh Chambers of Commerce and Industry (FAPCCI))

Employees: Out of 120 (As of the end of April, 2009), Technical and Finance departments are 40 each and 80 in total and the rest of 40 are assigned to Chairman & Managing Director's cell and Vigilance and so on.

Loan and assets (non-consolidated)

(Unit : Rs. crore)	'01-02	'02-03	'03-04	'04-05	'05-06	'06-07	'07-08
Total Assets *1	1860.46	2262.46	1950.4	1967.67	2134.49	2122.54	2137.20
Loan Outstanding*2	1942.48	2085.07	1970.24	1825.1	1763.35	1900.88	2195.59
Loan Sanctions (No. of Sanctions)	698.63	633.96	423.57 46)	599.73 56)	505.83 (46)	588.51 (33)	826.15 (29)
Disbursements	607.7	345.92	343.28	289.98	302.51	410.87	553.64

*1:This figure deviates from the figure in the B/S. *2:Term loans only.

(Source)"Highlight of our Performance" 2007-08 Annual Report

Debts/ Capital (non-consolidated

Unit: Rs. crore	'06-07	'07-08
Domestic Borrowings	1118.03	998.85
International Assistance	852.25	844.6
Equity	732.43	818.99
(Of which, Shareholders')	440.00	490.00
Liabilities and Equities	2702.71	2662.44

- The Capital ratios (Tier 1), 27.1.% (2006-07) and 30.8% (2007-08), satisfy BIS requirement (8% and above) and suggest that safety and soundness of management are good.
- CRARs against the risk adjusted assets based on Basel II (market/credit/operation risk considered), 33.86% (2006-07), 34.31 % (2007-08) fully satisfy BIS requirement (8% and above) as well.

Loan Portfolio

Loan balance as of March end in 2008: Rs. 2176.63 crore (Unit: Rs. crore)

Sectorwise Sanctions / Disbursement ('07-08)	Sanction	Disbursement
Wind Power	426.97	271.02
Small Hydro	226.23	119.39
Cogeneration	68.30	103.88
Biomass Power	0.00	9.81
Energy Efficiency & Conservation	53.73	13.57
Solar Photovoltaics	0.00	0.00
Solar Thermal	50.92	29.82
Waste Thermal Recycle	0.00	6.15
Others	0.00	0.00
Total	826.15	553.64

* Direct loans are provided and provision of indirect loans is limited.
* IREDA provides the loans to small hydro power plants by consortium, but according to the annual reports '05-'06, it seems that there is the regulation that "it is not allowed to be an lead arranger". However, according to "Wind Energy News"(May 2007 version, website), IREDA was the lead arranger to provide the loans to Tata Power Company for construction of Wind Energy Park (Maharashtra, 85MW, total project cost Rs. 400 crore) by consortium with ADB. (ADB Rs. 200 crore, IREDA Rs. 95 crore)

Earnings

(Unit:Rs. crore)	'01-02	'02-03	'03-04	'04-05	'05-06	'06-07	'07-08
Ordinary Income	225.87	253.51	248.34	263.13	195.05	232.78	246.93
Ordinary Expenses				216.20	159.20	137.56	173.32
Finance Charges				111.90	101.30	120.46	119.44
Personnel Expenses				5.40	6.00	5.86	8.82
Administrative Expenses				3.10	2.80	2.68	2.95
Net income after tax	4.1	17.33	23.34	30.41	30.65	34.60	47.96
Net income per share (Rs.)			71.74	81.01	79.82	85.79	103.91
Equity	327.02	397.49	453.15	517.95	566.12	732.43	818.99

・Profits increase in the past five years and equity capital was steadily accumulated.
・The expected dividends to the Government in 2007-08 are Rs.9.6 crore(dividend rates 19.84%) and the ones in the previous FY are Rs.7.0 crore(dividend rate 20.23%), and the almost same ratios are maintained.
・The Return on Equity(ROE) and the Return on Asset (ROA) were improved to 5.86% (2007-08) from 4.72% (2006-07) and to 1.80%(2007-08) from 1.28%(2006-07), respectively.
・The current net income per share was increased to Rs. 103.91(2007-08) from Rs. 85.79 (2006-07).

Breakdown of Debts (non-consolidated)

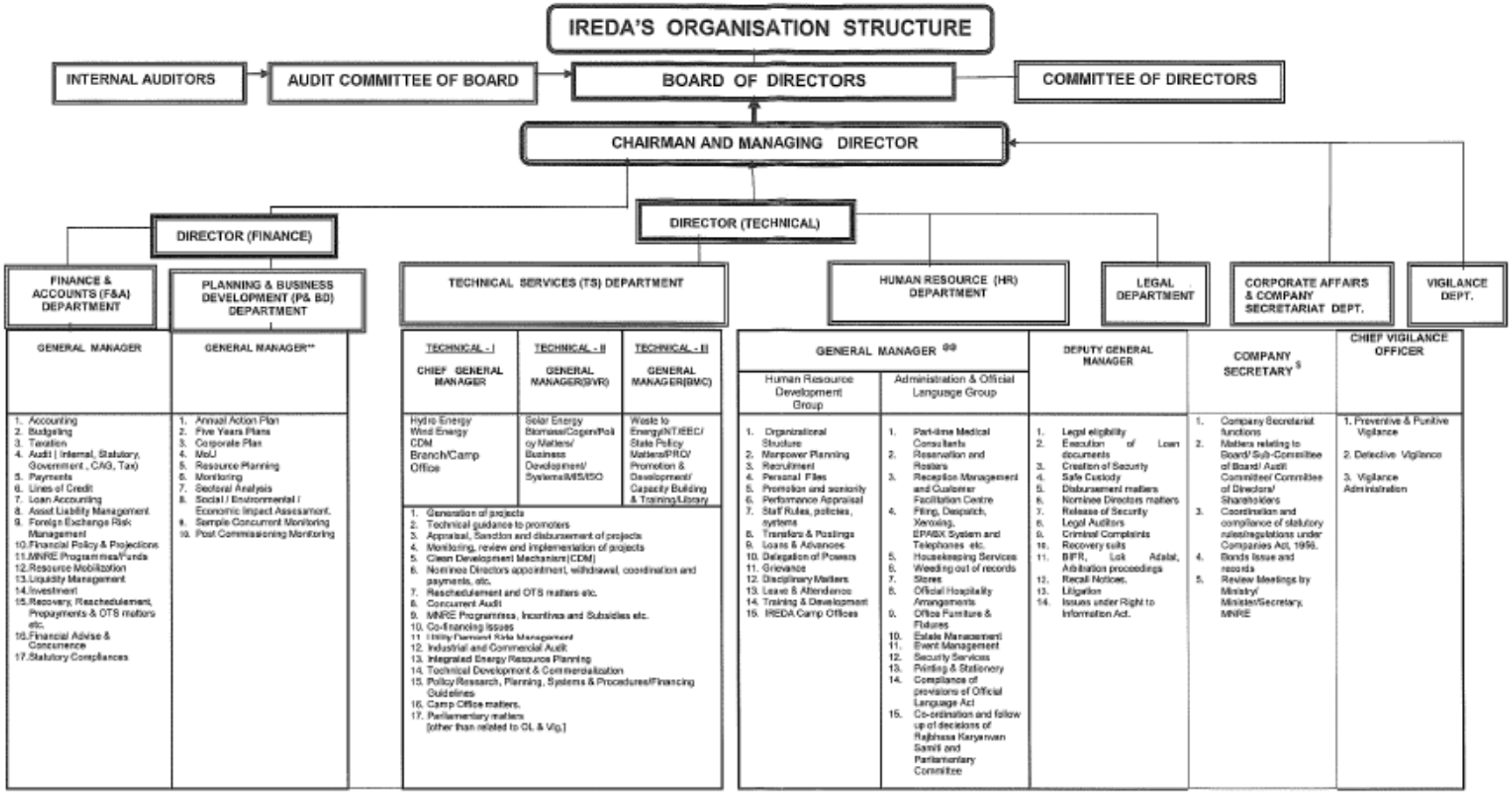
IREDA Source of Funds(Unit: Rs. crore)

	'05-06	06-07	07-08
Borrowings from Domestic Market			
Tax Free Secured Redeemable Energy Bonds	250.00	200.00	150.00
Borrowings from Domestic Commercial Banks		918.03	848.85
Canara Bank Term Loan (I & II)	101.92		
OBC Term Loan (I, II & III)	191.67		
The South Indian Bank Ltd.	23.75		
Dena Bank	50.00		
Bank of Baroda Loan (ADB Loan)	172.81		
Canara Bank Loan (KfW Loan)	284.34		
Bank of Baroda Loan (IBRD Loan)	130.00		
Subtotal	1204.49	1118.03	998.85
Borrowings from International Donors			
IDA Loan	220.70	235.7	241.85
ADB Loan	177.71	168.13	150.06
KfW Loan	293.70	287.82	166.67
IBRD-Loan	145.82	160.6	286.02
Subtotal	837.93	852.25	844.60
Total	2042.42	1970.28	1843.45

* Domestic sources of the funds include ADB Loan without government guarantees, KfW Loan, borrowing from the commercial banks (Bank Baroda and Canara Bank and so on) funded by IBRD Loan.
・The breakdown of the borrowings (FY2007-08, total Rs. 2176.63 crore) is 54.2% and 45.8% from the domestic sources and international organizations, respectively.

(Sources) the web site of IREDA (http://www.ireda.in/) (the financial data is the latest and as of March end in 2008), Annual Report 2007-08

Figure 6-A Organizational Chart



Additional charge with General Manager (DCCS)
$ Additional Charge with GM(F&A)
@@ Additional Charge with Director (Technical) as a Functional Director and DGM(Law) as a Department Head
** Vacant

(updated as on 17.04.2009)

6-1-4 Business outline

IREDA operates under the mission to promote renewable energy, improve energy efficiency and conserve energy following the government policy. After twenty years of its establishment, IREDA made a credible achievement as a pioneer. Especially, in the sector of the renewable energy projects, its market share has decreased to approximately 10% (end of 2008, based on total power generation), compared with over the half in the past as this sector commercially developed in India. For the future, it targets to maintain approximately 10% of the market share.

Loan size:

The outstanding loan is approximately Rs. 2,500 crore as of the end of April in 2009 and the annual loan amount is approximately Rs. 700 crore. The average tenor of the loan is 5 years. The sectors financed are wind, hydro, cogeneration and biomass, whereas EEC is less than 10% (Table 6-B, Table 6-C). The percentage of EEC loan was the highest in FY2005-06 (sanctioned amount 24.4%, disbursed amount 13.7%), tapered off to 3.6% and 7.2% in FY2006-07 and 6.5% and 2.5% in FY2007-08, respectively. The difference between the sanction and disbursed amounts is constantly about 30% and this difference is for the following reasons, which occasionally happen: the actual construction costs become less than the sanction amounts and the borrowers receive the finance from the commercial banks after IREDA's sanction.

Eligible borrower:

The loans are managed by four exposure limits: 1. promoters, 2. sectors, 3. areas and 4. industries; 1. is the credit lines by companies, 2. is by the sectors financed (i.e. credit lines by wind, hydro, solar photovoltaic, biomass & cogeneration and EEC), 3. is the credit lines by states and regions, 4. is the credit lines by the industry sectors such as the steel and cements. The loans are not managed by company's and project's sizes.

The small and medium projects by small and medium enterprises are mainly financed (including the non-recourse finance for the joint project with the large enterprise). The requirements for a borrower (promoter) are: a borrower is a private company, all laws and regulations such as approvals and licenses are complied, profits are yielded for more than two years and a project's financial income does not have problems (IRR more than 10% etc). IREDA does not have the policy to support specifically SMEs, since the current EE Act's target (19 clusters) does not cover SMEs. Furthermore, there are several schemes to finance the projects by micro, small and medium enterprises and these enterprises are financed though the amount is small.

Finance scheme:

Most of the finance scheme is direct finance. However, there are the schemes to address the small projects in order to cover the limited number of the branches. In addition, the finance is categorized as “project finance” and “equipment finance”, but both are corporate finance and the former is for new investment and the latter is for renewal/additional investment. The finance for EEC generally belongs to the latter.

Borrowing /Lending interest rates:

The total borrowing rates with the government guarantee in Euro or US dollar from World Bank, ADB and KfW are 8-9%, including the swap costs and the government guarantee charges. The government guarantee charges (the applied rates are 0.6%-1.2%) differ depending on the project contents and there seem to be no clear guidelines. Apart from that, there are the borrowings without the government guarantees from ADB and the commercial banks (Bank of Baroda, Canara Bank etc). IREDA has been discussing with ADB on the possibility of the borrowing for solar photovoltaic power generation. In addition, the discussion with KfW is ongoing regarding the borrowing for renewable energy and biomass cogeneration (20-50 million Euro). Also, IREDA is discussing with NIB. The main source of finance for IREDA is the commercial bank borrowing, bond issuance and donor finance, but the expectation to donor finance is increasing, since the condition of the commercial bank borrowing becomes tough due to the current financial crisis and IREDA is more inclined to the bonds issuance.

The paying interest rate of new JICA concessional loans is expected to be 8-9 %. IREDA explains as follows: “1. The following costs are added to paying interest rates to JICA (the concessional rate for Low-Income Countries, which is higher than the one for the Least Developed Countries.): 2. Japanese yen denominated deposit interest rate (6 month rolling), 3. Indian Rupee denominated borrowing interest rate (6 month rolling, foreign exchange/hedge costs) and 4. Government guarantee charge. For 40 year borrowing period, it can be temporarily calculated as follows: 0.65% + (minus 0.73%) + 8.10% + 1.00% = 9.02% in order of the items mentioned above. In the same manner for 30 year borrowing period, 0.55% + (minus 0.73%) + 8.10% + 1.00% = 8.92%. On the top of these rates, the commitment charges to JICA will be added.” Genrally speaking, it appears that JICA interest rate and JPY denominated deposit interest rate should be theoretically pararell as the structure of swap transactions, thus bringing 8.10% (INR denominated borrowing interest rate) + 1.00% (Government guarantee charge) = 9.10% as the total paying interest rate, for both 30 and 40 year, according to the above caluculation. IREDA is requested to make a clarification on this issue, perhaps differentiating ‘8.10%’ for 30 year case and 40 year case. However, it is still competitive, comparing the above

costs with the other sources of the finance, the borrowing from the commercial banks and the bond issuance costs 10.5%-11.5% and 9.0%-9.6%, respectively. Taking into account the tenor difference, it is obvious that Japanese ODA Loans are concessional. IREDA is considering choosing 40 years for the borrowing period to use the funds in a revolving manner and lend to more borrowers.

The lending interest rates are decided based on the sectors (wind, solar photovoltaic, EEC etc) and the ratings (Technical, Finance), regardless of the financial sources. For example, according to financing norms, the current EEC interest rates are Grade 1：11.50％, 2：11.75％, 3：12.00％ and 4：12.50％ depending on the ratings (1-4).

IREDA expects the lending rates of the JICA concessional loans to follow IREDA's financing norms like the other donors (World Bank, KfW etc). In the past, IDA financed fund included the rebates. Using this rebates, IREDA provided the interest rate subsidy (0.5%). However, it was the exceptional case.

The margin in the new JICA concessional loan concerned is 2.5% for the most favorable lending and 3.5% for the least favorable lending. This margin will cover the operational costs, reserves and profits. In general, the current interest rate of the commercial banks (mainly short-term loans) is 11.5%-12.5% as the primary lending rate, which is consisted of the deposit rates 6.25% and others 6.25% (the operational costs 3.25%, reserve 1.2% and profits 1.8%). The disbursement of the new JICA concessional loan is planned to be over three years. Assuming 500 crore Rs. (100 million USD), the disbursement is expected to be 200 crore Rs, 200 crore Rs and 100 crore Rs, respectively.

Lending procedure and sanctions:
There are three steps: 1. Submission, 2. Registration and 3. Sanction.

In 1. Submission, all projects are received by Chairman's Office and input in the computers. Next, in Technical Services Dept, the technical and financial aspects will be checked against the checklist in the following order: 1. Director, 2. Head (Technical 1: Hydro/Wind, Technical 2: Solar photovoltaic /Biomass/Cogeneration, Technical 3: Waste to Energy/EEC), 3. Group leader (Hydro group, Wind group, Solar photovoltaic group, Biomass/cogeneration group, Waste to Energy/EEC group). At this stage, it will be checked from the following four aspects: The type of the promoter, the sector and the areas plus the industries. This process virtually covers most of the appraisal process. The group is consisted of three to four staffs including an

administrative staff. For example, Waste to Energy/ECC group is consisted of a group leader, four staffs including an administrative staff. Lending projects are allocated to this three staffs, who will be person in charge of each lending project, i.e. appraise the projects from technical and financial aspects and prepare the reports. The same staffs will be consistently in charge of the following coordination with the other departments (2. and 3. described below) and monitoring after disbursement (to check use of funds, operation and financial statements etc). In this regard, each group will be PMU in the new JICA concessional loan. In case of the other donors, for example KfW biomass credit line, the biomass cogeneration group is PMU.

2. In registration, the registration number will be issued. Following that, Finance & Accounts Dept will conduct the following: Financial aspects are additionally checked, while credit rating is executed. The ratings are to quantitatively screen a project based on Credit Rating Mechanism (technical and financial aspects). Based on the ratings, whether the loans will be granted or not and the applicable terms (four categories) will be determined. The best category is 1 and the worst one is 4, to which the loans will be declined and the improvement measures will be proposed. The ratings used to have 14 categories, but are simplified now. This system was designed by the rating agency, ICRA.

In 3. Sanction, Technical Services Dept and Finance & Accounts Dept will appraise the projects from the aspects which were not covered so far. Following that, the loan will be sanctioned based on the authorized approval process. Thereafter, the Legal Dept will manage the process for their collateral and contracts.

The numbers of the projects are around 10 per month. The internal process takes three months at maximum from the submission to the sanction. IREDA recognizes this is longer than the commercial banks (one month on average). This is because the projects are appraised more carefully in respect of corporate and project facets and there are many transactions with single project companies. However, the following problems are also pointed out: limited number of the staffs and lack of systematic capacity development: financial appraisal skill and technical appraisal skill by for sector financed such as wind or solar photovoltaic.

The sanction limit is in Table 6-D.

Characteristic scheme:

(Business Development Associate Scheme)

IREDA is in cooperation with 50 institutions such as Technical Consultancy Organizations

(TCOs), State Nodal Agencies (SNAs), Local Productivity Councils (LPCs), National Productivity Councils(NPCs), Private Consultancy Organizations (PCOs), National Governmental Organizations (NGOs) and Technical Institutions and Agencies registered under Societies Act (TI&A). They are the State institution for investment promotion and provide the consulting services for the investment project formulation and financing. They provide the information not only to IREDA, but also to the commercial banks. However, IREDA can provide more effective supports than the commercial banks can, since IREDA has technical knowledge and is able to provide the long term finance in the field of renewable energy and EEC. In this regard, these institutions are powerful source of the deal inflow for IREDA. This scheme was started in World Bank 3CEE projects and IREDA used to pay the fees. In the past, IREDA and these organizations together conducted promotional activities based on the industry sectors such as steel and the States.

In addition to the approach above, the cluster approach is under consideration. IREDA has the bank accounts in the main regional banks (e.g. State Bank of Hyderabad, Punjab National Bank) in order to finance the end users. In this approach, IREDA collects cluster-wide project information from these regional banks. In these projects, the regional banks and IREDA finance working capital and funds for plants and equipment, respectively.

(Umbrella Financing Scheme)

This is the scheme to access to the extremely small projects (e.g. equipment finance for small solar photovoltaic and biomass) that IREDA lends to NBFC, cooperatives, ESCOs, non-governmental organizations and parts of the commercial banks and they will loan or lease to the end users. In this scheme, NBFC etc will bear the repayment risk of the end users. For example, IREDA has the agreement with Canara Bank (a commercial bank), and they established the operational rule that the loan amounts per project to a end user do not exceed Rs. 10 lakh. They started such agreement, since IREDA designed the technical assistance program for the commercial banks as a coordinator in India in World Bank 3CEE project and the participated bank, Canara Bank, approached IREDA for business cooperation. The partners of the leasing companies include SREI etc.

(Consortium Funding)

‘Consortium Funding’ means co-finance arranged, in which the lending terms are not unified. (This is different from syndicate loans, in which the lending terms are unified.) So far, IREDA’s finance was mainly solo in any project such as wind or hydro, since IREDA has been dealing with the small and less profitable projects. Furthermore, IREDA can finance up to 70% of the

target project and the remaining 30% is requested to be financed by the borrower's own funds considering the project's profitability. This is another reason for frequent solo finance by IREDA. In the coming years, the demand of the medium sized projects (especially wind) will grow following the government's energy supply enhancement policy. IREDA's finance is currently limited in this type of the projects due to its reasonable profitability. In this regard, IREDA might reinforce itself for this and the consortium arrangements might increase. In particular, IPP projects are in IREDA's mind.

(Non Recourse Loan)

The small wind projects are the main target for non resource loans and its general scheme is as follows: The small enterprises with the technology will establish SPC together with the large enterprises. The project, in which this SPC is the promoter and borrower, will be financed by non-recourse following the borrower's requests. It started in around 2005. These projects are made commercially viable since the government agrees to purchase at a certain price and the project's profitability is limited. When the projects are small and financed in non recourse, the commercial banks consider no rewards compared to the required time, efforts and risk. As a result, they do not enter into the market unlike the corporate loans (balance sheet loans) of the mid-sized or larger projects. Also for the promoters, the source of finance tends to be the corporate loans when the large companies invest in the mid-sized or larger projects. In the months ahead, the government intends to reinforce the policy supports in order to increase dependence rate in the renewable energy. Accordingly, IREDA plans to involve more in the relatively larger projects (but the limited profitability and qualitative enhancement required or quantitative enhancement required), compared with the past.

(Capital Subsidy Scheme/Interest Rate Subsidy Scheme)

Both schemes are the subsidies from MNRE. IREDA, their implementation institution, provides subsidies to the IREDA or the commercial bank financed projects which meet the policy requirements. The policy objective is to supports the disadvantaged areas such as Northeast India and penetration of solar water heating. Capital Subsidy Scheme is to supplement the certain amount of the investment amounts. IREDA receives the expected amount in present value from MNRE in advance and pays out based on the appraisal. Interest Rate Subsidy Scheme is to supplement two percents of the interest rates of the borrowing for the investments. IREDA receives the amount concerned every time from MNRE and pays out after the appraisal. For Interest Rate Subsidy Scheme (penetration of solar water heating), 35 commercial banks are specified as IREDA's designated financial institutions.

Table 6-B Sector-wise Loans sanctioned (Transition in the past 5 years, outstanding balance for 20 years)

(Rs. in crore)

S. No.	Sectors	2003-04	2004-05	2005-06	2006-07	2007-08	Cumulative since 1987
1	Wind Power	121.05	204.25	261.41	266.19	426.97	3241.23
2	Hydro Power	122.00	176.73	17.30	160.87	226.23	2095.16
3	Cogeneration	58.56	77.46	0.00	116.28	68.30	1319.57
4	Biomass Power	58.29	32.20	89.30	0.00	0.00	706.64
5	Energy Efficiency & Conservation	45.03	96.73	123.32	21.30	53.73	533.21
6	Solar Photovoltaics	2.96	0.00	0.00	0.00	0.00	585.95
7	Solar Thermal	11.43	12.36	7.00	13.00	50.92	188.03
8	Waste to Energy	0.00	0.00	0.00	9.19	0.00	58.33
9	Biomass Briquetting	0.00	0.00	0.00	0.00	0.00	19.47
10	Biomass Gasification	0.00	0.00	0.00	1.68	0.00	12.43
11	Biometh anation from Industrial Effluents	0.00	0.00	0.00	0.00	0.00	72.47
12	Miscellaneous	4.25	0.00	7.50	0.00	0.00	33.16
	TOTAL	**423.57**	**599.73**	**505.83**	**588.51**	**826.15**	**8865.65**

Source: IREDA Annual Report 2007-08

Table 6-C Sector-wise Loans disbursed (Transition in the past 5 years, outstanding balance for 20 years)

(Rs./Crores)

S.No.	Sectors	2003-2004	2004-05	2005-06	2006-07	2007-08	Cumulative Since 1987
1	Wind Power	93.37	102.47	134.82	258.19	271.02	2031.51
2	Hydro Power	79.52	90.04	64.73	58.36	119.39	916.75
3	Cogeneration	86.03	26.57	18.44	19.68	103.88	815.17
4	Biomass Power	52.69	45.67	36.74	38.99	9.81	523.28
5	Energy Efficiency & Conservation	5.3	0.65	41.44	29.40	13.57	170.99
6	Solar Photovoltaics	6.97	5.57	0.11	0.00	0.00	288.26
7	Solar Thermal	7.87	17.25	5.93	5.00	29.82	115.44
8	Waste to Energy	9.52	1.64	0.30	0.00	6.15	45.75
9	Biomethanation from Industrial Effluents	0.00	0.00	0.00	0.00	0.00	57.60
10	Biomass Briquetting	0.07	0.00	0.00	0.00	0.00	9.99
11	Biomass Gasification	0	0	0	1.25	0	5.12
12	Miscellaneous	1.94	0.12	0	0	0	3.24
	TOTAL	**343.28**	**289.98**	**302.51**	**410.87**	**553.64**	**4983.10**

Source: IREDA Annual Report 2007-08

Table 6-D Sanction limits

	Person/Entity	Sanction limits
1.	Board Meeting	No limits
2.	Functional Directors	
(i)	Chairman/ Managing Director	Projects except the coal briquette and hybrid technology industries. Borrowing amounts from IREDA: Rs 2.00 crores -Rs 7.50 crores (borrowing limit per year Rs 150.00 crores)
(ii)	Director (Technical)	Projects except the coal briquette and hybrid technology industries. Borrowing amounts from IREDA: Rs 2.00 crores and below (borrowing limit per year Rs 40.00 crores). Director (Finance)'s approval required in case of Director (Technical)'s approval. Recommendation from Chief General Manager or General Manager (CGM / GM) required in case of Director (Finance) approval

6-1-5 Financial condition

As of 1st April in 2007, the authorized capital was increased to Rs. 1,000 crore from Rs. 400 crore as a part of government initiative for renewable energy and EEC. After two payment (24.65 crore in FY2005-06 and 90 crore in FY2007-08), the paid in capital was Rs. 490 crore in the end of March in 2008. The capital ratios (Tier 1), 27.1% (2006-07) and 30.8% (2007-08), satisfy BIS requirement (8% and above) and indicate that the management is safe and sound. Also, CRARs against the risk adjusted assets based on Basel II (market/credit/operation risk reflected), 33.86% (2006-07) and 34.31% (2007-08), fully satisfy BIS requirement (8% and above). Borrowings (FY2007-08, Rs.2176.63 crore in total) are comprised of 54.2% from the domestic markets and 45.8% from the international donors.

Following RBI's guidance, IREDA, like the commercial banks, recognizes the loans delinquent more than 90 days as the defaulted receivables in the end of every March. Usually, the amount equivalent to 10% of the loans are set aside as the reserves for a year of the loan execution. (NPA is the sum of the defaulted assets (NPA: principal and interest delinquent more than 90 days) minus the assets acquired by foreclosure.) According to IREDA's annual report 2007-08, the net NPA rate in this FY is 11.28%, where "the net NPA rate" means the NPAs (total NPAs which are not covered by the reserves) to net loans and advances. This percentage was improved compared with the ones in the previous FY (12.52% in FY2006-07). The net NPA rate was temporarily deteriorated in FY2005-06 (from 5.53% in FY2004-05 to 12.36% in FY2005-06). The reasons behind this deterioration seems to be as follows: i) the definition of NPA was changed to 90 days delinquency from 180 days delinquency due to the change of RBI's prudence norms (31/03/2006) (according to the information from the then-interview with IREDA), ii) the revenues of Andhra Pradesh and Karnataka State Electricity Boards were decreased because of the electric utility charge's revision, and iii) since IREDA is the policy

financial institution, it will take time for the impact of the projects to be materialized and the projects tend to be affected by the force majeure such as natural disasters. (Example: Hydro power project: The power plant was constructed and immediately after its operation started, the drought occurred. As the result, it was impossible to generate the power for three years and the loans were categorized as NPA. Now the drought has ended and the plant is earning the profits.)

Table 6-E NPA（as of 31 March 2008）

(Unit：Rs. in crore)

Asset Type	Borrowers (Enterprises)	Outstanding Balance
SUBSTANDARD	n.a.	104.52
DOUBTFUL	n.a.	311.37
LOSS	n.a.	0.03
Total NPA	n.a.	369.49
Standard Assets	n.a.	1744.21
Total Loan Outstanding	n.a.	2160.13
Gross NPA %		19.25%
Net NPA %		11.28%

(Sources) IREDA Annual Report 2007-08

6-1-6 Profits and losses

In the past five years, IREDA maintained profit increases and steadily accumulated its equity capital. The expected dividend to the government (2007-08) is Rs. 9.6 crore (dividend rate 19.84%) and the same level was maintained as the ones in the previous year (Rs. 7.0 crore (dividend rate 20.23%)). ROE and ROA improved to 5.86% and 1.80% in 2007-08 from 4.72% and 1.28% in 2006-07, respectively. The current net profit per share was also increased to Rs. 103.91 (2007-08) from Rs. 85.79 (2006-07).

6-2 Outreach and finance for Energy Efficiency and Conservation

IREDA's EEC finance was promoted by World Bank 3CEE project (2001-2007). This project was implemented for renewable energy and EEC in phase 1(USD 6 million) and 2 (USD 5 million) and IREDA was its coordinator in India. Marketing assistance, awareness campaign and trainings for IREDA/commercial bank staffs were conducted. In addition to these, the followings were also part of the project: Research for the appraisal method of EEC projects, introduction of on-lending scheme (i.e. as an implementing institution under MNRE, to provide subsidy for interests of EE loans through the five commercial banks.) and sharing of the EE project experience with policy-makers and banks in China and Brazil.

However, the achievement in IREDA was the reinforcement of the operation mainly in the

renewable energy. For EEC, the sponge iron and cement sectors were specifically picked up. The achievement was that the appraisal methods for those sectors were entrenched, but its authorized benchmark was not set out. (e.g. “energy efficiency improvement 20%”)

Therefore, IREDA, especially for EEC, expects to expand the sectors and conduct marketing, awareness campaign and staff trainings again taking into account SME cluster approach. The linkage with the ongoing Japanese ODA Loans to SIDBI could also be the option. In addition, to set out the benchmark by the equipment list is effective especially for small and medium EEC projects. For medium and larger projects, it is appropriate to apply both the equipment list and energy audit methods, since EEC should be measured as a process rather than as a single equipment.

The next section covers the overview of IREDA’s Energy Efficiency & Energy Conservation (including DSM) Sector Finance.

Table 6-F IREDA’s EEC finance portfolio (2006 and 2007: n.a.)

Year of sanction	*No. of projects*	*Sectors*	*Project Cost (mil $)*	*Sanctioned amount (mil $)*	*Disbursed amount (mil $)*
1999	6	Steel, Sugar, DSM	20.6	15.9	13.8
2000	2	Sugar, DSM	5.5	4.2	4.2
2001	1	Cement	1.0	0.7	0.7
2002	1	Diversified group	0.3	0.2	0.2
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	9	Steel, Paper, Cement	60.5	35.9	0.0
2006					
2007					
All	19		87.9	56.9	18.8

(Source) ESMAP-UNEP (2006/5/10), “Developing Financial Intermediation Mechanisms for energy Efficiency Projects In Brazil, China and India: India Country Report” PP24-25

The details of this program are as below:

Definition of EEC measures:

- Measures to improve energy efficiency in a company, which could be implemented by the minimum investments such as operation, maintenance and cleaning. This will include the active activities in the office and small group activities.
- Measures to complement or convert the equipment, which require the medium investment.

- Measures to change the manufacturing process, which require the large investment.

Example of eligible equipment:

- Waste Heat Recovery Boilers/ Equipments
- Energy Efficient Drives, Variable Speed Motors etc
- Vapour Absorption Chiller/ Refrigeration Systems
- Energy Efficient Lighting (CFL/ Electronic Choke etc.)
- Efficient Boilers, High Pressure/FBC methods
- Control Systems for Energy Efficiency
- Capacitor Banks for Power Factor improvement
- Other Energy Efficient Plant & Machinery

Eligible entities, companies and projects:

Eligible entities are as follows:

- Listed and non listed companies, NBFCs and unions
- Individuals, management executives and partnership (subject to conditions)
- State Electricity Boards (limited to SEBs after the restructuring or in the process of restructuring, and are eligible for borrowing from REC/PFC)

Eligible companies are as follows:

- Profitable business and no accumulated debts (FIRR: higher than 12%)
- Debt to equity ratio (including borrowings from IREDA) is smaller than 3:1. (In case of NBFCs, 5:1 subject to the conditions.)
- No events of defaults to IREDA and other financial institutions (including banks)
- No impairment of paid in capital
- DSCR: higher than 1.2
- Asset coverage ratio: higher than 1.2

Eligible projects are as follows:

- Projects undertaken by ESCO modes/end users for implementation of energy efficiency/conservation projects (purchase/installation of energy efficiency equipment/system or equipment/system for electricity load management)
- Manufacturing of energy efficiency equipment
- Refinance of the projects which were implemented a year before or later of the registration date to apply the borrowing from IREDA.

Financing norms:

The financing norms are in Table 6-G.

Table 6-G Financing norms for EEC finance

Sector	Interest rate(%) p.a.	Max. Repayment period including Moratorium (Yrs)	Maximum Moratorium (Years)	Min. Promoters' Contribution (%)	Term Loan from IREDA (%)	Notes
A. Project Finance (e.g. construction of plants)						
EEC projects (including DSM projects, projects through ESCO model)	11.25*	10	2	30	Up to 70% of project cost	*1% additional interest rate will be charged by IREDA for all grid connected power generation projects till commissioning. If they meet WB scheme, the interests could be reduced by 2%.
	10.25	8	2	30		
B. Finance to Manufacturing of EEC Equipment/Facilities						
EEC Systems and Equipments	12.75	8	2	30	Up to 70% of project cost	
C. EEC Equipment Finance						
EEC Systems and Equipment (including DSM)	12.25	10	2	20	Up to 80% of project cost	Companies and intermediary are eligible. If they meet WB scheme, the interest could be reduced by 1%. EEC project costs include expense for energy audit and DPR preparation.
	10.25	7	1	20		
	9.75	6	1	20		

(Source) IREDA website: "Financing norms for EEC."

(Note)

1. The interest rates above are applicable for three years after the first disbursement or the reset date and they will be reset after three years.
2. It is possible to choose the fixed interest rate over the borrowing period. However, the interest rate will be higher by 1 %.
3. As for the grid connected power generation projects, 1 year grace period could be given for principal repayment related to commissioning (but after commencing) if that is within three years after the first disbursement.
4. For institutions with Pledge of FDR issued by Scheduled Banks, the interest rate will be reduced by 1.0%. (the information from the interview with IREDA)

Subsidy related to EEC finance:

The subsidy is attached to the loan scheme by IREDA. The details are in Table 6-H.

Table 6-H Subsidy for EEC related Finance

Category of Project	Purpose of Grant	Eligible Amount
End User EEC Projects Utility DSM hosted Program	Cost of carrying out energy audit and for preparation of bankable detailed project report, which were required to borrow the long term loan	Rs.20.00 Lakhs per project or 4% of the loan directly availed from IREDA, whichever is less.
Utility DSM Projects	Cost of carrying out energy audit and for preparation of bankable detailed project report, which were required for the long term loan	Rs.20.00 Lakhs per project or 4% of the loan directly availed from IREDA, whichever is less.
	For setting up a DSM cell in the utility	Rs. 10 lakhs (provided loan of minimum Rs. 50 lakhs is availed.)
ESCO promoted projects (shared saving/guaranteed saving or lease rental/fixed payment)	Cost of carrying out energy audit and DPR for availing financial assistance from IREDA, cost of preparation of performance contract including monitoring and verification protocol for the project and other project development costs	Rs. 30 lakhs per project or 6 % of the loan availed from IREDA, whichever is less
Recommendation to IREDA	Up on starting up EEC promoted projects, to obtain the recommendation for the borrowing application to IREDA. The current clients of IREDA, the BDA members, energy managers, energy consultants, ESCOs and industry organizations etc	Rs. 2 lakhs or 1% of the loan availed, whichever is less

(Source) IREDA website, "Energy Efficiency & Energy Conservation (including DSM): Concessions/Rebates and Special Provisions from IREDA"

IREDA's management considers that the keys of the successful EEC finance are as follows: The institutions, who are familiar with its effective usage, take initiative and participate in the project design in order to realize EEC impacts. In addition, EEC in SMEs might be promoted by charging SMEs for their power consumption in the days ahead (it seems that many companies are not charged for it so far) upon the implementation of Electricity Act.

Loans to ESCOs:

ESCOs are promoted as a national policy and IREDA recognizes the needs to promote, but the actual transactions are limited to three to four companies. The first problem is ESCO's business environment: SMEs, the expected clients of ESCOs, are legally not obliged to implement EEC following ESCO's advice. The second problem is ESCO's creditworthiness. There are no problems in ESCOs, who are the large companies (equipment manufacturers etc) or their subsidiaries. However, the independent ESCOs are the small and medium sized enterprises and like the commercial banks, IREDA tends to have difficulty to grant loans to them from the perspective of the collateral conservation. ESCOs can be categorized as 'vendor' or 'service' types. They differ in the repayment scheme from the end users, but are required to bear the

initial investment costs, which is not feasible without creditworthiness. Hence IREDA's portfolio ESCOs are mainly arms of established companies, which have assets for collateral. In other words IREDA does not extend loans to SME ESCOs, even in case where the final beneficiary is local government, thus generating solid cash flow for the ESCOs. IREDA understands that stronger appraisal capability and risk management will be able to expand IREDA's exposure to ESCOs.

An idea considered by IREDA as a solution is collaboration with a guarantee company for SME lending: CGTMSE (Credit Guarantee Trust for Micro, Small and Medium Enterprises), a joint undertaking by MSME (Ministry of Micro, Small and Medium Enterprises) and SIDBI. Moreover it is suggested by IREDA that guarantee amount should be increased from current Rs. 65 lakh to Rs. 5 crore, in line with prevailing definition of MSME. It is also requested by IREDA that guarantee ratio should be around 75 % up to the maximum guarantee amount.

EEC pipeline with loan target for new Japanese ODA Loan:

According to IREDA's pipeline list submitted in July 2009 (Table 6-I), whose projects are expected to be appraised and sanctioned during 2009, total project cost is around Rs. 1,350 crore and requested loan amount is Rs. 250 crore, excluding a project whose project cost and requested loan amount is before clarification. Other than this, IREDA reports of additionally expected pipeline, whose total project cost is around Rs. 430 crore and requested loan amount is Rs. 310 crore. IREDA understands that if new Japanese ODA Loan allocates 10% of the total line of credit, that is 10 million USD for EE and EC respectively, then they will be enough satisfied by coal and steel related projects (EE) as well as cogeneration projects (EC), with a contribution of Consortium Funding scheme which will have a solid deal flow in the future.

On the top of the pipeline list lies the loan demand from a DLF group company. It is a good example of Consortium Funding, which already finished appraisal and sanction, thus ready for disbursement by the end of 2009. Project information was brought to IREDA by PFC, based on the MOU agreement between the two organizations since the said DLF company is not an IREDA customer. Project cost: Rs. 1,000 crore is financed by promoter's own contribution 30%, PFC 40%, IREDA 10% alongside with commercial banks 20%. Indeed IREDA is not necessarily regarded competitive against commercial banks in terms of lending interest rate, because commercial banks are armed with low-interest rate deposits as their financial resource, but Consortium Funding allows IREDA to participate in a unified interest rate which is reasonable for IREDA. In this case, condition is as follows: lending interest rate: 12% (with revision every 3 year), maturity: 10 years, moratorium: 6 months, collateral: project assets.

Project is executed in several sites including Delhi, setting a cogeneration gas plant, providing an area-wide air conditioning, targeting to achieve EC by 33% through delivery improvement, by 2% through plant operational improvement. IREDA highly evaluates the project, based on the project's own viability and the DLF group's creditworthiness.

Moreover, as mentioned above, there are additionally expected projects, all of which are bagasse-cogeneration projects in the sugar factories. Their brief information is as follows: 1) Renuk Sugar Factory: 30MW, project cost as Rs. 120 crore, loan amount as Rs. 84 crore, 2) Deharanai Sugar Factory: 22MW, project cost as Rs. 110 crore, loan amount as Rs. 79 crore, 3) Seksaria Biswan Sugar Factory: 60.9MW, project cost as Rs. 320 crore, loan amount as Rs. 220 crore.

Finally, as a reference, there is a project which is specially considered from the standpoint of ESCO promotion. The potential borrower is an ESCO company: Pranat Engineers whose final beneficiary is a state electricity board. Pranat Engineers will provide shared-guarantee ESCO service, investing Rs. 14 million, requesting to borrow from IREDA by Rs. 8.6 million, changing street rights from sodium to T5 in 5,000 points, targeting EE by 67%.

Table 6-I EEC pipeline as of July 2009 (Rs., in crore)

S no.	Name of the Company	Project Description	Project Cost	Loan expected from IREDA
1.	M/s DLF Utilities Ltd.,	234 MW Co-Generation project at 11 locations across the country(Union Bank of India & PFC have have sanctioned balance loans)	1126.00 ✓	104 .00 ✓
2.	M/s. Shri Mahavir Ferro Alloys Pvt. Ltd.,Orissa	27 MW Coal Washrey rejects based power plant at Sundergarh, Orissa	148.80 ✓	104.16 ✓
3.	M/s.Shyam Steel Industries Ltd, Kolkata	4 MW Waste Heat Recovery Boiler (WHRB) Captive Power Plant in Integrated Steel Complex at Angadpur Unit, Durgapur	17.00 ✓	12.00 ✓
4	M/s N.R. Sponge	12 MWCPP [7.5 MW from Flue gases, Char and Dolachar. Balance power from the Linked Coal and Coal fines, generated during Sponge manufacturing]	58.00 ✓	24.00 ✓
5	M/s.Savitar Sol Energy Efficiency Pvt. Ltd,	Proposal for Installation of Energy Cost saving system for Hotel (two in number)	Hotel1: 4.47 ✓ Hotel 2: 1.80 ✓	4.20 ✓
6	M/s.NELCO Ltd, Navi Mumbai	Medium Voltage Variable Frequency Drives (VFD) of 2*5 MW capacity for Circulating Water Pumps for Units 1&2 for M/s.Costal Gujrat Power Ltd.(CGPL) 5*800 MW Ultra Mega Power Project, Mundra		

Comparison with similar institutions:

The comparable institutions with IREDA are PFC, REC and HUDCO. They are not wholly government-owned, but are the government linked companies (GLC, that is company in which more than half of the shares are owned by the government.) In addition, SIDBI is also financing EEC projects using the funds from the international donors such as JICA and KfW. PFC and REC are the institutions who support the power generation and electrification using the conventional energy such as the coal and now also moving on to the renewable energy. HUDCO is in charge of housing and urban development and finances the waste disposal and waste power generation in the city as well.

PFC is 70 to 80% owned by the government (MOP) and has approximately 300 staffs. It finances the medium or larger sized companies/projects such as the power companies owned by the local governments. In addition to Delhi Head Quarter, there are the branches in Mumbai, Chennai and Kolkata etc. Its source of finance is the bond issuance in addition to the capital from the government. Since its financial strength is sound, it is assigned 'AAA' rating and issued the bond with 8.5% coupon without the government guarantee (the latest data, year 2009). REC is similar to PFC, but specialized in the projects in the local areas and has approximately 800 staffs. Their clients are mainly small and medium sized companies/projects including the local government related ones. In addition to Delhi Head Quarter, there are the branches in 20-30 States. The main borrowers from PFC/PEC, the local government related companies, seemingly give an impression of nonperforming borrowers as they remind of State Finance Corporations which suffered from nonperforming loans workout. However, the problems are limited as a whole, since the price in the electricity business is subsidized and the power generation is stable as long as it is based on the conventional energy.

The large differences between IREDA and both above entities are: the most of the borrowers are non conventional energy related, limited to the private companies and the small to medium projects. As a result, IREDA's financial strength is slightly weaker and IREDA is assigned 'AAA' subject to the comfort letter from the government (different from the government guarantee) and the coupon upon the bond issuance was 9.6% (latest, 2009). The comfort letter and the upper limit of the guarantee are managed by Fiscal Responsibility & Management Act.

6-3 IREDA's expected internal set-up for new Japanese ODA Loan

It is considered basically relevant to follow the current IREDA's set-up for loan submission, registration, sanction and post-lending monitoring.

First, in Submission, all projects are received by Chairman's Office and input in the computers. Next, in Technical Services Dept, the technical and financial aspects will be checked against the checklist in the following order: 1. Director, 2. Head (Technical 1: Hydro/Wind, Technical 2: Solar photovoltaic /Biomass/Cogeneration, Technical 3: Waste to Energy/EEC), 3. Group leader (Hydro group, Wind group, Solar photovoltaic group, Biomass/cogeneration group, Waste to Energy/EEC group). At this stage, it will be checked from the following four aspects: The type of the promoter, the sector and the areas plus the industries. These groups will serve as the one-stop shop for both contacts with borrowers as well as intra-IREDA coordination for each project.

Then, in Registration, the registration number will be issued. Following that, Finance & Accounts Dept will conduct the following: Financial aspects are additionally checked, while credit rating is executed. The ratings are to quantitatively screen a project based on Credit Rating Mechanism (technical and financial aspects). Based on the ratings, whether the loans will be granted or not and the applicable terms (four categories) will be determined. The best category is 1 and the worst one is 4, to which the loans will be declined and the improvement measures will be proposed.

Finally, in Sanction, Technical Services Dept and Finance & Accounts Dept will appraise the projects from the aspects which were not covered so far. Following that, the loan will be sanctioned based on the authorized approval process. Thereafter, the Legal Dept will manage the process for their collateral and contracts.

After the loan disbursement, in terms of the Post-lending monitoring, groups of Technical Services Dept are assigned to check the use of funds, project operation, and borrower's credit condition.

Hence IREDA designs that groups in Technical Services Dept play the pivotal roles for IREDA's procedure throughout loan submission, registration, sanction and post-lending monitoring. It is noteworthy that a group is consisted of just three to four staffs including an administrative staff. In case of Waste to Energy/ECC group, it is consisted of a group leader, four staffs including an administrative staff. Lending projects are allocated to this three staffs that will be in charge of each lending project, i.e. appraise the projects from technical and financial aspects and prepare the reports. The same staffs will be consistently in charge of the coordination with the other departments and monitoring after disbursement (to check use of funds, operation and financial statements etc). These groups are appropriate to serve as PMU in

the new Japanese ODA Loan, as in the cases with other donors, like KfW biomass line of credit, with which biomass cogeneration group works as PMU.

However, it is said that IREDA's internal process takes three months at maximum from the submission to the sanction, which is obviously longer than the commercial banks (one month on average). IREDA explains that it is because the projects are appraised more carefully in respect of corporate and project facets and there are many transactions with single project companies. However, the following agendas are also pointed out: limited number of the staffs indeed currently and gradually empowered, together with lack of systematic capacity development, especially in terms of financial and technical appraisal skill on the concerned sectors, which will be essential to nurture capacity to check borrowers and projects in ante and post lending stages as well as to make timely proposals to borrowers for future investment and financing opportunities. These two agendas should be more carefully addressed especially for groups of Technical Services Dept, which will serve as PMU in the new Japanese ODA Loan, mobilizing IREDA's own effort as well as JICA's technical assistance.

Chapter 7 Analysis of Environmental and Social Safeguards

7-1 Objective

This chapter will examine whether IREDA has the system to appraise the projects following "Guidelines For Confirmation of Environmental and Social Considerations" established by Japan Bank for International Cooperation ("Guideline" below), when it grants the loans to the projects using Japanese ODA Loans in order to contribute to sustainable development efforts through renewable energy use and EEC in India.

In the analysis, the current environmental and social safeguards taken by the financial institutions, mainly IREDA, are analyzed. Furthermore, the measures taken by the entities who implement the projects for renewable energy and EEC and EIA will be studied. Regarding EIA, the interviews with MOEF and SPCB were conducted. Based on this study, the necessary assistance will be examined in order to establish the appraisal system following Guideline when IREDA grants the loans using Japanese ODA Loans in the future.

7-2 Environment Policy in India

7-2-1 Environment Policy in India

(1) Institutions in Central Government[35]

In India, there are ministries, agencies and departments related to environment in Central and State Government and ULBs. In Central Government, the lead ministry is MOEF while there are various ministries and agencies involved in the environment policy. In addition to CPCB[36] to implement the policies under MOEF, the related central administrative bodies are: MOUD who is in charge of infrastructure development such as water and sewerage and waste in the urban area, and MNRE who promotes waste and natural energy.

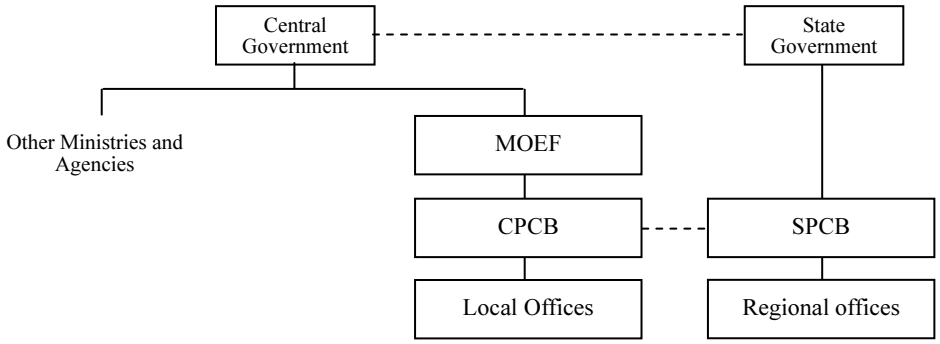


Figure 7-A Offices related to Environment in India

[35] India Environment Profile ("Indo Kankyo Profile") (JBIC October 2007)
[36] Central Pollution Control Boards: http://www.cpcb.nic.in/

(2) MoEF

MOEF is responsible for the overall plans and coordination of environment conservation and environment related issues in India and it is the main administrative body for environment. It administers the legal framework development to promote the environment policy, conservation of flora, fauna, forests and Wildlife, prevention & control of environment pollution, afforestation & regeneration of degraded areas, the framework development of environment policy promotion, development and notification of environment standards and various guidelines and the implementation of the treaty.

As mentioned earlier, MOEF in Central Government is in charge of the environment policy in India and the main policies are two as listed below. The main policies of the country in the environment sector are listed in "National Environment Policy 2006" [37] issued in 2006.

(i) Pollution control of air and water quality

For pollution control, the important objective is to control contaminant discharge in order not to have serious impacts on the area, inhabitants and nature in the future.

(ii) Future environment plan

It is to form the plan to reduce contaminants (e.g. for air, water quality etc) and minimize the impacts on the environment. This plan aims to prevent air pollution and water contamination in the future.

MOEF establishes the laws and ordinances based on Environment (Protection) Act established by MOEF in 1986, and amended in 1991. The detailed threshold levels are determined in CPCB or SPCB. MOEF supervises EIA, which are specified in Environmental Impact Assessment Notification 2006[38] issued in September 2006 under sub-rule (3) of Rule 5 of the Environment (Protection) Rules, 1986. Whether EIA is required or not differs depending on a project and in many cases, it is required for the large project.

7-2-2 PCB

(1) **CPCB (Central Pollution Control Board)**

CPCB is the independent institution aiming to prevent, manage and mitigate environment contamination and was initially established in 1974 following the Water (Prevention and Control of Pollution) Act. Later, its authority and role are specified in the Air (Prevention and Control of Pollution) Act in 1981. Following Environment (Protection) Act established in 1986,

[37] http://www.envfor.nic.in/nep/nep2006e.pdf
[38] http://www.envfor.nic.in/nep/nep2006e.pdf

CPCB started to provide the technical guidance and advice to MOEF and SPCB. More roles related to pollution are played by CPCB such as implementation of various environmental policies, establishment of guideline and the monitoring of environment standards and regulations. As described earlier, CPCB is the independent institution from MOEF but it plays the important role to implement the laws administered by MOEF and to promote the relevant policy.

(2) **SPCB（State Pollution Control Board）**

The environmental administration in each State is promoted by the environment departments in State government. SPCB is also set up in each State and it promotes various approaches for the environment conservation and prevention of environment pollution, establishes the environment standards and conduct research study, in addition to the technical guidance and advice to State government (Environment department).

(3) **APPCB（Andhra Pradesh Pollution Control Board）**[39]

The findings from the interview with SPCB in Andhra Pradesh State are summarized below:

(i) APPCB is the institution who establishes standards and conduct the research regarding the environment.
(ii) Environmental Clearance (EC) through EIA generally takes about 10-12 months.
(iii) The longest ones are sponge iron plants, thermal power plants and cement plants and their public hearings require around 8-12 months. The shortest one was the mining project which took three months.
(iv) For EEC projects (replacement of the existing installations) in cement and steel plants, State Environmental Appraisal Committee will decide whether EIA will be required or not based on a proposal submitted by a project implementation entity.
(v) For example, EIA is not required for a mining project below 25ha, but a project implementation entity prepares Environment Management Plan. For large projects and the projects with the great impacts on the environment, EIA will be required.
(vi) At present, EIA is not required for wind and SPV power generation projects. It is considered that wind and SPV has little impact on the environment, therefore preparation and clearance of EIA will not be necessary in the future.

[39] http://appcb.ap.nic.in/main/index_flat1.php

7-2-3 Environmental Impact Assessment (EIA) [40]

(1) **Relevant laws**

In India, EIA is the necessary process to obtain EC when the project with the significant impact on the environment is implemented. EC is specified in EIA Notification from MOEF.

(2) **EIA related laws**

In EIA Notification, EC is required when 39 types of projects (new or expansion) are implemented. However, in some projects, the detailed EIA is not required. Thus, whether EIA is necessary or not will be determined in the process of EC. The projects where EC is required are categorized in Category A or B based on the extent of the impact on the human health and resources and the project size. The EC process differs depending on this category.

EIA Notification requires EC for the following projects:

(i) New projects in 8 sectors and 39 types which were specified in Schedule of EIA Notification

(ii) The expansion works for existing projects (categorized in 39 types described above). However, they are limited to the projects which exceed the threshold limit specified in Schedule of Notification.

(iii) The limiting conditions described in Notification are exceeded when the projects in 39 types above are modified.

The projects in Category A are required to obtain EC from MOEF after the recommendation from Environmental Appraisal Committee ("EAC" below) set up by Central Government is obtained. For Category B, the projects are required to obtain EC from State Environment Impact Assessment Authority[41] ("SEIAA" below) set up by Central Government in the State. SEIAA issues EC based on the recommendation from State level Expert Appraisal Committee ("SEAC" below). In the States without SEIAA or SEAC, Category B projects are required to follow the same process (to obtain EC) as Category A projects.

(3) **Procedure for EIA studies and clearance**

(a) Application

EC process differs depending on the project category. Category A and B projects are applied to MOEF and SEIAA, respectively. As the first step, the following information will be submitted to them.

[40] India Environment Profile ("Indo Kankyo Profile") (JBIC, Oct 2007)

[41] SPCB is in charge of the management and information transmission of Authority.

(i) The following information from Appendix I of Notification of EIA

- Basic information (Name of the project, Location /site alternatives under consideration, size of the project, expected cost of the project, screening category and contact information)
- Activity

  1. Construction, operation or decommissioning of the project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

  2. Use of Natural resources (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply)

  3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment

  4. Production of solid wastes during construction or operation or decommissioning

  5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

  6. Generation of Noise and Vibration, and Emissions of Light and Heat

  7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea

  8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

  9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality
- Environmental Sensitivity
- Proposed Terms of Reference for EIA studies

(ii) Pre-feasibility project report (The conceptual plan can be substituted for it in case of Item 8 in Schedule (all Building /Construction projects/Area Development projects and Townships)

(iii) For the projects applicable to Item 8 in Schedule (all Building /Construction projects/Area Development projects and Townships), information in Appendix II of EIA Notification (Land environment, Water environment, Vegetation, Fauna, Air environment, Aesthetic, Socio-Economic aspects, Building materials, Energy conservation, Environment Management Plan)

(b) EC process for a project

After applying EC to MOEF (or SEIAA), there are four steps at maximum depending on the project types.

(i) Screening (only Category B)

For Category B projects, SEAC appraises and decides whether EIA studies are necessary for EC. The projects for which EIA is required and not required are categorized as B1 and B2, respectively.

(ii) Scoping

Scoping is conducted by EAC or SEAC. Category A and B1 projects are assessed by EAC and SEAC, respectively. At this stage, the discussion is conducted based on the documents submitted by the applicant and TOR of EIA to be studied by the applicant will be prepared and notified to the applicant and its information will be published on the website of MOEF (or SEIAA). (Exception: For the activity which is categorized as "B" in Item 8 of Schedule in EIA Notification (Construction/Township/Commercial Complexes/Housing), EC will be decided based on the information presented by the applicant and TOR for EIA will not be presented. It is possible to deny EC at this stage.

(iii) Public Consultation

Upon the request by an applicant, SPCB or UTPCC will conduct public consultation. The applicant will reflect the opinions collected in the draft EIA report and it will be submitted to MOEF or SEIAA together with the details of public consultation and the final result of EIA will be issued.

(iv) Appraisal

Appraisal is that EAC or SEAC appraises EIA final report, application and the results from public consultation and make its decision on EC. In this stage, the applicant is sometimes requested to provide an additional explanation on the questions regarding the submitted documents. Based on the opinion of EAC or SEAC, MOEF or SEIAA issues EC (or denies issuing EC). MOEF or SEIAA can request EAC (or SEAC) to reconsider.

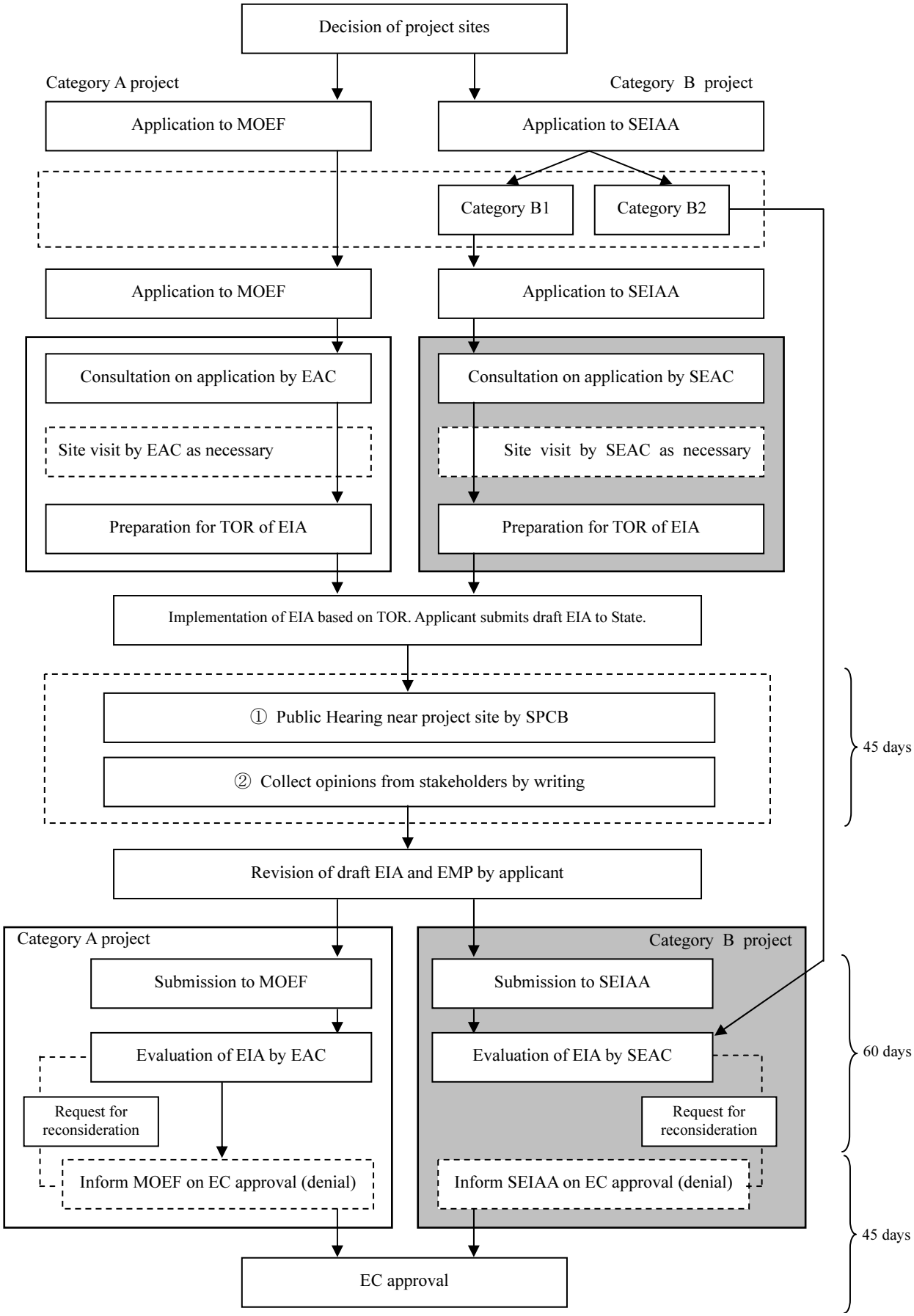


Figure 7-B Process to obtain EC in India

(4) **Approval institutions**

The institution to evaluate EIA and approve EC is MOEF or SEIAA depending on Category A or B, respectively.

(5) **Items to be included in EIA**

The following items are necessary in EIA[42]:

(i) Introduction (Purpose of the report, Identification of project & project proponent, Brief description of nature, size, location of the project and its importance to the country, region, Scope of study)
(ii) Project description (Type of project, Need for project, Location, Maps, Size/magnitude, Proposed implementation schedule, Mitigation measures and assessment of new technology)
(iii) Description of environment
(iv) Anticipated environmental impacts & mitigation measures
(v) Analysis of alternatives (Technology & site)
(vi) Environmental Monitoring Program
(vii) Additional studies
(viii) Project benefits
(ix) Environmental cost benefit analysis
(x) EMP
(xi) Summary & conclusion
(xii) Disclosure of consultants engaged.

The specific parameters for assessment are determined in the stage of scoping and differ depending on a project.

(6) **Public Consultation**

All Category A and B1 projects shall undertake Public Consultation, except the following:

(i) Modernization of irrigation projects
(ii) All projects located within industrial estates or parks approved by the concerned authorities, and which are not disallowed in such approvals.
(iii) Expansion of Roads and Highways which do not involve any further acquisition of land
(iv) All Building /Construction projects/Area Development projects and Townships
(v) All Category 'B2' projects

[42] Please refer to Appendix III of EIA Notification

(vi) All projects concerning national defense and security or involving other strategic considerations as determined by the Central Government.

The Public Consultation shall have two components comprising of:

(i) Public Hearing at the site or in its close proximity

By publishing the summary of EIA beforehand, SPCB or UTPCC will lead to hold a public hearing. The applicant will present EIA report (summary) in Public Hearing.

(ii) Written response from the stakeholders

SPCB or UTPCC publishes the summary of EIA on the website and obtains responses in writing. In addition, it will make EIA draft possible to be reviewed if there are a request from the citizens.

(7) Monitoring

Twice a year (1 June and 1 December), an applicant is required to report to MOEF or SEIAA whether the requirements specified at the time of EC approval are observed after the project completion. These reports are published on the website of MOEF or SEIAA.

(8) Enforcement by Environment related Authorities in case of a problem

EAC and SEAC members have authority to visit a project site as necessary before EIA evaluation. Furthermore, denial of EC can be recommended to MOEF or SEIAA as a result of the member's project site visit.

In addition, it is not limited to EIA process, but EC can be withdrawn after SPCB inspects an office regarding air pollution, water contamination and treatment of hazardous waste.

(9) Comparison with JBIC Guideline

JBIC Guideline is one of the approaches to confirm whether the appropriate environmental and social consideration is made before granting loans. On the other hand, EIA in India is part of EC approval process. The great difference is that EC approval process and EIA studies evaluate only environment impacts, but not social ones. (Social assessment is made when a project involves the relocation of the inhabitants.) "Example of the sectors/characteristics, which tend to be influential, and regions, which tend to be vulnerable" described in Guideline and the targeted projects in EIA Notification are compared in the Table in the following page. In case of EIA Notification in India, a project might not be applicable for EIA depending on the target sector size.

Table 7-A Comparison of the sectors assessed for environment in EIA and JBIC

JBIC Guideline		EIA Notification in India
1. Influential sector: the large scale projects in the following sectors		
(1)	Mining	○
(2)	Oil and Natural Gas Development	○
(3)	Pipeline	○
(4)	Steel and iron industry (with Large scale furnaces)	○
(5)	Refining of nonferrous metal	○
(6)	Petrochemistry (raw material manufacturing. Including industrial complex)	○
(7)	Petroleum refinery	○
(8)	Oil, Gas and Chemicals terminal	○[43]
(9)	Paper, pulp	○
(10)	Harmful and toxic material manufacturing /transport (specified in International Treaty)	—
(11)	Thermal Power Generation	○
(12)	Hydropower generation, dam, reservoir	○
(13)	Transmission/ transformation/ distribution of electricity (which involve large scale involuntary resettlement and deforestation, and transmission wire underwater)	—
(14)	Roads, railways, bridges	○[44]
(15)	Airports	○
(16)	Ports	○
(17)	Sewerage, wastewater (which involve influential constituent or is located in the vulnerable areas)	○
(18)	Waste disposal	○
(19)	Agriculture (which involves large cultivation or irrigation)	—
(20)	Forestry, afforestation	—
(21)	Tourism (Construction of hotels etc)	—
2. Characteristics which tend to be influential		
(1)	Large scale involuntary resettlement	—
(2)	Large groundwater pumping	—
(3)	Large filling in land, land development, cultivation	○[45]
(4)	Large deforestation	—
3. Vulnerable areas: the following areas or its surrounding		
(1)	National Park, Conservation areas designated by country (coastal areas designated by country, marsh, the areas for ethnic minority/indigenous people, cultural heritage etc.)	—
(2)	Area where prudent consideration is necessary for the country or a region	—

[43] Isolated handling of hazardous chemicals is applicable.
[44] Railway is out of scope. Bridge is not mentioned, but it will be included if combined with the road construction.
[45] It might be included in “Buildings and construction projects”.

7-2-4 Summary of Environment policy in India

MOEF is responsible to coordinate the environment sector in India and it establishes the basic policy for environment and the laws and regulations based on this. For the detailed guidelines, regulations and standards, PCBs located in Central or State levels are responsible and play an important role as the independent institution.

For EIA, the projects are categorized depending on the project type and size and ECs for the relatively large projects (Category A) and the small and medium sized ones (Category B) are approved by MOEF and SPCB, respectively. The contents wise, EC approval of EIA requires screening, scoping, public hearing/ written response and appraisal. This process involves the wide areas and the detailed examination is necessary. In addition, the monitoring is conducted after EC approval to check whether the environment standards are observed by regularly reporting the environment data to the relevant institutions. When the standards are not satisfied, EC might be withdrawn.

In conclusion, EIA system is established in India and approval of EC is necessary when a plant or power generation installation above a certain size is constructed. This EIA system involves the environment policy by Indian Government and it is the mechanism to promote the consideration for environment directly to the implementation entity. When compared with JBIC Guideline, EIA system covers most of the target sectors except some in Environment Impact area. However, the social impacts are not mentioned, therefore other assessment seems to be necessary.

7-3 Current status of environmental and social safeguards in Financial Institutions

7-3-1 IREDA

(1) Hydropower projects

(a) The projects in the past

IREDA granted the loans to hydropower generation projects for 21 years since 1987, which are 94 in total as of now. They are not solely by IREDA alone, but in cooperation with the other donors such as WB and KfW. The projects by IREDA need to satisfy the standards of PCB and the serious environmental or social issues are not observed at the development stage or as of now. In addition, IREDA grants the loans to the projects mainly with the power generation capacity of less than 5MW. This is because EIA is necessary in principle for the projects with the capacity of 5 MW or more.

(b) Environmental/social safeguard in hydropower projects

Upon the hydropower project implementation a project is implemented according to the State Ordinances and the standard (e.g. PCB standards) but the details in EIA are not examined since the power generation capacity is small as described earlier. However, even for the projects which are not required to prepare the detailed EIA, the preliminary study for a project is conducted using IREDA's check list or screening sheets[46] (attached in the following page onward) regarding the impacts on environment and society. This system is applied since IREDA conducted the 45 projects together with WB in the past and prepared the check lists and screening sheets and they are utilized to date. (They are used to assess the projects under appraisal, thus not disclosed to the public.)

A screening sheet is used as one of the submitting documents when a project owner applies for finance, and the project owner fills the sheet by itself. The way to fill the form is the same as the way in which the clearance is obtained from the relevant institutions in State Government. IREDA also assesses the submitted screening sheet in the same way. Furthermore, the person in charge in IREDA (hydropower group) actually visits a project site and conducts a field survey regarding environmental/social impacts using the check sheet for the project assessment. These sheets are the important evaluation items for environment/social safeguards to finance an applied project.

Upon the project implementation, to ensure the drinking water for the workers during the construction and the construction of the access roads to the site are necessary. In this regard, the measures for cliff failure are also examined as necessary. The impacts on the nature such as the rivers and fishes where the water is taken are also considered. In addition, when a project site is the inhabited area, the consultation regarding relocation is also conducted. (For the project sites, in case of the government owned land, the land is leased by the government for 30-40 years. In case of the privately owned land, the project owner purchases the lands and implements the projects.) As described so far, IREDA has the experience of hydropower projects to date with the donors such as WB, KfW and ADB and the safeguard measures are taken to certain extent.

[46] Obtained from IREDA (small hydropower team)

Figure 7-C Environment/Social impact check sheets (provided by IREDA)

इरेडा IREDA Quality Management System ISO 9001:2000	Other Controlled Documents Title: **Disbursement - Details Status on Environment & Social Impacts - SHP**	Doc. No. : OCD/PTS/FOM – 5.7.1 Issue No. : 01 Page Revision No:00 Page : 1 of 1 Effective Date : 15-Jan-08
Prepared by : **Chief General Manager (PTS)**	Approved by : **Director (Technical)**	Issued by : **Management Representative**

ENVIRONMENTAL & SOCIAL IMPACTS (SHP):

	Current Status (REMARKS)
Environmental Impact:	
• Regulatory clearances if any, please provide specific information on status of implementation with respect to conditions of clearance by borrower	
• Have the management identified staff, their capacity needs and their responsibility to manage environmental health and safety issues of the project during the preparation and the implementation stage. Give details of structure and training	
• Has the management prepared an environmental management plant for mitigating the impacts of blasting and muck disposal; access road construction; soil erosion, minimum water flow in bypass stream etc. Please provide specific information on quality of planning and implementation by borrower	
• Any surveys available for the area of archaeological, biodiversity and cultural resources that might be threatened by the proposed project. Give status of consultations, complaints if any from public.	
Social Impact:	
• No of people and families affected if any.	
• Are there expected social impact in terms of Loss of home; Loss of sources of income/livelihood; Loss of access to grazing; Loss of access to collection of fuel wood and other minor forest produce; Loss of access to drinking water; and Loss of access to irrigation, please give in detail.	
• Cultural Impact if any in terms of loss of access to cultural properties such as sacred groves, temples, places of worship and others	
• Need for rehabilitation and Resettlement	
• Positive Impacts	
• Negative Impacts	
• Details of Land Required - Private "Patta" land; Forest land; Panchayat land; Other Government land including Revenue other types, please specify	
Other information if any:	

Figure 7-D Environmental screening sheets (provided by IREDA) (1/2)

Environmental Screening Sheet – Small Hydro Project

Name of the Promoter with full address:
Name of the Small Hydro Project (SHP):
Geographical Location of SHP: The State, District / Block / Gram Panchayat:
Is the District / Block a part of Tribal Sub Plan area: Yes / No
Name, Designation and Address of Authority responsible for this SHP

Major Environmental Issues (e.g. Forest, Land, Water Flow, Pollution etc.)	
Is there any environmental mitigation or management plan available?	
Area of forest / tribal land required for the project	
Length & Budget for access road to site (RS)	
Minimum water flow planned during dry season (cumecs) in the bypassed river section	
Evidence / record available of endangered biological species in the area to be enclosed?	
Provide a copy of clearance received from the Department of fisheries / Other concerned Department	
Is there any village irrigation scheme in the bypassed river section? If yes, provide details	

Contd. 2/-

Figure 7-E Environmental screening sheets (provided by IREDA) (2/2)

- 2 -

Area of land proposed to be cleared for access road and transmission lines	
Provide the evidence / documents of Public Consultation (including summary of the discussion) on environmental issues.	
Approximate no. of trees proposed to be felled for the project.	
Area where muck / excavated waste material is proposed to be disposed	
Minimum flow proposed in the river during construction period.	
Is there any community complaints against the project?	

Place: _____ Signature _____

Date: _____ Name _____

Designation _____

Rubber Stamp _____

Figure 7-F Social screening sheets (provided by IREDA) (1/3)

Social Screening Sheet – Small Hydro Project

Name of the Promoter with full address:

Name of the Small Hydro Project (SHP):

Geographical Location of SHP: The State, District / Block / Gram Panchayat:

Is the District / Block a part of Tribal Sub Plan area: Yes / No

Name, Designation and Address of Authority responsible for this SHP

1. Details of land under different tenure system required for SHP

Type of land	Area Required (HA)	Area Transferred / Acquired / Purchased
Forest		
Dongar / Hills		
Gram Panchayat		
River bed		
Private / Patta		
Revenue		

2. Patterns of current use of above mentioned areas. Tick √ if applicable.

Cultivation [ ] Grazing [ ] Collection of fodder / fuel wood [ ]

Cultural properties: temples, sacred groves etc. [ ] Homesteads [ ]

Other structures [ ] Burial / Cremation Ground [ ]

2A. Where answer is Yes, indicate within the box the number of affected families

Cultivation [ ] Grazing [ ] Collection of fodder / fuel wood [ ]

Cultural properties: temples, sacred groves etc. [ ] Homesteads [ ]

Other structures [ ] Burial / Cremation Ground [ ]

Contd. 2/-

Figure 7-G Social screening sheets (provided by IREDA) (2/3)

2B Provide the evidence / documents of Public Consultation (including summary of the discussion) on Social issues such minutes of the Gram Panchayat Meeting and the copy of the Advertisement in the Local Newspaper.

3. Indicate whether:

(i)	Forest Clearance Obtained	Yes		No	
(ii)	Alternate land for afforestation provided to Forest Department				
(iii)	Gram Panchayat has cleared the project if it is within Tribal Area				
(iv)	All payments for land / structures paid to individuals				
(v)	Attach copies of relevant documents				

Indicate the distance involved in diverting water from the river to Power House: _____ Kms.

5. Tick √ if diverting water affects the following:

Irrigation		No. of affected families	
Drinking water		No. of affected families	
Other domestic use		No. of affected families	
Milling "Chaki"		No. of affected families	
Fishing		No. of affected families	
Cultural use – festivals		No. of affected families	
Ponds / Nallahs		No. of affected families	

Contd. 3/-

Figure 7-H Social screening sheets (provided by IREDA) (3/3)

- 3 -

6. Tick √ if following benefits available to families who live within project area:

(i) Royalty to Gram Panchayats within tribal area ☐

(ii) Free / subsidized supply of electricity to families ☐

(iii) Employment to village individuals during Construction. If yes, number of employed: ☐

Skilled ☐

Unskilled ☐

Average monthly income per person Rs. _____

(iv) Employment to village individuals during SHP operation. If yes, number of employed: ☐

Skilled ☐

Unskilled ☐

Average monthly income per person Rs. _____

7. Indicate whether or note formal and / or informal meetings had been organized with Gram Panchayat, Gram Sabha, NGO / CB's and other in the area. If answer is yes, give dates of meetings and details of important social, economic, cultural and environmental issues raised by participants of meetings.

8. If social, economic, cultural and environmental issues had been raised, give details of actions taken to address them.

Place: _____ Signature _____

Date: _____ Name _____

Designation _____

Rubber Stamp _____

(2) **Wind power generation projects**

(a) Current status

Wind power generation is renewable energy and considered the technology by which the impact on the environment is extremely little, since it uses the energy occurring in the nature such as solar and biomass energy in order to generate the power.

(b) EIA

The wind power generation uses the wind to generate the power. As a result, the wind power generation can reduce the contaminant such as CO_2 and SO_2 compared with power generation using the fossil fuel, accordingly there are no needs to prepare EIA. Therefore, neither IREDA's own checklist nor screening sheets are prepared. Furthermore, the problems related to the inhabitant relocation in the project sites were not occurred so far, since the former projects are located in nonresidential areas (shore frontage). However, if a project is implemented in the residential areas, the inhabitants will be compensated by the owned lands to be purchased.

(c) If a project is implemented with the donors such as WB and ADB and they request to follow their own guidelines, IREDA will observe them. In addition, IREDA considers that it is necessary to prepare IREDA's own guideline following a donor's guideline as necessary. (However, it was not required so far, since there are no such projects to date.)

(3) **SPV power generation projects**

(a) Current status

SPV projects which IREDA has involved are mainly very small ones (to be installed in the roof of buildings) and there are no projects applicable for JBIC guideline. Therefore, IREDA has not established its own guideline for the environmental or social safeguards. As of now, approximately 30 SPV projects are planned but are mainly the small ones (less than 1MW). Therefore, IREDA does not plan to prepare the safeguard guideline for it.

(4) **EEC projects**

(a) Current status

In case that EEC projects are financed, IREDA emphasizes the environmental standards for air/water pollution. Especially, the followings are checked: whether the SPCB standards in each State (e.g. for exhaust gas concentration, the standards differ depending on a State, 115mg/Nm^3 or 150mg/Nm^3 etc) are observed and the environmental control units (ESP, scrubber, cyclone separator etc) are equipped in order to observe the standards. The approach for check is that a specialized environmental consultant studies/examines an environmental impact for each project

and IREDA conducts the final check based on this assessment. For the different emission standards by States, CPCB under MOEF defines the environmental standards (CO, CO_2, SOx, NOx, BOD, COD, RSPM etc) in principle and SPCB defines the standards by areas/business sectors based on them.

(b) Environmental/Social Guidelines

Unlike small hydropower projects, the guidelines are not set for EEC sectors but the issues for environmental/social impacts are examined in Detailed project reports[47]. The applied technologies differs in EEC and small hydropower projects. It is easier to establish a specific guideline when the equipment standardized to certain extent is installed like for small hydropower generation. On the other hand, it is hard to establish the formatted guideline for EEC projects in industrial sector, since various kind of equipment are applied in those projects However, it is necessary to address the impacts on the environment such as air and water by EEC projects as well. In this regard, the impacts on the environment are mitigated by following the standards specified by SPCB.

[47] Obtained from IREDA(EEC project team) (The example of "27MW COAL WASHERY REJECTS BASED PWER PLANT")

Figure 7-I DETAILED PROJECT REPORT
(Section for environment/social consideration) (1/9)

27 MW COAL WASHERY REJECTS BASED POWER PLANT

DETAILED PROJECT REPORT

SHRI MAHAVIR FERRO ALLOYS PVT. LTD.
KALUNGA INDUSTRIAL ESTATE, ROURKELA
DIST.: SUNDARGARH, ORISSA

PREPARED BY:

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Figure 7-J DETAILED PROJECT REPORT
(Section for environment/social consideration) (2/9)

CHAPTER 15

ENVIRONMENT PROTECTION AND WASTE MANAGEMENT

15.1 General

Environmental protection and the control of solid, liquid and gaseous effluents or emissions are key elements in the design of all steam and power generating systems. The emissions from combustion systems are tightly regulated by State and Central Governments and specific rules and requirements are stipulated and are constantly changing. At present the most significant of these emissions are sulfur dioxide (S02), oxides of nitrogen (NO_X) and fine airborne particulate. All of these require specialized equipment for control.

Environmental control is primarily driven by Government legislation and the resulting regulations at the local and National levels. These have evolved out of a public consensus that the real costs of environmental protection are worth the tangible and intangible benefits now and in the future. To address this growing awareness, the design philosophy of energy conversion systems such as steam generators have evolved from providing the lowest cost energy into providing low cost energy with an acceptable impact on the environment. However, minimizing aqueous discharges and safely disposing of solid by-products are also key issues for captive/ independent power systems.

One major redeeming factor about coal based power plants in India is the presence of high quantity of ash in Indian coal. Although much technology has been developed like fly ash bricks, Fly ash based cement plant etc. sheer quantity of fly ash generated makes it very difficult for its handling. One has to therefore acquire sufficient land for ash disposal. Sufficient area within the plant area will be demarcated for fly ash disposal. SMFAPL proposes to set up a fly ash based brick plant and fly ash based tiles manufacturing facility based on the technology developed by NML for making value added products from fly ash.

Atmospheric emissions arise primarily from the by-products of the combustion process SO_2 NO_X, particulate fly ash, volatile organic compounds (VOC) and some trace quantities of other materials and are exhausted from the stack. A second source of particulate is fugitive dust from coal handling equipment. A final source of air emissions is the cooling tower and the associated thermal rise plume

Figure 7-K DETAILED PROJECT REPORT
(Section for environment/social consideration) (3/9)

which contains heat and some trace materials along with the water vapour.

Aqueous discharges arise from a number of sources. These include cooling tower blow down, sluice water from the bottom ash handling system, boiler chemical cleaning solutions, gas side water washing waste solutions, as well as a variety of low volume wastes including ion exchange regeneration solutions from the Demineralized Water Plants, boiler blow down, sewerage system discharges from buildings and plant floor drains.

15.2 Particulate matter and gases

The elements polluting the air that are discharged from the proposed
Power unit are:

- Dust particulate from fly ash in flue gas.
- Nitrogen oxide and Sulphur oxides in flue gas.

The pollution control regulations limit the particulate matter emission from coal fired steam generators as 115 mg/Ncum. In future even this present day allowable limits will be brought down to much lower values. Table 15.4 gives the Pollution Control Board fixed norms for the permissible emission from boilers.

SMFAPL proposes to install a 120 TPH boiler and the boiler will be installed with the Electro Static Precipitator. The power plant is proposed to operate with various types of low grade fuels. SMFAPL management considering the ecology has decided to select Electrostatic Precipitators for the new 120 TPH boiler based on all types of fuels the boiler is capable of firing and also as per the pollution norms. A RCC stack will be constructed for the 120 TPH boiler having sufficient height to dispose off flue gases. The boiler will adopt CFBC firing technology. Sulphur content if any in the fuels will be absorbed by addition of limestone and dolomite.

The temperatures encountered in the CFBC steam generator while burning these fuels are low enough to produce high levels of nitrogen-oxides. Hence, no separate measures are taken to contain the nitrogen oxide pollutants.

The Table 15.3 gives the ambient air quality standards as per the Pollution
Control Board.

Figure 7-L DETAILED PROJECT REPORT
(Section for environment/social consideration) (4/9)

15.3 Dry fly Ash And Furnace Bottom Ash

Fly ash collected from the ESP hoppers and the air heater hoppers and the ash collected from the furnace bottom hoppers can be used as landfill. The ash content in Indian coal is as high as 60%. The total fly ash collected could be used as a landfill. SMFAPL proposes to set up a fly ash based brick plant and fly ash based tiles manufacturing facility based on the technology developed by National Mettallurgical Laboratory for making value added products from fly ash.

15.4 Water Pollution

Effluent from water treatment plant

Hydrochloric acid and sodium hydroxide will be used as regenerants in the existing Demineralized water plant. The acid and alkali effluent generated during the regeneration process of the ion-exchangers would be drained into an epoxy lined underground neutralizing pit. Generally these effluents are self neutralizing. However provisions will be made such that the effluents will be neutralized by addition of either acid or alkali to achieve the required pH of about 7.0. The effluent will then be pumped into the effluent treatment ponds which will form part of the mini integrated steel plant's effluent disposal system. As the DM plant is expected to run continuously after the implementation program, the effluent discharge from the neutralizing pit will be approximately 30 Cu.m/day. The effluent form the neutralizing pit will be pumped by 2 x 100 % capacity pumps to the mini integrated steel plant's effluent treatment system.

Chlorine in cooling water

In the condenser cooling water, residual chlorine of about 0.2 ppm is maintained at the condenser outlet. This chlorine dosing is done mainly to prevent biological growth in the cooling tower system. This value would not result in any chemical pollution of water and also meets the national standards for the liquid effluent.

Steam generator blow down

The salient characteristics of blow down water from the point of view of pollution are, the pH and temperature of water since suspended solids are negligible. The pH would be in the range of 9.8 to 10.3 and the temperature of blow down water will be

Figure 7-M DETAILED PROJECT REPORT
(Section for environment/social consideration) (5/9)

around 260°C. The quantity of blow down from the boiler is about 2.5 TPH, but however part of this will be flashed and hence the blow down water to be released to the drains will be 1.70 TPH from both the boiler, and the temperature of this blow down water after flashing will be in the range of 100 to 127°C. As this quantity is very small, this can be put into the trench and taken to the effluent ponds.

Sewage from various buildings in the plant

Sewage from various buildings in the power plant area will be conveyed through separate drains to the septic tank. The effluent from the septic tank will be disposed in soil by providing disposing trenches. There will be no ground pollution because of leaching due to this. Sludge will be removed occasionally and disposed off as land fill at suitable places.

Table 15.2 gives the tolerance limits for the effluents

15.5 Waste Water Treatment

Waste water treatment for the plant will be based on discharges of the various waste waters to ponds for clarification and filtration. This treatment will be done in the mini integrated steel plant's effluent treatment plant. Oily water will be treated separately to remove oil / grease before discharge into effluent ponds. The oily water collection in the plant is basically due to floor cleaning, leaky oil filters, etc. Clarification is used to settle out large suspended particles and condition smaller colloidal particles to make them settle. A pond, reservoir tanks or tank is used to allow larger particles to settle in a matter of hours. The finer particles overflow and are made to settle more quickly by the addition of chemical agents, coagulants and polymers that cause agglomeration to sizes large enough to settle out of suspension.

Filtration will be made to a porous barrier across flowing liquid to remove suspended materials. Filtration can be used to supplement clarification and permits reducing suspended solids to the parts per billion levels.

As required and with approvals from appropriate regulating bodies, final waste stream pH is controlled by combining various plant streams to provide a neutral pH product. Where needed, acid or alkali addition will be used to achieve the final pH. Effectively all water brought into the plant is evaporated through cooling towers,

Figure 7-N DETAILED PROJECT REPORT
(Section for environment/social consideration) (6/9)

ponds or stack. Residual solids are then sent for disposal.

15.6 Thermal Pollution

A close circuit cooling water system with cooling towers has been proposed. This eliminates the letting out of high temperature water into the canals and prevents thermal pollution. Blow down from the cooling tower will be trenched out and ultimately conveyed to the effluent ponds. Hence, there is no separate pollution on account of blow down from cooling water system.

15.7 Noise Pollution

The rotating equipments in the power plant will be designed to operate with a total noise level of not exceeding 85 to 90 db (A) as per the requirement of Occupational Safety and Health Administration (OSHA) Standards. The rotating equipment are provided with silencers wherever required to meet the noise pollution. As per OSHA protection from noise is required when sound levels exceed those given in the following Table- 15.1.

Table – 15.1
PERMISSIBLE NOISE LEVELS

Sl.No	Exposure Duration in hrs. / Day	Sound Level db(A)
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	1	102

Table – 15.2
TOLERANCE LIMITS FOR TRADE EFFLUENTS

Sl.No	CHARACTERISTICS	TOLERANCE LIMITS FOR DISCHARGE OF TRADE EFFLUENTS DISCHARGED INTO	
		Inland surface water	On land for Irrigation
1	Suspended solids mg/1	100	200
2	Dissolved solids (inorganic) mg/1	2100	2100
3	pH value	5.5 to 9.0	5.5 to 9.0

Figure 7-O DETAILED PROJECT REPORT
(Section for environment/social consideration) (7/9)

4	Temperature (Deg. C)	40 at the point of discharge	45 at the point of discharge
5	Oil and grease (mg/1)	10	10
6	Biochemical Oxygen demand (5 days at 20 Dec.C)	30	100
7	Chemical Oxygen Demand (mg/1)	250	
8	Chloride (as CL) (mg/1)	1000	600
9	Sulphates (SO_4) (mg/1)	1000	1000

Table – 15.3
AMBIENT AIR QUALITY STANDARDS

Sl.No	**Characteristics**	**Concentration in Micrograms per cub. Mtr.**			
		SPM	**So_2**	**CO**	**NOx**
1	Industrial and mixed use	500	120	5000	120
2	Residential & Rural	200	80	2000	80
3	Sensitive	100	30	1000	30

Table – 15.4
EMISSION STANDARDS FOR BOILERS

Sl.No	Capacity of Boiler	Particulate Emission Limits
1	Less than 2 tons / hrs	1600 mg/Nm3
2	2 to 15 tons/hr	1200 mg/Nm3
3	More than 15 tons/hr	120 mg/Nm3

In case of industries where particulate emission control are adopted to the limits prescribed, the stack height can be relaxed to H = 74 $Q_p^{0.27}$ where Qp = Particulate Emissions in Tonnes/hour.

15.8 Monitoring of Effluents

The characteristics of the effluents from the plant will be maintained so as to meet the requirements of State Pollution Control Board and the minimum national standards for effluent from thermal power plants. Air quality monitoring will also be undertaken to ensure that the dust pollution level is within limits.

Figure 7-P DETAILED PROJECT REPORT
(Section for environment/social consideration) (8/9)

27MW COAL WASHERY REJECTS BASED POWER PLANT
SHRI MAHAVIR FERRO ALLOYS PVT LTD, ROURKELA, ORISSA

Air Quality Monitoring Programme

The purpose of air quality monitoring is the acquisition of data for comparison against the prescribed minimum standards and thereby assures that the air quality is maintained within the prescribed levels.

The following will be monitored from the stack emissions:

- Suspended Particulate Matter.
- Sulphur-Di-Oxide.

The Laboratory attached to the mini integrated steel / power plant will be equipped with the necessary instruments for carrying out air quality monitoring. Alternatively approved agencies will be appointed for carrying out air quality monitoring. It is also proposed to monitor the particulate emission at the stack to keep a continuous check on the performance of the ESP. Adequate sampling openings will be provided in the stack

15.9 Impact of the Pollution on the Environment.

As all the necessary pollution control measures to maintain the emission levels of dust and SO_2 are taken and other effluents will be treated in the effluent treatment plant, there will be no adverse impact on either the air or water quality in around the Power plant site on account of the installation of the plant.

15.10 Quantity of effluents for SMFAPL Power Plant

The figures given below are for the normal operation of the plant with Coal / washery rejects as fuels. Since the usage of Dolochar in the boilers is an emergency operation and is rare, the corresponding figures are not given.

Gaseous effluents from the Power Plant:

Flue Gases from the stack	Nm^3 / Sec	18.5
Temp. of flue gases leaving the stack	Dec. C (Max)	160
SO2 emission		NIL
NO2 emission		NIL
Particulate emission through the gases	Mg/Nm3	100
Dry fly ash	TPH	16
Wet bottom ash from furnace	TPH	2

Figure 7-Q DETAILED PROJECT REPORT
(Section for environment/social consideration) (9/9)

Liquid effluents : Less than 80 ppm		
a) Boiler Blow down water (Max)	Kg/hr	500
Total dissolved solids	Ppm (Max)	2000
pH @ 25 Dec. C		9.8 to 10.3
b) Cooling tower blow down (Max)	Kg/hr	500
Total dissolved solids	Ppm (Max)	800
pH @ 25 Dec. C		8 to 9
Chlorine	ppm	0.2

7-3-2 Current status of IDBI Bank

(1) **Current Status**

Each project is implemented according to Country or State Environmental standards in principle. For the project implementation, the following two standards need to be observed in terms of environment and social safeguards.

- Policy and standards of MOEF
- Standards of Central and State PCB

Basically, the clearance through MOEF and PCB's standards ensures the confirmation (assessment) for the safeguards, IDBI does not establish nor request the project owner to observe its own guideline. Also, when IDBI finances the projects using the donor funds, they are, in principle, implemented using Central and State standards and establishment of its own guideline is not requested by other donors. As of now, IDBI Bank does not have its own guideline and does not disclose its social/environmental policy (e.g. on the website).

There are many projects in IDBI through the loans from KfW, they are financed by observing Central and State standards as well. There are some projects (e.g. pharmaceutical companies) which are required to observe Good Manufacturing Practice of EU standard or ISO14001. For these cases, the assessment will be conducted according to these guidelines. However, when they are not required, the projects are implemented following Central and State standards as described earlier.

7-3-3 Summary: Current status of environmental/social safeguards by Financial institution

(1) **IREDA**

IREDA's environmental and social safeguards are implemented using its own guideline (screening sheets and checklist) only for the hydropower projects. This is because IREDA implemented the projects with WB in the past and prepared the guideline at that time. To date, IREDA is not requested to observe IREDA's own guideline and there are no significant problems in terms of environmental/social issues. For other projects, its own guidelines are not established and the projects are implemented following the environmental standards of Central or State PCB.

In future, it is uncertain that how the country/state standards are revised, but the same methodology will be taken over the future if the projects are implemented based on the current investment amount (hydropower below 5MW and wind power 1-2MW). In case of a large

project such as SPV project by ADB or the request to establish/follow IREDA's own guideline, IREDA is prepared to follow.

From above, as of now, IREDA assesses a project in terms of environmental/social safeguards by the person in charge from the responsible group of the project or a consultant from outside depending on the group (hydropower generation group, EEC group). However, IREDA's own guideline is established not for all projects and the unified approach to confirm (assess) environmental/social safeguards is not in place.

(2) **IDBI Bank**

IDBI, who has experience to finance RE and EEC projects, does not establish its own guideline for environmental and social safeguards. As confirmed in IREDA, the projects are implemented following the Central or State ordinances or standards and the safeguard guideline of the donors in principle. On the other hand, in some specific project (e.g. the loans to pharmaceutical factories), its own guideline and standards are required and the projects are implemented by following them.

7-4 Current status of Environment/social safeguards in Industrial sectors in India

7-4-1 Sponge iron manufacturing plant

(1) **Mahendara Sponge＆Power Ltd**

(a) Environmental/Social safeguards upon introduction of EEC installation

When the waste heat recovery system (waste heat boiler + steam turbine generators) was installed in 2007, the attention was paid to waste gas and water in terms of environment. For waste gas, the company considered that especially reduction of CO emission is important along with burning, therefore it was planned accordingly. When other projects were financed by the financial institutions in the past, environmental/social safeguards were not requested as the requirements for finance.

(b) Environmental standards upon EEC installations

When the equipment was installed, the country's law and State and CPCB's standards were followed in the process. In addition, MOU[48] was signed with the State government on October 1, 2008, regarding the plant operation and this includes the consideration for environment etc. For example, the investment related to environmental/social safeguards needs to be segregated from the other investments and the recruitment of the local population needs to be promoted.

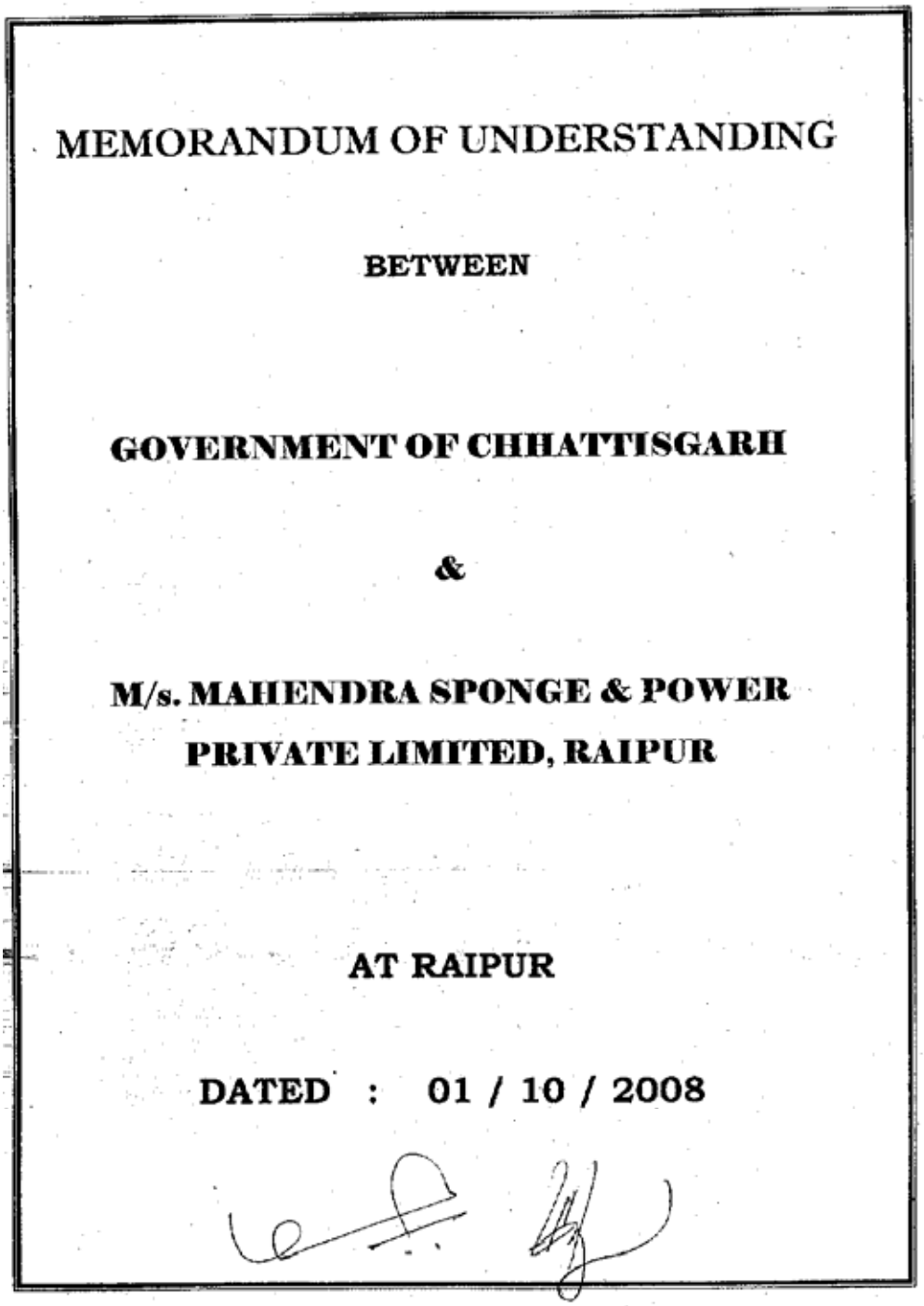
[48] Received from Mahendara Sponge＆Power Ltd

(c) EIA

When this equipment was installed, EIA was prepared and EC was obtained from MOEF. The monitoring based on EIA is also conducted and the main items for monitoring are some such as steam flow.

Picture 7-A Waste Heat Recovery System

Figure 7-R MEMORANDUM OF UNDERSTANDING (1/4)



MEMORANDUM OF UNDERSTANDING

BETWEEN

GOVERNMENT OF CHHATTISGARH

&

M/s. MAHENDRA SPONGE & POWER PRIVATE LIMITED, RAIPUR

AT RAIPUR

DATED : 01 / 10 / 2008

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Figure 7-S MEMORANDUM OF UNDERSTANDING (2/4)

MEMORANDUM OF UNDERSTANDING

This **Memorandum of Understanding** (MoU) is made on this 1st day of October, 2008 at Raipur between **THE GOVERNMENT OF CHHATTISGARH** (hereinafter referred to as **"State Government"**) of the FIRST PART.

AND

M/s. MAHENDRA SPONGE & POWER PRIVATE LIMITED a company incorporated under the Companies Act 1956 (No.1 of 1956) and having its registered office at ***Dadabadi, M.G.Road, Raipur - 492001, Chhattisgarh*** (hereinafter referred to as **"MSPPL"** which expression shall, unless repugnant to the context or the meaning thereof include its successors and assigns) as the OTHER PART.

AND WHEREAS **"MSPPL"** is desirous of setting up the following manufacturing facilities programme in the State of Chhattisgarh with proposed Investment of Rs. **485.00** Crore.

Sr.No	Plant / Facility	Annual Capacity / Unit	Project Cost (Rs. Crore)
1.	Sponge Iron Plant	2,700 LTPA	100.00
2.	Steel Billet	1.50 LTPA	15.00
3.	Coal Washery	10.00 LTPA	15.00
4.	Ferro Alloys	0.30 LTPA	20.00
5.	Captive Power Plant	40 MW	160.00
6.	Pig Iron Plant	1.20 LTPA	60.00
7.	Palletization & Beneficiation Plant	3.00 LTPA	80.00
8.	TMT / Structural Rolling Mill	2.5 LTPA	35.00
Total			**485.00**

AND WHEREAS, the **Government of Chhattisgarh** agrees to provide all help, prevailing incentives and facilitate clearances necessary for the aforesaid projects in the State of Chhattisgarh through the intervention of the **STATE INVESTMENT PROMOTION BOARD** constituted under the *Chhattisgarh Audyogik Nivesh Protsahan Adhiniyam 2002.*

NOW THEREFORE, **MSPPL** and **Government of Chhattisgarh** have come together to record their intentions through this Memorandum of Understanding (MoU), as set out herein below :

2.1 It is agreed to by the parties that **MSPPL** will set up the aforesaid projects in the State of Chhattisgarh, for which the State Government and its agencies will extend all necessary assistance and fullest cooperation for successful implementation of the projects.

2.2 **MSPPL** will earmark separate funds for environmental upgradation and social upliftment of surrounding areas/villages etc., to maintain the ecological balance.

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Figure 7-T Figure7-T MEMORANDUM OF UNDERSTANDING (3/4)

2.3 **MSPPL** will facilitate setting up of ancillary industries promoted by the **Industries Department** or any State Government agency.

2.4 **MSPPL** will provide employment to local people and implement all the directives in letter & sprit as per the Industrial Policy and Rehabilitation Policy of State Government.

2.5 **MSPPL** will make provisions as per law for utilization and disposal of fly ash generated in their power project and other Industrial activity.

2.6 **MSPPL** will set-up and operate **40 MW** Captive Power Plant as per the provisions of the Electricity Act, 2003 read with the Electricity Rules, 2005 and applicable regulations issued from time to time. In case, it is observed that, the installed capacity is such that captive consumption of power is less than 51% of the installed capacity, the status of the Captive Power Plant shall become Independent Power Plant and accordingly the Company shall be required to supply power to Government of Chhattisgarh or its nominated agency on annualised basis 5% of the net power produced at variable (Energy) charges if the supply of coal to the power plant is through long term coal linkage. Provided that company shall be required to supply 7.5% in place 5% of the net power produced at variable (Energy) charges if the supply of coal to the power plant is though captive coal block located in Chhattisgarh. Further company shall be required to supply additional 30% power of the aggregate capacity to Govt. of Chhattisgarh or an agency nominated by the Govt. of Chhattisgarh. The quality of net power to be provided at variable (Energy) charges shall be firm power and at no time the company shall supply such power less than 90% of quantum of power. The tariff of Electricity to be supplied by the investor shall be determined by appropriate Electricity Regulatory Commission.

2.7 **MSPPL** will initiate all necessary steps to implement the projects mentioned herein above with a view to contribute to the industrial development and the economic growth of Chhattisgarh State within the time limit set out herein below.

2.8 **MSPPL** will commence implementation of the project as early as possible, but not later than 2 years from the date of signing of this MoU. If project implementation does not commence within two years, this MoU will be deemed to have expired.

3.1 The **State Government** will facilitate, through Chhattisgarh State Industrial Development Corporation Limited (CSIDC) all necessary assistance in procuring optimum land free from all encumbrances as required for implementation of the projects mentioned herein above.

3.2 The **State Government** through the State Investment Promotion Board will facilitate expeditious grant of approvals under the purview of the State Government for speedy implementation of the project.

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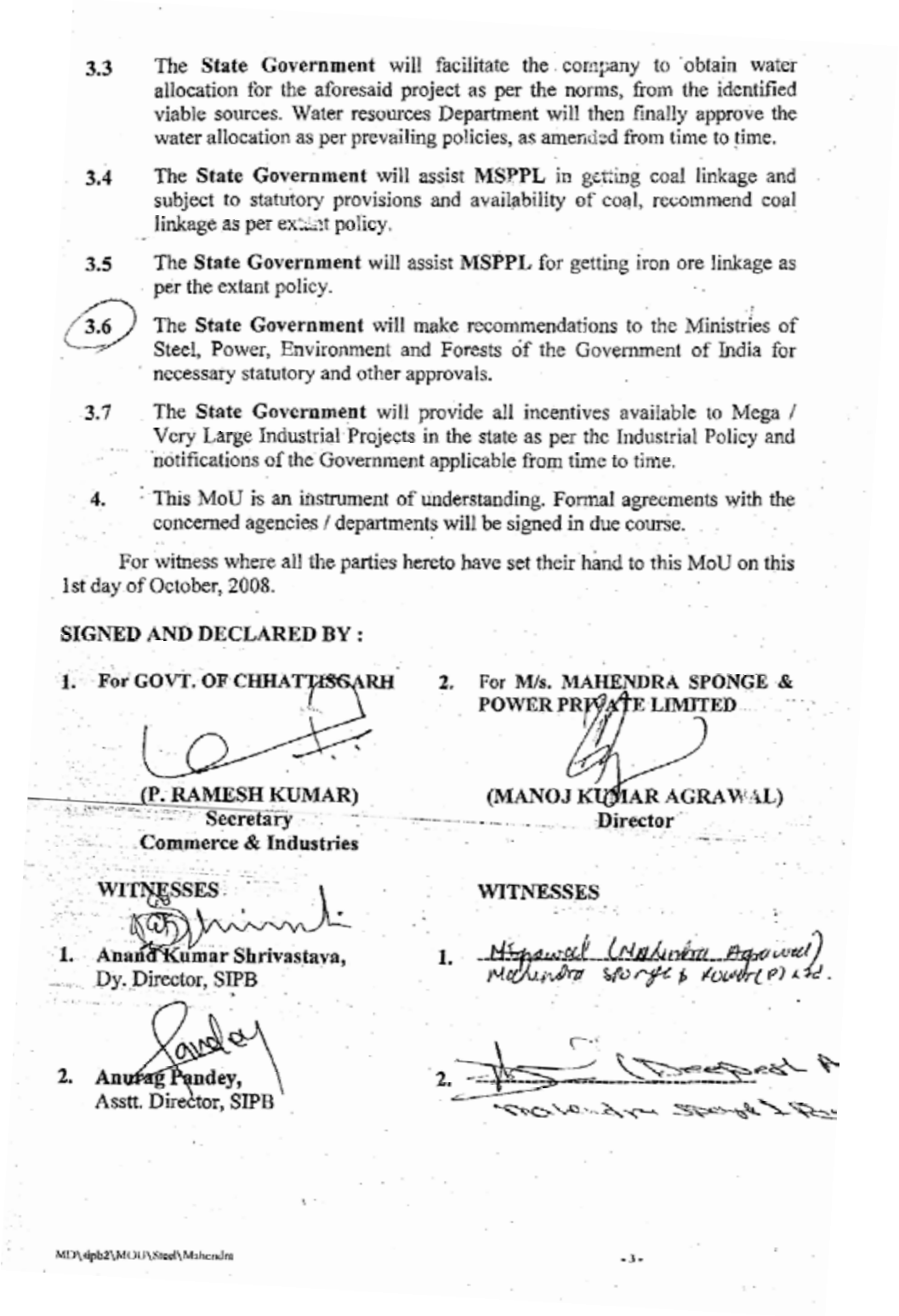
-2-

Figure 7-U MEMORANDUM OF UNDERSTANDING (4/4)



3.3 The **State Government** will facilitate the company to obtain water allocation for the aforesaid project as per the norms, from the identified viable sources. Water resources Department will then finally approve the water allocation as per prevailing policies, as amended from time to time.

3.4 The **State Government** will assist **MSPPL** in getting coal linkage and subject to statutory provisions and availability of coal, recommend coal linkage as per extant policy.

3.5 The **State Government** will assist **MSPPL** for getting iron ore linkage as per the extant policy.

3.6 The **State Government** will make recommendations to the Ministries of Steel, Power, Environment and Forests of the Government of India for necessary statutory and other approvals.

3.7 The **State Government** will provide all incentives available to Mega / Very Large Industrial Projects in the state as per the Industrial Policy and notifications of the Government applicable from time to time.

4. This MoU is an instrument of understanding. Formal agreements with the concerned agencies / departments will be signed in due course.

For witness where all the parties hereto have set their hand to this MoU on this 1st day of October, 2008.

SIGNED AND DECLARED BY :

1. **For GOVT. OF CHHATTISGARH**

(P. RAMESH KUMAR)
Secretary
Commerce & Industries

WITNESSES

1. **Anand Kumar Shrivastava,**
Dy. Director, SIPB

2. **Anurag Pandey,**
Asstt. Director, SIPB

2. **For M/s. MAHENDRA SPONGE & POWER PRIVATE LIMITED**

(MANOJ KUMAR AGRAWAL)
Director

WITNESSES

1. M. Agrawal (Mahendra Agrawal)
Mahendra Sponge & Power (P) Ltd.

2.

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-3-

(2) **Vandana Global Ltd**

(a) Environmental/Social safeguards upon introduction of EEC installation

When a new project is implemented in India, the environmental policy of Central Government needs to be observed in all States. Based on this policy, the standards of SPCB in each State will be observed. Any project implementation requires the clearance from SPCB. For the clearance, the standards of the main items such as air/water etc need to be satisfied. In the past, EIA preparation was required for all projects. This was not only for new projects, but for introduction of new installations in a plant under operation. In the monitoring process, air and waste water are always measured and reported quarterly to SPCB.

(b) Environmental/Social safeguards in the past projects

In the past projects, environmental/social safeguards are one of the requirements for finance when financial institutions grant loans. For example, they are compensation for the land and relocation as consideration to the local population. The guidelines of financial institutions are the same as the standards of PCB. Since a project cannot be implemented without PCB clearance, financial institutions request a company to observe the environment standards of PCB.

Picture 7-B Waste Heat Recovery System (Steam turbine power generator)

7-4-2 Cement Manufacturing Plant

(1) **Associate Cement Company Limited (ACC)**

(a) Company's policy for environmental/social safeguards

ACC already established the policy for environment. [49] Basically, its objective is to mitigate the impact on environment. For this purpose, various monitoring (exhaust gas concentration, SOx, NOx, CO, CO_2, heavy metal etc) is conducted and regularly checked. Those data from the monitoring are reported to SPCB monthly and to CPCB quarterly. Exhaust gas concentration, one of the monitoring items, is 50-150mg/Nm^3 in State standard, but the plant is operated with 30mg/Nm^3 using bag filters.

Picture 7-C Environmental policy

(2) **Andhra Cement Ltd. Durga Cement Works**

(a) Environmental/Social safeguards upon introduction of EEC installation

When the new project was implemented, the attention was paid especially to waste gas. At present, a plant is operated by keeping discharge from a chimney pipe at 50mg/Nm^3 or below. For waste water, the recycle system is introduced trying to reuse. The daily consumption is about 2,000m^3 .

(b) Environmental/Social safeguards in the past projects

In the past projects, implementation of environmental/Social safeguards was never the requirement for finance. The requirements for finance were other items except environment.

[49] http://www.acclimited.com/newsite/nation_environment_en.asp

The plant's operation follows the standards of APPCB, thus the company considers that the attention to environment is fully paid.

(c) Preparation of EIA

When a new project is implemented in any plant, environmental clearance by APPCB is necessary. The officers from State Government visit the plant and check whether the installations in place and exhausted gas concentration satisfy State environmental standards. When a new project is implemented, preparation of EIA is necessary. EIA was prepared for Andhara Cement plant as well. For monitoring, air is always measured. The monitoring data is reported to APPCB monthly.

(3) **The India Cement Ltd. Vishnupuram factory**

(a) Environmental/Social safeguards upon introduction of EEC installation

When Waste Heart Recovery System (WHRS) was installed, mitigation of air pollution was especially emphasized for environment. When the system was installed, Public Opinion was collected from the neighboring area of the project site and received the satisfied result. Base on this, Clearance was obtained from SPCB regarding the system installation. When a new project is implemented, the environmental requirement from a financial institution is to observe PCB standards.

(b) Environmental/Social safeguards in the past projects

Preparation of EIA was required for any project in the past. When the installation capacity is reinforced or discharge to the air is increased along with introducing the part of installations, preparation of EIA will be required for those projects. It is not required for renewal of the existing installations. There is no difference for EIA preparation between new and existing installation.

(c) Preparation of EIA

There are two approaches for EIA preparation: A project is categorized in either Category A or B according to EIA Notification by MOEF. For Category A, EC from MOEF is required while EC from the State Government is required for Category B. For Category B, the draft of EIA is submitted to State Government and a public hearing is conducted. After the opinions being reflected, EC of the final EIA will be granted by State Government. Upon obtaining EC, the project can be implemented. When WHRS was introduced, EC process of EIA took about 6-7 months. Air is always monitored and this data is sent to the local agency monthly and reported to SPCB quarterly.

7-4-3 Biomass power generation plants

(1) **Auro Mira Bio Energy Madurai Limited**

(a) Environmental/Social safeguards upon construction of the current plant

Upon the construction of the current plant, the attention in terms of environment was paid to incineration ash. In this regard, the system introduced ESP. Since the plant was constructed in wild land, other issues were not particularly considered. The construction of this plant required the acquisition of the land and the monetary compensation (payment to purchase the land) was made based on the negotiation with the landlord. Since it was wild land, there was no relocation of the local population. The plant employs the local population for operation, so the company considers the plant contributes to the society in terms of employment creation. For air environment, data is always collected. The data is monthly submitted to TNPCB. By satisfying environmental standards every month, one-year Certification for operation is granted by TNPCB (renewed annually).

(b) Preparation of EIA

The standards referred for the plant construction are EIA Notification. The plant is a thermal power plant with 10MW capacity, which is categorized in Category B (EC by State Government) according to EIA Notification. However, there are no institutions to grant EC in TNPCB, therefore EC was granted by MOEF following EIA Notification. Since EC of EIA was obtained, there was no request by the financial institutions regarding environmental/social safeguards when the project was financed. There was no additional request.

Picture 7-D Biomass Power Generation System

7-4-4 Paper mill

(1) **Tamil Nadu Newsprint and Papers Limited (TNPL)**

(a) Environmental/Social safeguards in the past projects

The finance for the past projects was never rejected for the reason of the environmental/social safeguards. When the production capacity was increased from 90,000 tons to 180,000 tons in 1995, the project was financed by WB. For this, the environmental/social safeguards were necessary following WB guidelines and Environmental Specialist (Afghani) was deployed from WB. WB guideline was mainly to prepare EIA and Environment Specialist assisted this process. In case of the new project implementation, the attentions are paid especially to the environment (air, water and local community).

For the monitoring, air (below SPM: 80mg/Nm^3) and waste water (COD, BOD) are always recorded and reported to TNPCB monthly. The data are also submitted to CPCB semi-annually. For the submission to TNPCB, the staffs from TNPCB visit the plants irregularly but every month, check and bring back the monitoring data.

Picture 7-E Waste Water Treatment Facility

7-4-5 Summary: The current status of Environmental/Social safeguards in industrial sector

Out of the industrial sector in India, the plants for sponge iron manufacturing, cement manufacturing, biomass power generation and paper are visited and the interviews were

conducted regarding environmental/social safeguards. The findings are as follows. The requirements to construct a plant or introduce EEC equipments are: i) to obtain Clearance of EIA and ii) to satisfy the environmental standards of SPCB in each State. After the plants started their operation, the items such as air and waste water (observing SPCB standards) are always monitored and the monitoring data is submitted to SPCB. In some States, Certification for operation in the following year is granted provided that the reported data to SPCB is below the State environmental standards.

From above, it can be said that EIA approval and the observation of the environmental standards by SPCB are required to construct a plant and to install EEC equipment. After a plant operation starts, the monitoring data needs to be reported to the public institutions and the operation certificate of the following year needs to be obtained based on this data. Thus, in industrial sector, environmental/social safeguards are obliged by Central or State government's law and ordinances etc.

7-5 Summary of Environmental/Social safeguard system

The team examined whether the system is in place to appraise sub-projects following JBIC's guideline when IREDA finances sub-projects through Japanese ODA Loans. For this purpose, the interviews with various parties (the existing financial institutions, Central/local governments, entities to implement the projects) were conducted. As a result of the survey, the appraisal system (checklists, appraisal method and staffing) is not established in IREDA for all projects (renewable energy and EEC) following JBIC's guideline. The main reasons are summarized below. However, if JICA requests IREDA to follow JBIC's guideline when it finances IREDA, it is likely that IREDA will ask JICA for the assistance to establish the appraisal system for environmental/social safeguards.

7-5-1 Rational for renewable energy

In the department of hydropower projects, the screening sheets and checklists for environmental/social safeguards are in place. They were prepared when IREDA conducted the project with the donors such as WB in the past and are used to date. On the other hand, the environmental/social safeguards for wind power generation projects are not in place for the following reasons: i) the projects are relatively small, ii) the impact on the local population is little, since the project sites are often constructed in wild area and iii) there are no requirements of EIA and little impact on the environment, since a substance to affect environment is not exhausted. Similarly in SPV power projects, the projects tend to be small and there are no requirements of EIA and little impact on the environment, since a substance to affect

environment is not exhausted.

7-5-2 Rational for EEC

For EEC projects, IREDA considers that it is hard to establish the standardized guideline like the one for hydropower projects, since equipment to be installed differs depending on the sectors (e.g. cement plants, sponge iron plants, paper mills, biomass power generation plants). However, in industrial sector the attentions are paid to the environment by obtaining EC of EIA, which is required for EEC installations (e.g. waste heat recovery power generation system) or expansion of a plant. When the project owner who installed EEC were interviewed, the team received the answer that the attention is fully paid to the environment in the process of EC approval of EIA and the impact on the environment is mitigated by observing SPCB standards and the monitoring. In addition, there were some cases that EC was the requirement for receiving loans from the financial institutions and it was recognized as an important issue. When IREDA finances a project, the detail project reports are prepared and in this reports the specialist's opinions regarding the impact on the environment by the project implementation are summarized. In this regard, the environmental/social safeguards are implemented to certain extent.

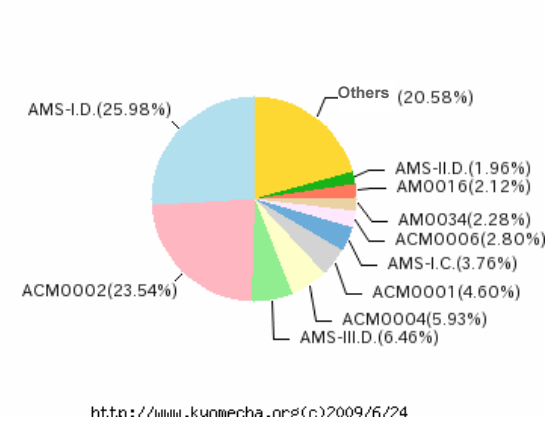
Chapter 8 Application to CDM Project

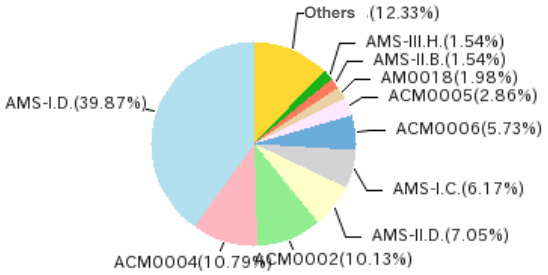
8-1 Current status of CDM

8-1-1 Achievement of CDM projects in India

The number of CDM project approved in the whole host countries in the world and in India are summarized by methodology below. According to Figure 8-A and Table 8-A, share of the Small-Scale CDM projects using RE are the highest in the approved CDM projects in the host countries as a whole and India. It is followed by ordinary sized CDM projects of RE in the host countries and CDM projects using waste gas and waste heat power generation in India.

In both graphs, 50% of all projects are RE projects including Small-Scale and Consolidated methodology. The graphs indicate the tendency that the approved projects for waste gas and heat recovery in industrial facilities are about 5% in the host countries while it is more than 10% in India.





Methodology No.	Project
AMS-I.D.	491
ACM0002	445
AMS-III.D.	122
ACM0004	112
ACM0001	87
AMS-I.C.	71
ACM0006	53
AM0034	43
AM0016	40
AMS-II.D.	37
Others	389
Total	1,890

Methodology No.	Project
AMS-I.D.	181
ACM0004	49
ACM0002	46
AMS-II.D.	32
AMS-I.C.	28
ACM0006	26
ACM0005	13
AM0018	9
AMS-II.B.	7
AMS-III.H.	7
Others	56
Total	454

Figure 8-A The approved CDM projects by methodology
(Left: host countries as a whole, Right: within India)

*The highlighted in gray are explained in Table 8-A

(Source: Kyoto Mechanism Information Platform website)

Table 8-A Title of main methodologies

Methodology No.	Title
AMS-I.C.	Thermal energy for the user with or without electricity
AMS-I.D	Grid connected renewable electricity generation
AMS-II.D.	Energy efficiency and fuel switching measures for industrial facilities
AMS-III.D	Methane recovery in animal manure management systems
ACM0001	Consolidated baseline and monitoring methodology for landfill gas project activities
ACM0002	Consolidated methodology for grid-connected electricity generation from renewable sources
ACM0004	Consolidated methodology for waste gas and/or heat for power generation
ACM0005	Consolidated Methodology for Increasing the Blend in Cement Production
ACM0006	Consolidated methodology for electricity generation from biomass residues

8-1-2 Achievement of CDM projects in IREDA

Below is the number of CDM projects in India and the number of CDM projects financed by IREDA by methodology, based on PDD on UNFCCC website. However, this data includes the projects in the application stage and there is small disparity between this data and the project number mentioned earlier. In addition, there is disparity between the project numbers and the total project number by methodology, since the same project is counted in several methodologies when a single project uses several methodologies.

Table 8-B The number of CDM projects in India and IREDA related projects

01-Jun-09

CDM project in INDIA	Gross		related IREDA		Proportion	
Number of project	508		51		10.0%	
Reductions Amount t-CO2 /annum	39,186,909		1,467,610		3.7%	
Reductions Average t-CO2 /annum・project	77,140		28,777		37.3%	
Number of Methodology	533		52		9.8%	
AM0001	5	0.9%	0	0.0%	0.0%	Incineration of HFC 23 Waste Streams
AM0004	2	0.4%	0	0.0%	0.0%	Grid-connected biomass power generation that avoids uncontrolled burning of biomass
AM0008	2	0.4%	0	0.0%	0.0%	Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility
AM0009	1	0.2%	0	0.0%	0.0%	Recovery and utilization of gas from oil wells that would otherwise be flared or vented
AM0013	1	0.2%	0	0.0%	0.0%	Avoided methane emissions from organic waste-water treatment
AM0014	1	0.2%	0	0.0%	0.0%	Natural gas-based package cogeneration
AM0015	2	0.4%	1	1.9%	50.0%	Bagasse-based cogeneration connected to an electricity grid
AM0018	9	1.7%	0	0.0%	0.0%	Baseline Methodology for steam optimization systems
AM0024	2	0.4%	0	0.0%	0.0%	Methodology for greenhouse gas reductions through waste heat recovery and utilization for power generation at cement plants
AM0025	2	0.4%	0	0.0%	0.0%	Avoided emissions from organic waste through alternative waste treatment processes
AM0029	5	0.9%	0	0.0%	0.0%	Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas
AM0037	2	0.4%	0	0.0%	0.0%	Flare (or vent) reduction and utilization of gas from oil wells as a feedstock
ACM0002	62	11.6%	5	9.6%	8.1%	Consolidated methodology for grid-connected electricity generation from renewable sources
ACM0003	4	0.8%	0	0.0%	0.0%	Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement
ACM0004	54	10.1%	2	3.8%	3.7%	Consolidated methodology for waste gas and/or heat for power generation
ACM0005	17	3.2%	0	0.0%	0.0%	Consolidated Methodology for Increasing the Blend in Cement Production
ACM0006	38	7.1%	2	3.8%	5.3%	Consolidated methodology for electricity generation from biomass residues
ACM0009	1	0.2%	0	0.0%	0.0%	Consolidated methodology for industrial fuel switching from coal or petroleum fuels to natural gas
ACM0012	6	1.1%	0	0.0%	0.0%	Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system
AMS-I.A	2	0.4%	1	1.9%	50.0%	Electricity generation by the user
AMS-I.C	33	6.2%	0	0.0%	0.0%	Thermal energy for the user with or without electricity
AMS-I.D	199	37.3%	40	76.9%	20.1%	Grid connected renewable electricity generation
AMS-II.B	8	1.5%	0	0.0%	0.0%	Supply side energy efficiency improvements – generation
AMS-II.C	4	0.8%	0	0.0%	0.0%	Demand-side energy efficiency activities for specific technologies
AMS-II.D	40	7.5%	0	0.0%	0.0%	Energy efficiency and fuel switching measures for industrial facilities
AMS-II.E	2	0.4%	0	0.0%	0.0%	Energy efficiency and fuel switching measures for buildings
AMS-III.B	5	0.9%	0	0.0%	0.0%	Switching fossil fuels
AMS-III.C	1	0.2%	0	0.0%	0.0%	Emission reductions by low-greenhouse gas emitting vehicles
AMS-III.D	4	0.8%	0	0.0%	0.0%	Methane recovery in animal manure management systems
AMS-III.E	4	0.8%	1	1.9%	25.0%	Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment
AMS-III.F	3	0.6%	0	0.0%	0.0%	Avoidance of methane production from decay of biomass through composting
AMS-III.H	7	1.3%	0	0.0%	0.0%	Methane recovery in wastewater treatment
AMS-III.I	1	0.2%	0	0.0%	0.0%	Avoidance of methane production in wastewater treatment through replacement of anaerobic lagoons by aerobic systems
AMS-III.P	2	0.4%	0	0.0%	0.0%	Recovery and utilization of waste gas in refinery facilities
AR-AM0001	1	0.2%	0	0.0%	0.0%	Reforestation of degraded land
AR-AMS0001	1	0.2%	0	0.0%	0.0%	Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands

From Table 8-B, CDM projects in IREDA account for about 10% and 3% of the projects in India and all host countries, respectively. However, reduction of emission in CDM, which IREDA involved, is about 4% of the total reduction in India. In this regard, it can be said that IREDA tends to involve in relatively small projects compared with the size of the projects in India.

The figures below (Figure 8-B) are the project numbers by Small-Scale / Consolidated methodology. In India, Small-Scale Methodology accounts for about 60% while it accounts for 80% in IREDA. The graphs indicate that IREDA is relatively involved more in Small-Scale methodology.

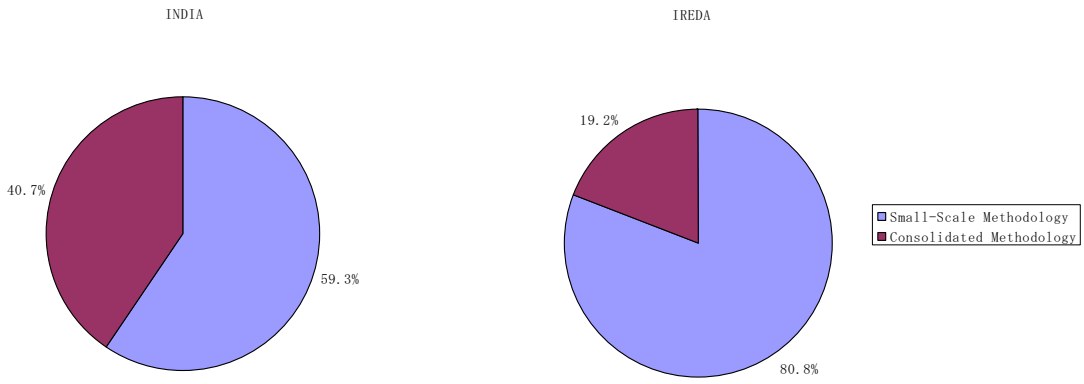


Figure 8-B Ratio of Small-Scale and Consolidated Methodology application
(Left: In India, Right: IREDA involved)

The following graphs (Figure 8-C) are the project numbers by methodology. The projects with RE related methodology account for nearly 90% in IREDA, which is about twice of the ratio in India. Apart from RE, the ratio of Consolidated methodology for electricity generation from biomass residues (4%) and Consolidated methodology for waste gas and/or heat for power generation (4%) is high in IREDA involved projects. They account for around 17% in India and the involvement of IREDA is relatively low.

IREDA has experience in financing EEC projects and out of these projects, there are two projects approved as CDM projects. However, the team was informed that there are no CDM projects in EEC at the interview with IREDA. Therefore, it was found out that not necessarily all CDM projects financed by IREDA are recognized as CDM projects in IREDA internally.

In addition, “Energy efficiency and fuel switching measures for industrial facilities” methodology (AMS-II.D) of Small-Scale CDM accounts for 8% in India, but none in IREDA to date.

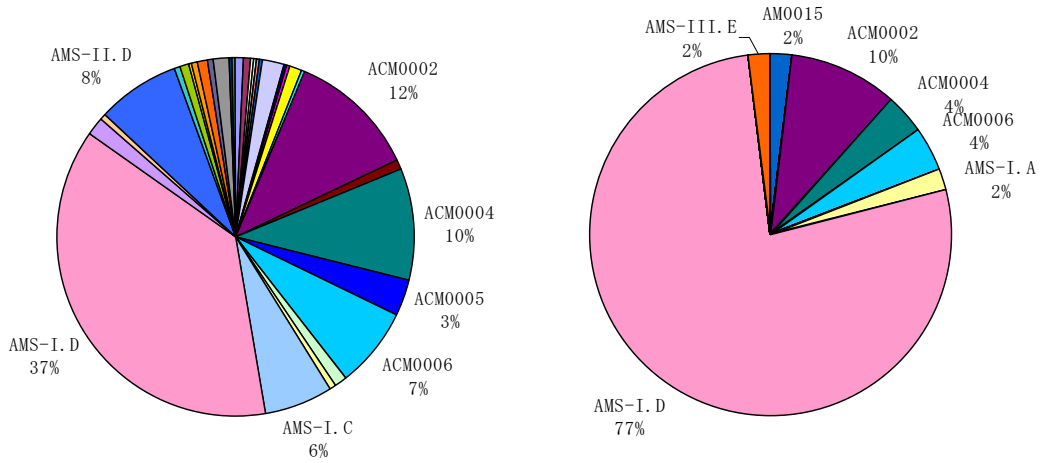


Figure 8-C CDM project numbers by methodology (Left: in India, Right: in IREDA)

8-1-3 CDM application through this study

The analysis above has shown that IREDA’s involvement is limited in EEC. Considering CDM potential and the possibility of its approval in India, it will be effective to transfer the technology and promote the capacity building in the sector of the projects which have certain share in India but were not implemented in IREDA so far. This approach will contribute to reduce GHG, promote CDM and increase the loans by IREDA.

Regarding RE, IREDA has sufficient experience and it will be possible to acquire know-how of introduction through the discussion with the promoters and local consultant and to implement CDM projects. However, EEC projects are a challenge for IREDA to run the sustainable business hereafter considering potential of this sector in India.

Regarding the approval of CDM project in EEC sector, the projects in India account for more than 80% of the use of Methodology AMS-II.D: Energy efficiency and fuel switching measures for industrial facilities. This fact suggests that there is high probability that Designated National Authority will approve CDM projects in this methodology, since there is the experience in the country. In this regard, this methodology is deemed to be suitable to obtain the approval for EEC projects in India.

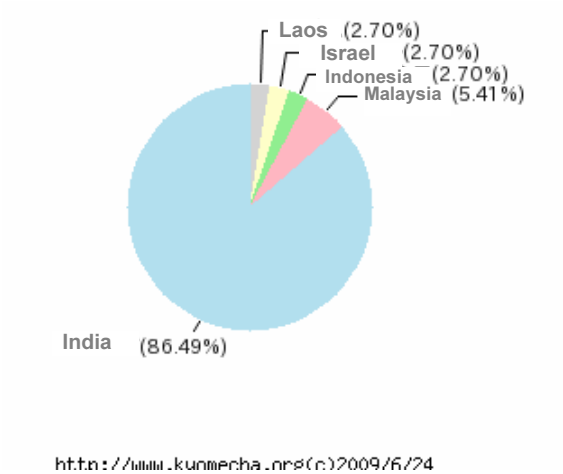


Figure 8-D Small-Scale CDM methodology: use of AMS-II.D by host country

8-2 Institutional set up to implement CDM in IREDA

As for the current CDM structuring in IREDA, a promoter (an enterprise or a consultant etc) proposes a project including CDM and IREDA considers whether it will grant a loan or not. This scheme is applied across the projects in any categories such as SPV, wind, small hydropower and biomass. IREDA's internal understanding is that CDM project is one of the profit added approaches for IREDA and a project tends to be financed if profitability of the project satisfies IREDA's requirement.

In the next 6 months to 1 year, IREDA would like to prepare itself to implement CDM projects in the future: to looks for / support the potential projects. The expected supports are to prepare the project's advisory report and to advise to sell CER to the market (e.g. to supply the market price information).

To date, IREDA appraises the projects proposed by a promoter and decides only to grant a loan or not. Accordingly, EEC impact and GHG reduction are not estimated and confirmed and IREDA does not have/manage those data involving these estimation. Data related to estimation of GHG reduction impact differs depending on projects but the basic data can be obtained from the following:

The basic data for wind power generation such as wind velocity and wind direction can be obtained in C-WET. C-WET was interviewed in the 2nd field mission and it was confirmed that wind power data is provided to companies etc at low cost (Rs. 20,000/site, year). This data will be useful to examine the potential projects in IREDA.

Table 8-C Data and data source for GHG reduction estimates

Kind of project	Kind of Data	Obtaining organization
Wind power generation	Wind speed Wind Direction Height of measurement	C-WET : Center for Wind Energy Technology
Small scale hydropower	Flow rate	CWE : Center Water Commission
Photovoltaic power generation	Insolation data	SEC : Solar Energy Center
Energy conservation	Fuel input rating of factories Kind of fuel	CII : Confederation of Indian Industry
Other	Outside temperature* Atmospheric pressure* Altitude*	Metrological department

*For air density

8-3 Possibility for CDM projects to be accredited

When CDM is accredited, MOEF who is CDM's designated national authority and chairperson considers how much the project will contribute to the domestic sustainable development. As GHG reduction is not taken into account in this process, small and medium sized developments tend to be many at this moment. In the assessment, the transparency in the estimation process of the impact is also considered.

It seems that most of the projects, to which CDMs were not accredited, do not fully satisfy the necessary conditions for the environmental impact, while most of the applied projects satisfy them. From this situation, it can be assumed that possibility for CDM accreditation will increase by using the existing scheme, baseline scenario and methods to estimate the effects. In this process, it is important that the attention is fully paid to the project's impact on the environment.

For the projects aiming at EEC, about which this study is conducted, the measures in plants seems to be effective. However, as Indian economy is growing, the measures for residence and small and medium sized buildings will also be important in the future. MOEF's opinion in this issue is as follows: "Regarding energy consumption in buildings in India, EEC is promoted by applying more efficient lights and air conditioners when a large project is implemented such as development or rehabilitation of the certain area. However, we consider that the buildings equipped with air conditioners are limited and energy consumption in India as a whole is not high. If India economically develops in the future, energy consumption in buildings and residences could be increased. Therefore, we would like to pay attention to it hereafter." (Hearing from Mr. R.K. Sethi (Director) in MOEF) It seems that EEC in housings receive less attentions India and there are the needs for the technical assistance and capacity building from Japan in this area such as district heating and cooling for the regional development and housing

construction projects.

8-4 Sales channel of CER

In one of CDM projects financed by IREDA, about 35% of CER generated from the projects could be obtained. (e.g. 6MW biomass plant project) These obtained CER are all sold following Emission Reduction Purchase Agreement with the buyers.

The emission credit including CER is EUR14.15/t in European Climate Exchange (ECX) and USD0.9/metric ton in Chicago Climate Exchange (CCX) in July 2009, while they were EUR30/t and USD4.9/metric ton in July 2008, respectively. That is, there are price differences of about twice in ECX and five times in CCX. These slumps seem to be due to the financial crisis since the second half of the last year and it is possible to enjoy more profits compared with before by considering the timing to sell. In addition, it will be the beneficial approach for IREDA to sign ERPA with the countries/companies to purchase the emission credit such as CER in order to achieve the emissions reduction targets toward the deadline of Kyoto Protocol, 2012 and operate them widely.

At present, IREDA does not participate in emissions trading and sells all CER to the buyers. But it seems that IREDA does not consider difficult to manage CER by trading after consolidating in a fund. In order to participate in trading, IREDA needs to be registered in ECX and CCX, but is not resisted yet. The team was informed that IREDA will consider the registration if there are possibilities for profitability in the future.

Through ISTSL, SIDBI currently supports SMEs to sell CER in bundle using Special Purpose Vehicle. ISTSL confirmed that the financers could be IREDA instead of SIDBI and there are no restrictions of companies to sell CER through SPV and any company can participate. Therefore, it is necessary to consider this scheme.

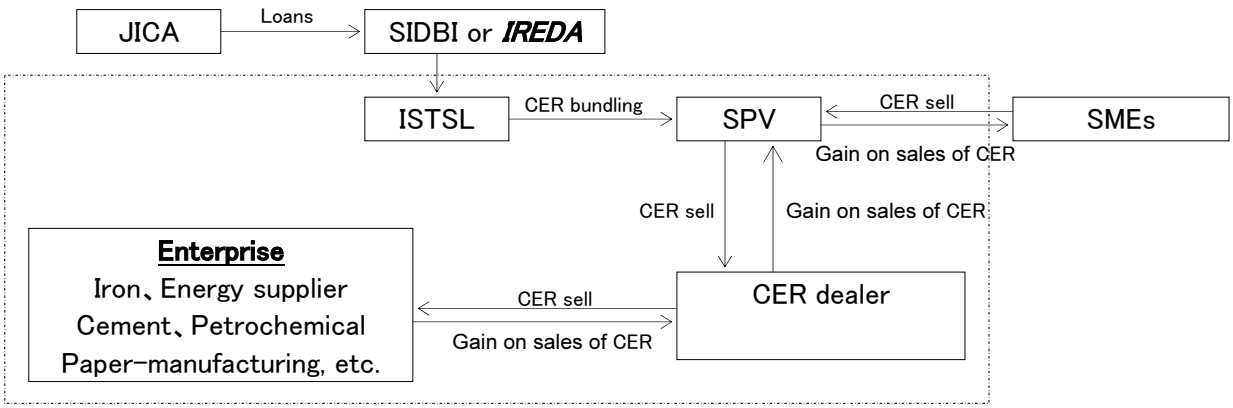


Figure 8-E Sales scheme of CER (Example)

8-5 Indian Company's Experience of CDM project and the interview memo with them

In the 2nd field mission, CDM project experience and issues for their implementation were surveyed in companies. The findings are summarized in Table 8-D. Most of companies interviewed have experience in CDM projects and do not feel difficulties for CDM approval. However, many companies were requesting to reduce the interest rates and there is room for consideration when CDM is implemented through two step loans in IREDA in the future.

IREDA currently sells CER obtained from CDM projects to buyers. It is not known what the buyers do with CER. However, structuring the Win-Win scheme to ensure IREDA's profits is expected: IREDA trades CER and signs ERPA with the parties to which CER can be sold at higher price than the buyers or in exchange of other incentives, while providing the loans with the low interest rate to companies to implement the projects.

Table 8-D CDM project experience in companies

Name of companies	CDM Project Experience	Issues in CDM and Selection of Financial Institutions
Mahendra Sponge Iron	○	・ As the technical issue, the technology to supply waste heat to one waste heat recovery boiler from two rotary kilns was not used in India before. Therefore, it was the issue at approval. ・ For projects such as CDM, choose FI with low interest rates.
Vandana Global Company	○	・ No issues at CDM approval ・ No impression for difficulties in CDM projects ・ FIs for CDM projects are already predetermined in the scheme proposed by a promoter and no room for the company to select. ・ As the expected cooperation with Japan, the company expects Japan to provide the various proposals. If the proposal is beneficial for the company, it will consider their implementation.
India Cements Ltd	○	・ The issue of CDM project is that the financial benefits for a company such as an interest rate is limited. ・ CDM is implemented from the funds of NEDO. Therefore, FI is not involved in the scheme. ・ The expected cooperation with Japan is the proposal of the financially beneficial scheme.
AndhraCement Ltd	×	・ If the company can earn the profits from CDM projects, it is eager to participate. ・ Since the company does not have experience in CDM project, the expected assistance from Japan is cooperation / information provision in various areas such as TA, CDM approval and environmental safeguards.
Associated Cement Company Ltd (ACC)	○	・ No impression that CDM projects are hard to be approved. ・ Projects are implemented using its own funds, so no FI involved. ・ The expected assistance from Japan is the proposal of the scheme with low interest rates and beneficial for a company.
Selco International Ltd	○	・ Approved in India, but PDD is under review in UNFCCC.
AUROMIRA	○	・ The issue in CDM project is that the financing bank cannot be decided until CDM approval in some cases. This is because the cash-flow of the whole project will change by applying CDM projects and FIs suspend their loan decision to avoid this risk. ・ On selection of FI, the government FI was selected since it was cooperative for the project. ・ The expected assistance from Japan is the proposal of the approach with the low interest rates.
Tamil Nadu Newsprint and Papers Ltd	○	・ To date, 5 projects were applied for CDM and 2 were approved. 3 are under review. ・ Even when divergence is observed from the estimated value in PDD, there are no penalties in CDM and only the additional profits are decreased. Therefore, the risk is not high in particular. ・ The expected assistance from Japan is the proposal of the scheme with low interest rates.

Interview memo regarding CDM (2nd field mission)

8-5-1 Mahendra Sponge Iron

(i) In the approved CDM projects, the issue in terms of finance was not found.

(ii) For CDM approval, the team was informed that the technology to supply waste heat to one waste heat recovery boiler from two rotary kilns was not used in India before. Therefore, it was the issue at approval on the technical side.

(iii) From (ii), it was found that the projects will be approved for CDM scheme even using the relatively new methodology as long as GHG reduction and the project impact by monitoring can be proved by the proposed methodology.

(iv) In this CDM, the company cannot obtain CER.

(v) The incentive for the company is sales income.

(vi) When the projects such as CDM are implemented, FIs with low interest rates are selected.

(vii) If CDM projects are to be materialized with Japan, the company would like to be proposed the scheme with low interest rates.

8-5-2 Vandana Global Company

(i) The CDM project named "Waste heat based 4MW captive power project at Raipur" is implemented in Vandana Sponge Iron.

(ii) It is estimated that 18,965.2t-CO_2/Year of CER will be obtained, but CER is not obtained yet.

(iii) There are no particular issues for CDM approval and no impression that CDM projects are hard to be implemented.

(iv) Since the financial institutions for EEC/CDM projects are predetermined in the scheme proposed by a promoter, the company does not have room to select FI.

(v) The company would like to receive the various proposal regarding CDM projects. If the proposal is beneficial for the company, it will consider their implementation.

8-5-3 India Cements Ltd

(i) The company implements CDM project named "India Cement WHR project".

(ii) The issue of CDM project is that the financial benefits for a company such as an interest rate is extremely limited.

(iii) 5,000t-CO_2/year is obtained from the current ongoing CDM project. This is about 10% of CER generated in the project above.

(iv) CER distributed to India Cement out of the ones generated by the project is annually

fixed, so there will be no divergence from the estimate in PDD.

(v) As for FI selection, FI does not involve in the scheme, since this CDM project is implemented using NEDO funds.

(vi) The company is interested in CDM projects in the area of EEC ones in the future, but would like to be proposed the beneficial scheme in terms of interest rates.

8-5-4 Andhra Cement Ltd

(i) If the company can earn the profits, it is eager to participate in CDM project.

(ii) Since the company does not have experience in CDM project, the expected assistance from Japan is cooperation / information provision in various areas such as TA, CDM approval and environmental safeguards.

8-5-5 Associated Cement Company Ltd

(i) Since New Wadi is implementing CDM project using the methodology in which fly ash is mixed, the system cannot be replaced.

(ii) According to PDD of CDM, CDM projects with the methodology in which fly ash is mixed are implemented in 6 plants in New Wadi, Tikaria, Chanda, Kymore, Lakheri and Chaibasa.

(iii) The implementation of the waste heat recovery system is under review in 5-6 plants where CDM projects are not implemented.

(iv) Out of these 5-6 plants, 2 plants are considered as 'Advance Plan'.

(v) ACC has the vision that 22-25% of energy consumption in ACC will be covered by RE in the future.

(vi) For new energy, small hydropower and solar hear use (5MW) are in the planning stage and wind power is in operation.

(vii) It has the impression that the approval of CDM projects is not hard in particular.

(viii) ACC implements the projects using its own funds, so any FI is involved in the project.

(ix) CER is yet to be distributed, since the project is still under review by DOE.

(x) In the future, 100% of CER will be distributed to ACC.

(xi) As the expected cooperation with Japan, ACC expects the proposal which is beneficial for the company in terms of interest rates.

8-5-6 Selco International Ltd

(i) Selco's project is applied for CDM and is under review for approval in UNFCCC while it was approved in Indian Government already.

(ii) The person interviewed is not aware why the project in 6.6MW plant by Selco is not

CDM project while the similar project in 6MW plant by Shriram Energy System ("Municipal Solid Waste Based Power Project" in Hyderabad) is approved for CDM.

8-5-7 AUROMIRA

(i) 2 biomass plants are in operation now and the plant in Pudukkottai was already approved for CDM. (Registration number: 0736).

(ii) The visited JuliFlore is applied for CDM in May 2008 and currently under review.

(iii) From the experience to apply CDM, the issue in CDM project is that the financing bank cannot be decided until CDM approval in some cases. This is because the cash-flow of the whole project will change by applying CDM projects and FIs suspend their loan decision to avoid this risk.

(iv) On selection of FI, the government FI was selected since it was cooperative for the project.

(v) The expected assistance from Japan is the proposal of the approach with the low interest rates.

8-5-8 Tamil Nadu Newsprint and Papers Ltd

(i) The following 5 projects were applied for CDM.

A. Methane Extraction and Fuel Conservation Project
B. 6.75 MW Small Scale Grid Connected Wind Electricity Generation Project
C. Energy Efficiency improvement in Chemical Recovery Boiler plant in TNPL
D. 13.75MW Grid connected wind electricity generation project at Devarkulam by TNPL
E. Methane extraction and utilization as fuel project Biogas – II

(ii) The project A and B are approved by UNFCCC.

(iii) All CER obtained from the project in (ii) are sold.

(iv) CER is distributed to Indian Government and TNPL with 50% each.

(v) Even when divergence is observed from the estimated value in PDD, there are no penalties in CDM and only the additional profits are decreased. Therefore, the risk is not high in particular.

(vi) The project C and D are already applied and in the validation process by United Nations.

(vii) The project E is in the stage of application.

(viii) The expected assistance from Japan is the proposal of the scheme with low interest rates, since the interest rates through two step loan are still high.

Chapter 9 Collaborations with other donors and JICA's technical assistance

9-1 Assistance from International Donors

So far, the Government of India has been receiving various supports for the promotion of renewable energy and energy efficiency and conservation.

The JICA study team reviewed the supports from international donors to IREDA and to other Indian government entities and analyzed its outcomes to identify the area where the prospective Japanese ODA Loan could be made the best use of in terms of quality / quantity supplement, by avoiding duplication of supports and/or to attain synergetic effect from other donors' activities.

9-1-1 Donor supports for Renewable Energy and Energy Efficiency and Conservation Projects in India

The table in the following page summarizes the assistances IREDA received from the international donors relating to RE and EEC. IREDA was originally established as a financial arm of the government, to promote, develop and extend financial assistance for renewable energy and energy efficiency/conservation projects - as the nature of the institution, being under the administrative control of Ministry of Non-Conventional Energy Sources (MNES), IREDA extended its finances mostly to the RE related projects, utilizing the fund from international donors such as World Bank (WB), Asian Development Bank (ADB), and Kreditanstalt für Wiederaufbau (KfW).

Table 9-A Donor supports for IREDA

Donor	Project Title	Implementation Period	Components							
			Renewable Energy					Energy Efficiency and Conservation	TA, Consultancy Services	
			Wind	Small Hydro	Solar Photovoltaics	Biomass	Bagasse		Capacity Development for IREDA	TA & Training for investors and other stakeholders
WB	Renewable Resources Development Project	1993-2001	X	X	X				X	X
	(WB)		X	X	X					
	(DANIDA)		X							
	(SDC)				X				X	X
	(Government of Netherland)								X	X
	(GEF)		X		X				X	X
WB	Second Renewable Energy Project	2000-2008		X				X	X	X
ADB	Renewable Energy Development Project	1996-2004	X		X	**	X		X	
KfW	Promotion of Renewable Energies (IREDA-I)	2000-2003	X		X	X				
KfW	Sustainable Energy Program (IREDA-II)	2008	X	X	X	X		X	X	
KfW	Removal of Barriers to Biomass Power generation in India, Phase-I	2009*				X	X			

Note: * : Expected to be signed in September / October 2009.

**: Even though the bio methane projects were determined as eligible, they were eventually excluded as the demand turned out to be insufficient because of the recession and policy changes (changes in the tax rate).

(1) **World Bank Projects**

(a) Renewable Resources Development Project

The first WB-led project, "Renewable Resources Development Project" (RRDP), from 1993 to 2001, was the first project led by the WB, with the loan portion (USD 254 million) from IDA, co-financed by DANIDA (Danish International Development Agency), SDC (Swiss Agency for Development and Cooperation), and GON (Government of Netherlands), and the grant portion (USD 6 million) from GEF (Global Environment Facility) grant.

For the loan portion, 4 objectives were set for IREDA, including 1) Promote commercialization of renewable resources technologies by strengthening IREDA's capacity to promote and finance entrepreneurial investments in alternative energy, 2) Create marketing and financing mechanisms for the sale and delivery of alternative energy systems based on cost-recovery principles, 3) Help set up an institutional framework for encouraging entry of private sector investments in small-scale power generation, and 4) Promote environmentally sound investments to prevent depletion of India's limited forest resources and to reduce the energy sector's dependence on fossil fuels.

In order to materialize the objectives above, the targets to generate additional capacity by each renewable energy technologies, namely, the small hydro, wind and SPV, were set. Following table depicts the target, and actual capacity additionally generated and the degrees of commercialization for each sector attained through RRDP. Through the implementation of the

RRDP, IREDA played the role as a catalyst; IREDA's investment in RE sectors helped reduce other financiers' risks, thus encouraging other lenders to support the sector, which led other financial institutions to invest to the RE fields and generating additional capacity to the targeted RE sector as in the following table.

Table 9-B Project objectives, installed capacity and degree of commercialization for small hydro, wind, SPV by RRDP.

Renewable Energy Technology	Project's Objectives (MW)	Actual MW generated under the Program	Degree of Commercialization	Additional MW Funded from Other Sources
Small Hydro	100.0	117.9	Fully Commercialized	155*
Wind	85.0	87.2	Commercialization is advancing rapidly	184*
Solar PV	2.5 to 3.0 (MWp)	2.145 (MWp)	Marketing being developed	4 ** (MWp)

Note: * Using other resources, including domestic borrowings, ** Using MNES funds
Source: Project Performance Assessment Report, India, Renewable Resources Development Project, the World Bank, October 2003

The objective of the grant portion from the Global Environment Facility (GEF) was to promote the commercialization of wind energy and SPVs by strengthening IREDA's capacity to promote and finance private investments in the sector. Through this technical assistance program, 51 activities were supported, including 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.

The resource allocations per components are as follows;

Table 9-C Project Costs by Component

Component	Appraisal (US$ million)	Actual Disbursement (US$ million)	Actual Percentage Share
Small Hydro	94.0	166.0	58.5
Wind Farms	125.0	87.7	30.9
Solar Photovoltaics Systems	55.0	23.8	8.4
TA	6.0	6.4	2.2
Total Project Costs	280.0	283.9	100.0

Source: Project Performance Assessment Report, India, Renewable Resources Development Project, the World Bank, October 2003

(b) Second Renewable Energy Project

As a follow-up to the RRDP, the World Bank extended a second line of credit to IREDA through the "Second Renewable Energy Project" from 2000 to 2008. The size of the project is USD 300

million of which, the loan component of USD 130 million (IBRD Loan: USD 80 million[50], IDA credit: USD 50 million) is from the World Bank while USD 165 was to be financed by IREDA, and TA component was USD 5 million from GEF in the form of Grant.

The purpose of this project was to broaden the impact of the RRDP and supporting the development of Small Hydro Plants (SHP) in the areas of high potential (Northern states) which RRDP did not cover. Additionally, a line of credit for energy efficiency was included to build capacity within IREDA to finance energy efficient projects, given the unmet financing needs of industrial and commercial end-users who paid relatively high power prices but under-invested in energy efficiency.

The objectives and key performance indicators of the Project is summarized as in the following table.

Table 9-D Project Objectives and Key Performance Indicators

Project Development Objectives		Key Performance Indicators
Loan		
	Augment power supply through environmentally sustainable small hydro plant (SHP) investments	Increase in SHP installed capacity under the project and sector wide
	Mobilize private sector investments in renewable energy power projects	Private sector promoter's contributions to renewable energy sub-projects and number of sub-projects supported
	Promote energy efficiency and demand side management (DSM) investments	Increased availability and utilization of energy efficient products and equipment and of ESCO services - measured as investments under the WB project and as equivalent generation capacity IREDA builds up a sound and sustainable energy efficiency portfolio
TA		
	Enhance and sustain improved end-use energy efficiencies with consequent reduction in carbon emissions	Energy efficiency service providers are able to gain market entry - measured as number of ESCOs operating in the country Avoidance of carbon emissions resulting from energy efficiency investments under the project

Source: Implementation Completion and Results Report, Second Renewable Energy Project, the World Bank, September 2008

The project was initially prepared to start in 1997-8, but it was delayed due to the international sanctions against India. This delay caused some of the identified sub-projects unfunded. In addition to that, in the beginning stage, there was no clear central policy guideline and inadequate tools to determine the economic cost of renewable energy compared to the conventional power, which led to significant regulatory uncertainty for new SHP project developers who were unable to get approval for proposed power purchase agreement for their potential plans. Moreover, IREDA faced increasing competition from commercial banks which were more interested in financing small hydro and energy efficiency projects even though those

[50] Interest rate was determined based on 6-month LIBOR, and the duration was for 35 years including 10-year grace period.

commercial banks showed little interest in investing in these areas at the time of project appraisal. Actually, it was IREDA who demonstrated financial viability in the RE field - and the credibility of IREDA's expertise in appraising potential projects became increasingly recognized by the financial institutions over the course of the project. There were several project developers who had initially applied for IREDA loans eventually able to obtain financing from other commercial sources with better terms as loan applications made stronger by the fact that IREDA sanctioning approval had been obtained[51]. For all of these reasons, the disbursements under this project were slow in the beginning stage, which led to cancellation of part of the proceeds. On top of this, a state where 6 hydro projects were implemented faced drought conditions from 2001-02 and 2003-04 and all those projects were classified as non-performing assets, which made IREDA provide a restructuring package in 2005/6.

The TA portion was forced to change conditions, because of the formation of the BEE and the reduced prospects for utility-led Demand Side Management (DSM) caused the changes of the conditions. Initially, the TA was aimed to support BEE policy activities, however, this policy support was no longer identified as a policy priority as BEE become more established, and TA activities were refocused on other EE market and pipeline development tasks, including an increased focus on increasing financial sector capacity to lend for EE and to increase broader awareness and capacity for EE. For this purpose, IREDA assigned CII's energy management cell to prepare the "Investor's Manual" [52] for 16 industrial sub sectors[53] to promote market development for energy efficiency and conservation products and services. This "Investor's Manual" covers topics such as energy saving potential for various industries, technologies available to improve energy efficiency, equipment suppliers, government policies and incentives available for the sector, terms of IREDA and other financial institutions extending support to such projects[54]. In addition to that, the related activities like EE information manual and development of codes and standards for performance evaluation of industrial equipment were conducted, aimed at identifying the potential areas in energy intensive sectors that needed to be

[51] There were 35 small hydro projects approved / under approval process by IREDA but eventually cancelled as the borrower could find alternative finance from commercial bank, due to the better interest rate and/or quick loan procedure.

[52] http://www.ireda.in/Download/IREDA-InvestorManual.pdf

[53] 16 sectors include 1.cement, 2.caustic chlor, 3.aluminum, 4.glass, 5.ceramic, 6. paper, 7. fertilizer, 8. foundry, 9. sythetic fiber, 10. textile, 11. tire, 12. drags and pharmacy, 13. sugar, 14. engineering, 15. copper, 16. power plants. IREDA/CII did not include Steels, sponge iron, petrochemical, refinery sectors as IREDA/CII analyzed these sectors are technology specific, the players in these sectors are very few in number, and the players in these sectors are cash-rich and may not approach financial institutions for funding energy saving projects immediately (they may approach for technology upgrading in the future).

[54] Through the TA, IREDA utilized the knowledge gained under the TA to develop their portfolio in EEC financing by extending finance to 11 projects in the priority energy-intensive industries like cement, pulp, paper, sugar, steel, and hotel, to improve their existing technology and profitability with achievement in reduction in overall specific energy consumption and emissions.

targeted for energy efficiency.

The TA component also provided strategic support to IREDA for its market development for increased EE investment, resource mobilization and organizational restructuring to enable better response to increasing competition in the Indian market for clean energy financing.

While the initial project included a specific focus on ESCO development to promote DSM, this has not achieved widespread success in the Indian context. ESCOs in India face a number constraints including inability to prepare bankable projects, limited legal and contractual capabilities, poor contract enforcing environment, poor balance sheets and limited experience and expertise in structuring projects with adequate payment structures. The ESCO activities under this project have been passed to BEE, which is in charge of promoting ESCOs.

The total estimated energy and CO_2 savings which will be achieved assuming successful commissioning of the projects under implementation is 6.70 million tons of CO_2 reduction.

The detailed TA activities, and the project cost by component are summarized as below;

Table 9-E Outputs of Technical Assistance Component

	Name of the TA Activity	Indicator	Output
1	Advisory Services for ESCO	• Number of ESCO project supported	8
		• Number implemented	nil
2	Project monitoring and verification	• Number of projects monitored/evaluated	4
3	Policy support initiative	• Number of policy / knowledge products produced	5
4	Knowledge management plan	• Number of systems improved	23
5	Energy efficiency capacity building initiative	• Number of persons trained (including IREDA)	3690 (external) + 200 (IREDA) = 3890
6	Project development scheme	• Loan amounts supported by grant scheme	Rs. 3914 lakhs
7	Procurement advisory services	• Number of procurement tasks supported by consultants' work	12 (SHP & EEC projects) & 9 (IT projects)
8	Performance evaluation	No Indicator	
9	Project partnership program	No Indicator	
10	Market awareness and outreach initiative	• Number of unique marketing products produced (i.e. advertisements, posters, films, brochures, etc)	Adv-15 types, Poster-10types, Films-12 (U/P), Brochures-5
		• Number distributed (total)	Ads/posters - 25,000
		• Number of persons reached (estimation)	Adv/brochures - NA
11	Creative market development initiative	• Number of audits supported	24
		• Number of projects implemented	12
		• Total value of investment and annual energy savings from implemented projects	Rs. 746.6 lakhs (estimated) Rs. 650.88 lakhs
12	Support to commercial banks	• Number of energy audits supported by SBI scheme	45 projects
		• Number of SME projects implemented from focused cluster marketing	Nil

Source: Implementation Completion and Results Report, Second Renewable Energy Project, the World Bank, September 2008

Table 9-F Project Costs by Component

Component	Appraisal Estimate for Cost, including Contingencies (US$, M)	Actual / Latest Estimate (US$, M)	Percent of Appraisal
a. Small Hydro Investments:			
Run-of-River (100MW)	155	106	68.39
Canal Falls / Dam-toes (65MW)	75	63.3	84.40
Thermal cooling water tail-ends (20MW); plant upgrading & rehabilitation (10MW); stand-alone microhydros (5MW)	33	2.7	8.18
Sub-Total	263	210.14	79.90
b. Energy-Efficiency (EE) Investments:			
by industrial, commercial, utilities, ESCOs, equipment vendors	30	42.23	140.77
c. Technical Assistance			
Pre-investment activities: EE investment pipeline; business development & procurement models	2	2	100.00
Strengthening of IREDA's in-house capacity in project appraisal, monitoring and promotion of EE	3	1	33.33
Policy development for private sector investments in ESCOs and DSM	1	1	100.00
Program outreach and training	1	1	100.00
Sub-Total	7	5	97.00
Total Project Cost	300	257.37	85.79

Note: The figures are as shown in the World Bank report - some figures (e.g. Sub-total of actual / latest estimate for component a. and % of appraisal for subtotal of TA are varied from actual calculation.
Source: Implementation Completion and Results Report, Second Renewable Energy Project, the World Bank, September 2008

(2) **ADB Project**

ADB conducted “Renewable Energy Development Project”, with the loan amount of USD 100 million and TA support for USD 0.3 million from 1997 to 2002. The maturity of the loan was 25 years with 5-year grace period, with the LIBOR based interest rate (6.82% p.a.).

The main objective of the project was to promote renewable energy technologies (RET) commercialization in India, with a focus on i) biomethanation for energy production, ii) bagasse-based cogeneration, iii) wind power, and iv) solar-thermal systems.

ADB dealt with the project with greater flexibility. Firstly, due to recessionary conditions in industry and certain changes in tax policies, no demand existed from the biomethanation subsector, while the wind subsector experienced reduced interest. Hence, at IREDA’s request, ADB reallocated the loan, with USD 60 million for bagasse-based cogeneration, USD 36 million for wind generation, and USD 4 million for solar-thermal systems. Secondly, given the low cost of solar-thermal units and limited outreach of IREDA, it was suggested that IREDA to channel the facility through retail financing. In addition to that, in line with the Government’s policy to encourage the solar-thermal sector, ADB agreed to a lower promoters’ contribution of

15%, from the stipulated 25%[55]. In the wind sector, investors were often deterred by the need to deal with various formalities, such as obtaining permission from utilities; purchasing land; micro-siting and grid interphasing, which are prerequisites to establishing a wind farm. ADB approved financing project developers who provide these services to investors, who are then relieved of such responsibilities.

For the details of the initial, revised and actual fund allocations and achievements, please find following tables.

Table 9-G Project Costs by Component

(in millions of USD)

Category	Initial Fund Allocation	Revised Fund Allocation	Actual Disbursement
Biomethanation	10.00	0.00	0.00
Bagasse-Based Cogeneration	25.00	60.00	55.34
Wind Energy	60.00	36.00	40.35
Solar-Thermal	5.00	4.00	4.09
Capitalization of Interest	0.00	0.00	0.12
TA Cost Recovery	0.00	0.00	0.10
Total	100.00	100.00	100.00

Source: Project Completion Report on the Renewable Energy Development Project in India, ADB, June 2004

Table 9-H Implementation Data

Range	Cogeneration		Wind		Solar-Themal		No of Subloans	Aggregate Amount
	No	Amount	No	Amount	No	Amount		
Up to $1 mil	1	0.92	2	1.60	21	3.03	24	5.55
$1 - 3 mil	5	10.11	7	17.80	1	1.06	13	28.97
$3 - 5 mil	2	6.67	6	20.95	0	0.00	8	27.62
over $5 mil	6	37.64	0	0.00	0	0.00	6	37.64
Total	14	55.34	15	40.35	22	4.09	51	99.78

Source: Project Completion Report on the Renewable Energy Development Project in India, ADB, June 2004

Regarding the TA portion, it initially included assistance to strengthen IREDA's capabilities[56] to complement the TA of the World Bank's RRDP to enhance commercial orientation, with the amount of USD 0.6 million – however, to avoid duplication of the TA activities under RRDP, the scope of the TA was subsequently reduced, to include technical, environmental and institutional aspects, at a reduced budget of USD 0.3 million.

[55] As a consequence, the relative clause of the loan agreement was amended as follows; a qualified enterprise shall contribute out of its own resources a minimum of 25% of the total cost of the qualified project, except for solar-thermal, which was amended to 15%.

[56] Including credit analysis and risk management; financial management; loan portfolio management; foreign exchange risk management; environmental, social, and economic impact assessment; and economic analysis of projects.

(3) **KfW Projects**

Currently, IREDA has been conducting the "Sustainable Energy Program", through concessional finance received from KfW from December 2008. The total amount of the project is 51 million euros, comprised of 50 million euros line of credit for renewable energy and energy efficiency projects through the interest-reduced loan (with 3-4% of interest for the repayment period of 12 years, including 3-year grace period), and €1 million for TA. For the loan portion, it is intended to allocate 75% of the fund for the RE investments, and the remaining for the EEC sector[57]. The borrowing cost borne by the end users are about 10%, with 3.5% of interest rate for KfW, 1.2% of government guarantee cost, 0.15-0.2% of KfW management cost and commitment fee, 3% of foreign exchange / hedge cost between Euro and Indian Rupee, and 2% of IREDA's management fee. KfW does not require IREDA to have the revolving fund for this project, as the term of the loan is too short to revolve.

Regarding the TA portion, KfW waited for IREDA to propose the TA ideas – however, as there was no concrete suggestions from IREDA, KfW consigned Frankfurt School of Finance & Management to prepare a report to identify the needs for TA which was published in April 2009. Currently, KfW is waiting for IREDA to define the priorities of the items which need to be supported by the TA component.

KfW also negotiating with IREDA for the new project, named "Removal of Barriers to Biomass Power Generation in India, Phase-I". The loan agreement of this project is expected to be signed in September / October 2009.

The project details, along with other prospective projects, are described in the following section.

[57] According to KfW, the eligible EEC investment project is the ones able to attain more than 15% improvement in energy efficiency.

Table 9-I Donor Supports for Energy Efficiency and Conservation in India

Donor	Project Title	Implementation Agency	Implementation Period	Objectives
ADB	Industrial Energy Efficiency Project in India	IDBI Bank	1995-2000	・ Financial support for cement, chemistry, fertilizer, paper, iron, sugar, and garment industry ・ Capacity building for IDBI
USAID	Energy Conservation & Commercialization (ECO) Program I, II and III	BEE, Ministry of Power and others	I: 1999-2001 II: 2001-2003 III: 2003-2008	・ Lending to the medium-sized companies for their purchase of energy efficient / conservation equipments through Energy Efficient/ Energy Conservation Loan Fund. ・ Framing "Energy Conservation Act", establishment of BEE, capacity building for BEE, implementation of demand side management (DSM) program, institution of energy efficacy code and labeling system
	Greenhouse Gas Pollution Prevention Project (GEP)	National Thermal Power Corporation Ltd.	1995-2010	・ Conduct F/S to improve the performance in coal-fired power stations, promotion of utilization of alternative energy resources, introduction of clean cost-saving practices, fosters the use of alternative fuels such as biomass and bio-gas, to reduce the emission of greenhouse gasses from coal-fired power station.
KfW	Energy Efficiency Programme in Rural India	Ministry of Energy, Rural Electrification Corporation	2005-2009	・ Rehabilitation of distribution networks in the rural areas, extending low-interest loan for the installment of renewables, and providing grant for the trainings.
	Cleaner Production measures	SIDBI	2007	・ Low-interest loan to promote the clean production of the small and medium enterprises

Table 9-J Major donor supports for CDM activities in India

Donor	Project Title	Implementation Agency	Implementation Period	Objectives
KfW	Clean Development Mechanism Project	IDBI Bank	2007	・ Project identification, funding implementation of SME's CDM projects, registration and verification, advisory services for trading CER.
IFC	Clean Development Mechanism Project	IDBI Bank	2007	・ Project identification, funding implementation of CDM projects, registration and verification, advisory services for trading CER.

9-1-2 New Projects to IREDA under consideration

As explained in the section above, IREDA has also been negotiating with KfW, and other agencies including ADB and Agence Française de Développement (AFD), for their possible assistance.

KfW aims to extend its assistance exclusively aiming at removal of barriers in biomass projects. The project is expected to be launched shortly.

ADB is currently hiring a consultant to conduct due diligence of IREDA for its prospective "Integrated Renewable Energy Development Project". Through this project, ADB's finance intended to be allocated for the investments in solar thermal and solar photovoltaic subsectors to facilitate public-private partnerships (PPP). However, the Government of India might plan to set up a new government finance institution to finance solely for solar photovoltaic projects, ADB might wait to see which institution would be an appropriate agency for their counterparts.

AFD is also preparing its new loan to IREDA to finance RE sectors including wind-power generation, photovoltaic generation, small-hydraulic power generation, co-generation, etc.

The details of the projects are as follows.

(1) **Kreditanstalt für Wiederaufbau (KfW)**

KfW is actively preparing its financial and technical support for promoting RE and EEC in India[58]. In relation to IREDA, KfW is going to launch the "Removal of Barriers to Biomass Power Generation in India, Phase-I", and its loan agreement is expected to be signed in September / October 2009. Through this project, the KfW is going to arrange for a line of credit in the amount of 20 million euros, with the interest rate of 0.75% for the duration of 40 years including 10-year grace period. The objectives of the project is to remove the barrier in biomass projects, and plans to provide sub-loans to bagasse based bio-mass cogeneration (with focus on co-op sugar mills), biomass power generation (through combustion), industrial cogeneration, biomass gasifier of power generation as well as heating appliances, biomass methanation, etc.
As of August 2009, KfW identified all the projects to be financed by fully utilizing this credit scheme as follows[59].

[58] Currently, KfW is under negotiation with SIDBI to extend line of credit for energy efficiency in micro, small and medium enterprises. LA is expected to be signed in September / October 2009. The total credit size is estimated to be ･50 million, with 3-4% of interest. The repayment period is to be 12 years, with 3-year grace period. KfW is planning to provide ･ 0.5 million TA (grant) in addition to the loan scheme under this program for the promotion of programmatic CDM and to discover the targeted clusters by consigning the work to ISTSL as a consultant, which is a group company of SIDBI.

[59] According to KfW, they could allocate all the funds in advance before the signing of LA, as the loan size is small - if KfW finds more eligible projects, it will allocate some funds from the currently ongoing project ("Sustainable energy program").

Table 9-K

Sector	No of Project	Interest rate for the end user
Biomass Cogeneration	1	1%
Biomass Power Generation	2	1%
Industrial Cogeneration	2	2%
Biomass Gasifier for power generation	2	2%

Source: KfW (through interview conducted by JICA study team), August 2009

In this scheme, no TA is expected to be provided, and KfW does not seek for IREDA to have the revolving fund, as the size of the scheme is relatively small.

(2) **Asian Development Bank (ADB)**

In 2008, the Government represented by the Ministry of New and Renewable Energy (MNRE) entered a MOU with both the Energy and Resource Institute (TERI) and IL&FS Infrastructure Development Corporation (IIDC) which is 100% subsidiary of IL&FS, the pubic financial institution with 44% of government holdings. The objectives of the MOU are to develop a viable and environmentally friendly sustainable grid interactive solar photovoltaic (SPV) power projects, rooftop photovoltaic power system and geothermal power projects in various states across India, by taking public-private partnership (PPP) approach. In order to accelerate solar and geothermal power development, a strategic partnership between the Government and ADB is proposed. Under this partnership, ADB is supposed to provide a financial assistance to IREDA or to a newly planned government financial institution specializing in financing SPV projects[60], and technical assistance for project development and implementation as well as capacity development of the stakeholders through the "Integrated Renewable Energy Development Project", which is under project formulation.

The ADB and the Government of India are still under discussion and have not reached on the project details including the counterpart and the financial scheme. The followings are the information currently being discussed between ADB and Government of India on the assumption that the project will be actually implemented to IREDA as a counterpart for the financial component.

The total amount for the loan component of "Integrated Renewable Energy Development Project" is expected to be around USD 200 to 250 million, and the TA component would be

[60] The final decision on setting up a new organization has not been made by the Government of India.

USD 1.4 million. IREDA will be the executing agency of the proposed lending facility, while the MNRE will be the executing agency for the technical assistance grant.

The lending facility aims to promote renewable energy development through public-private partnerships (PPPs), by limiting total ADB lending up to 20% of the total capital cost of the subproject, and ADB is open for IREDA to cover the remaining portion of the subproject using the Japanese ODA Loan. Currently, the targeted project areas envisaged include large-scaled SPV power generation (more than 10MW), but the details will be finalized later.

The ADB is planning to help formulate 2 to 4 potential projects in Gujarat, Rajasthan[61], and Tamil Nadu, and has been discussing with the local government authorities to find out the potential projects.

The TA is expected to be implemented from May 2009 to April 2010, aiming to (i) support capacity development within IREDA (or the new institution if it would become a counterpart) to manage market and credit risks; and (ii) to train IREDA staff in risk assessment, management, and mitigation.

(3) **Agence Française de Développement(AFD)**

Agence Française de Développement (AFD) is also keen to extend its assistance for RE and EEC development in India[62]. Currently, AFD plans to provide €40～80 million loans to IREDA, to support development of RE related projects in the field of wind power generation, SPV power generation, small-scale hydropower generation, co-generation. AFD obtained the approval from the headquarter, and waiting the official request from the Department of Economic Affairs, Ministry of Finance under the Government of India. AFD plans to dispatch an appraisal mission to IREDA in September 2009, and aims to sign the loan agreement sometime from December 2009 to March 2010.

9-2 Support for Japanese companies' business development in India

There are several Japanese companies with world leading technologies in the RE and EEC fields considering ways of penetrating Indian market. The JICA study team discussed with JETRO New Delhi Center and NEDO New Delhi office in India, and contacted to some industry groups such as the Japanese Business Alliance for Smart Energy Worldwide (JASE-World), and the

[61] There are two proposed subjects (（Solar thermal power, solar photovoltaic power）being assessed in Rajasthan. ADB plans to dispatch a mission to Rajasthan to further investigate the proposed projects and to discuss with the counterpart, Rajasthan Energy Development Agency within this year.

[62] AFD also plans to extend its loan (€50 million) to SIDBI to promote EEC to small and medium enterprises and currently waiting for the internal approval to proceed this project.

Japan Consulting Institute to find out the potential projects or the companies to be penetrated in India.

JETRO analyses that there are great EEC potentials in the logistic industry, especially for the investment or improvement for the cold chain facilities. According to JETRO, it was requested by the Ministry of Commerce to support developing food distribution system to minimize the amount of wasted food[63] in relation to the development of Delhi-Mumbai industrial corridor. It is said that the Indian government is planning to establish the food logistic center in 20 clusters in India, which would function as bases of processing cash crops, such as oranges and soya beans, and plans to provide special tax reduction through upcoming tax reform. In this context, there is a great potential for the Japanese refrigerate-related equipment makers, which have world-leading technologies, to enter the Indian market. In addition to that, JETRO suggested the needs for in-house power generator for the industrial park to solve the current problem of unreliable power supply for the industrial production facilities, which Japanese companies might have advantages.

JETRO is now running "Indo New Window" portal site (http://www.indo-new-window.org/) with CII to support finding business partner between Japanese and Indian investors, and to provide more information on investment climate in India to the Japanese companies. Through this activity, it is expected that JETRO to facilitate the investment for RE, and/ or especially EEC sector of Japanese companies having advanced technologies in these fields.

The Japan Consulting Institute shared the information on this potential Japanese ODA Loan to the member companies, to seek for the Japanese companies or subsidiaries or group companies of Japanese companies in India which interested in borrowing the Japanese ODA Loan. In addition to that, the Team introduced the "Japanese State-of-the art Smart Energy Products & Technologies" compiled by the JASE-World to IREDA, as a reference of the Japanese leading technologies enable to attain energy efficiency and conservation in India, to help IREDA consider the eligible sectors and/or equipments under the Japanese ODA Loan.

As the consequences, the Team was introduced several Japanese companies, including a member company of JASE-World, and two member companies of the Japan Consulting Institute. Through the discussion with IREDA, the Team provided overall information of the projects, and necessary technical information from the "Japanese State-of-the art Smart Energy Products &

[63] It is said that about 40% and 10% of the food is discarded due to the poor distribution and cold storage system in India, respectively.

Technologies" for IREDA's perusal, for IREDA to include those Japanese leading technologies as their eligible projects for the Japanese ODA Loan.

Table 9-L Japanese State-of-the art Smart Energy Products & Technologies (By Sector) Edited by JASE-World

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Residence	R-1	Inkjet MFP	CANON	F31			●						●	
	R-2	Condensing Water Heater	Tokyo Gas	G34			●					●		
	R-3	High Efficiency Gas Cooking Stove	Tokyo Gas	G34			●					●		
	R-4	Heat Pump Water Heater with Natural-Refrigerant	HPTCJ	R			●				●	●		
	R-5	Heat Pump (General Purpose)	HPTCJ	R			●				●	●		
	R-6	Residential Fuel Cell	Nippon Oil	F18			●				●			
	R-7	Waste to Energy System	Hitachi Zosen	F26				●					●	
	R-8	Highly Efficiency Permanent Magnet Motor	Hitachi	F27	F		●						●	
	R-9	Highly-Efficient Inverter Compressor for Refrigerators	Panasonic	F27		●							●	
	R-10	Spiral-Flat typed Fluorescent Lamp	Panasonic	F27			●						●	
	R-11	High-Performance Vacuum Insulation	Panasonic	F29		●							●	
	R-12	Heat Pump Washer/ Dryer	Panasonic	F27			●						●	
	R-13	Compressors for Air Conditioner	Panasonic	F27		●							●	
	R-14	Energy-Saving Household Room A/C	Panasonic	F27			●						●	
	R-15	Energy-Efficiency Household Refrigerator-Freezer	Panasonic	F27			●						●	
	R-16	Natural Refrigerant (CO2) Heat Pump Water Heater	Panasonic	F27			●						●	
	R-17	White LED Module for Light Fixtures	Panasonic	F27			●						●	
	R-18	Self ballasted Compact Fluorescent Lamp(CFL)	Panasonic	F27			●						●	
	R-19	Space Heating and Domestic Water Heating Heat Pump	Mitsubishi Electric	F27			●						●	
	R-20	Creating Energy-Saving Household Air Conditioners with Sensing Technology	Mitsubishi Electric	F27			●						●	
	R-21	Energy-Efficient Refrigerator	Toshiba	F27			●						●	
	R-22	Heat Pump Washer & Drying Machine	Toshiba	F27			●						●	
	R-23	Light Bulb-Shaped Fluorescent Lamp	Toshiba	F27	O		●						●	
	R-24	Residential Fuel Cell	Tokyo Gas	G34			●					●		

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Office	O-1	Remote Energy Saving Tuning Service (Energy Saving Service for Building Air Conditioning)	Daikin	F26					●				●	
	O-2	Black and White Multifunctional Printer	CANON	F31			●						●	
	O-3	Machineroom-less Elevator	Mitsubishi Electric	F27				●					●	
	O-4	Escalator (Converter regenerating controller)	Mitsubishi Electric	F27				●					●	
	O-5	Commercial Heat Pump Hot Water Supply Unit	HPTCJ	R			●				●	●		
	O-6	Building Energy Management System	Yamatake	F28	F				●			●	●	
	O-7	Actival with Flow Rate Measurement & Control Functions	Yamatake	F28	F		●						●	
	O-8	Sophisticated Green Building Design	NIKKEN SEKKEI	E					●			●	●	
	O-9	Sustainable Urban Design & Management System	NIKKEN SEKKEI	E					●			●	●	
	O-10	Mirror Duct System to Use Natural Light	NIKKEN SEKKEI	E	R				●			●	●	
	O-11	Revolutionary Prototype Openings for Next Generation Buildings - Facade system with a combination of External Blinds with Heat - generating double glazing -	NIKKEN SEKKEI	E					●			●	●	
	O-12	Building Structure Thermal Storage System with Package Air Conditioner	Hitachi	F27				●					●	
	O-13	High Performance Environment-conscious Hf Fluorescent Lamp	Panasonic	F27			●						●	
	O-14	Semiconductor Memory Video Recording System for Broadcasting and Commercial Applications	Panasonic	F27			●						●	
	O-15	ESCO Service with CO2 Emissions Reduction Guarantee	TEPCO et al.	S					●		●			
	O-16	Commercial Heat Pump Air Conditioning System (Multi-system Air Conditioner for Highly-Efficient Buildings)	HPTCJ	R			●					●	●	
	O-17	High-Efficiency Heat Supply System (Unused Energy Utilization and Heat Recovery Heat Pump)	TEPCO	G33					●				●	
	O-18	Thermal Storage Air Conditioning System	HPTCJ	R			●				●	●		
	O-19	Centralized Controller for International Markets	Mitsubishi Electric	F27			●						●	
	O-20	VRF Air Conditioning and Hot Water Supply System	Mitsubishi Electric	F27			●						●	
	O-21	Highly efficient LED downlight	Toshiba	F27	R		●						●	
	O-22	LED lamps shaped like conventional incandescent bulbs	Toshiba	F27	R		●						●	
	O-23	Ceramic metal halide lamp	Toshiba	F27	R		●						●	
	O-24	Elevator Renewal	Toshiba	F27				●					●	
	O-25	Energy-saving air-conditioning control for offices	Toshiba	F27					●				●	

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Factory	F-1	Multiple Installation System of High-efficiency Small Once-through Boilers	Miura Co.	F26				●			●	●		
	F-2	Exhaust Heat Recovery Type Burner	Toho Gas	G34				●				●		
	F-3	Waste Treatment and Waste Heat Recovery Technology Using a Fluidized Bed Combustion Furnace	Showa Denko	F17				●			●			
	F-4	Total Solution for Saving Energy	MUFJL&F	K					●		●		●	
	F-5	Vacuum Deaeration Type of Packaging/Weighing System for Increasing the Bulk Density	Mitsubishi Chemical	E				●			●			
	F-6	Ultra High-Speed Long-Fiber Filter	Mitsubishi Chemical	E				●						●
	F-7	High-performance Industrial Furnace Equipped with Regenerative Burner	Tokyo Gas	G34				●				●		
	F-8	Natural Gas Cogeneration	Tokyo Gas	G34				●				●		
	F-9	General Purpose Inverter	Mitsubishi Electric	F27	O		●						●	
	F-10	Gas Turbine Cogeneration Systems	Hitachi Zosen	F26				●					●	
	F-11	Far Infrared Heating	JFIRA	F26				●				●	●	
	F-12	Centrifugal Chiller	MHI	F26	O		●						●	
	F-13	Miller Cycle Gas Cogeneration Package	MHI	F26				●				●		
	F-14	Environment-friendly Diesel Cogeneration System	MHI	F26				●					●	
	F-15	Energy-saving High-voltage Direct Inverter	Hitachi	F27			●						●	
	F-16	Inverter for Energy Saving	Hitachi	F27			●						●	
	F-17	Inverter-driven Air Compressor (Oil Flooded Type)	Hitachi	F27			●						●	
	F-18	Inverter-driven Air Compressor (Oil-free Type)	Hitachi	F27			●						●	
	F-19	Laser Drilling Machine for Printed Wiring Board	Hitachi	F27				●					●	
	F-20	ESCO (Energy Service Company) Business	Hitachi	F27					●			●	●	
	F-21	Small AC Servo Press	KOMATSU	F26				●					●	
	F-22	Far Infrared Drying	JFIRA	F26				●				●	●	
	F-23	Energy Saving at Oil Refineries and Chemical Plants	TEC	P	P				●		●	●		
	F-24	Key Enablers of Vigilant Cycle for Global Environment	Yokogawa Electric	F27			●				●			
	F-25	Zirconia Oxygen Analyzer	Yokogawa Electric	F27			●				●			
	F-26	Pressure Transmitter	Yokogawa Electric	F27			●				●			
	F-27	TruePeak Tunable Diode Laser Spectrometer (TDLS) Analyzer	Yokogawa Electric	F27			●				●			
	F-28	Infrared Gas Analyzer	Yokogawa Electric	F27			●				●			
	F-29	Magnetic Flowmeter	Yokogawa Electric	F27			●							●
	F-30	Turbidity Analyzer	Yokogawa Electric	F27			●				●			

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Factory	F-31	Plant Information Management System Package	Yokogawa Electric	F27					●		●			
	F-32	Paperless Video Graphic Recorders	Yokogawa Electric	F27			●				●			
	F-33	Consolidated Alarm Management Software	Yokogawa Electric	F27					●		●			
	F-34	Next-generation Distributed EMS Energy Control System	Yokogawa Electric	F27					●				●	
	F-35	Advanced Process Controller	Yokogawa Electric	F27					●		●			
	F-36	Operation Efficiency Improvement Package	Yokogawa Electric	F27					●		●			
	F-37	Integrated Production Control System	Yokogawa Electric	F27					●		●			
	F-38	Safety Instrumented Systems	Yokogawa Electric	F27					●		●			
	F-39	Energy-saving Control for Various Utilities	Yokogawa Electric	F27					●				●	
	F-40	Low-power Consumption Type Intelligent Remote Terminal Unit (RTU)	Yokogawa Electric	F27			●						●	
	F-41	Energy Saving Control System for Water Pumps	Yokogawa Electric	F27					●				●	
	F-42	Clamp Wattmeter for Visualization of Energy Saving	Yokogawa Electric	F27			●						●	
	F-43	Film Sheet Thickness Measuring and Controlling System	Yokogawa Electric	F27				●					●	
	F-44	Ceramic Metal Halide Lamp	Panasonic	F27			●						●	
	F-45	Gas Turbine Cogeneration System	KHI	F26				●			●		●	
	F-46	Waste Heat Recovery Power Plant	KHI	F26				●					●	
	F-47	High-Efficiency Turbo Compressor	IHI	F30				●					●	
	F-48	High-Efficiency Gas Burning Boiler	IHI	F26			●					●		
	F-49	Food Processing by Far Infrared Rays	JFIRA	F26				●				●	●	
	F-50	Area-wide Pinch Technology	Chiyoda Corp.	F26					●		●			
	F-51	Water Heat Source Type Industrial Hot Water Supply System	Mayekawa MFG.	F26	R		●				●		●	
	F-52	Non-fluorocarbon Type Energy Saving Air-conditioning System	Mayekawa MFG.	F26	O		●						●	
	F-53	Hybrid Cooling Unit	Mayekawa MFG.	F26	C		●						●	
	F-54	Adsorption Chiller	Mayekawa MFG.	F26			●						●	
	F-55	Air Freezing System	Mayekawa MFG.	F26			●						●	
	F-56	Vortex Flowmeter	Yokogawa Electric	F27			●						●	
	F-57	High-speed Heating Machine for Solar Cell	NGK Insulators	F22				●					●	

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Construction & Transport	C-1	Environmental Tires	Bridgestone Corp.	F20		●					●			
	C-2	Environmentally Friendly Small Diesel Engine	MHI	F30			●				●			
	C-3	Hybrid Forklift	MHI	F30	F		●				●			
	C-4	Energy-efficient Hydraulic Excavators	Hitachi	F27			●				●			
	C-5	Ring Belt Material for CVT	Hitachi	F27		●					●			
	C-6	Hybrid Hydraulic Excavator	KOMATUS	F26				●			●			
	C-7	Dissemination of a Fuel-efficient Operation	KOMATSU	F26				●			●			
	C-8	Hybrid Electric Forklifty Truck	KOMATSU	F26	F			●					●	
	C-9	Tires From Non-petroleum Natural Resources	SRI	F20		●					●			
	C-10	Permanent Magnet Synchronous Motor for Rolling Stock	Toshiba	F27			●						●	

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Electricity	E-1	One-stop Service for Energy Saving	Kyushu Electric Power Company	G33					●				●	
	E-2	CIS Photovoltaic Module	Showa Shell Solar	F27			●						●	
	E-3	Power Semiconductor Devices	Mitsubishi Electric	F27		●							●	
	E-4	Sodium-sulfur (NAS) Battery for Large-capacity Power Storage	TEPCO & NGK Insulators	F22				●					●	
	E-5	2MW Downwind Turbine Power Generation System	Hitachi	F27				●					●	
	E-6	Amorphous Transformer	Hitachi	F27				●					●	
	E-7	Thin-film Solar Cell	MHI	F26				●					●	
	E-8	Wind Turbine Generation	MHI	F26				●					●	
	E-9	Switching Loss Measurement for Energy-Saving Power Device Development	Yokogawa Electric	F27			●						●	
	E-10	PWM Waveform Measurement for Energy-Saving 3-Phase Inverters	Yokogawa Electric	F27			●						●	
	E-11	Data Center Power Consumption Measurement	Yokogawa Electric	F27			●						●	
	E-12	Measuring Power Conversion Efficiency in Solar Power Generating Systems	Yokogawa Electric	F27			●						●	
	E-13	Aiding Energy Efficiency in Inverter Motors	Yokogawa Electric	F27			●						●	
	E-14	Green Gas Engine	KHI	F30				●				●		
	E-15	Steam Turbines for Environment-oriented Power Generation	KHI	F26				●		●				
	E-16	Engineering Service: Network Protection Scheme	TEPCO	G33					●				●	
	E-17	Engineering Service: Distribution Automation System (DAS)	TEPCO	G33					●				●	
	E-18	Engineering Service: Hydro Power Plant Development	TEPCO	G33					●				●	
	E-19	Engineering Service: Hydro Power Plant Operation and Maintenance	TEPCO	G33					●				●	
	E-20	Engineering Service: Thermal Power Plant Operation and Maintenance	TEPCO	G33					●				●	
	E-21	Engineering Service: Power System Planning	TEPCO	G33					●				●	
	E-22	Engineering Service: Renewable Energy Development	TEPCO	G33					●				●	
	E-23	Engineering Service: Thermal Power Plant Development	TEPCO	G33					●				●	
	E-24	Engineering Service: Technical Support in Energy-saving Master Planning	TEPCO	G33					●				●	
	E-25	Next-generation Multi-crystalline Photovoltaic Cell	Mitsubishi Electric	F27			●						●	
	E-26	Inverter for Photovoltaic Applications	Meidensha Corp.	F27				●					●	
	E-27	Power Converter for NAS Battery Energy Storage System	Meidensha Corp.	F27				●					●	
	E-28	Adjustable Speed Pumped Storage Systems	Toshiba	F27				●					●	
	E-29	Supercritical Pressure High Efficiency Thermal Power Plants	Hitachi	F27				●		●				
	E-30	New Type of Rechargeable Battery	Toshiba	F27	C		●						●	
	E-31	Supercritical Pressure High-Performance Thermal Power Plants	Toshiba	F27				●					●	

Applicable Sector	File No.	Title	Corporate Name	JSIC	2nd Applicable Sector	keyword Y				keyword Z				
						Material or Part	Device	Equipment or Facility	System or Software	Solid Fuels	Oil	Natural Gas	Electricity	Water
Iron & Steel	S-1	Sintering Waste Heat Recovery System	Steel Plantech	F26				●					●	
	S-2	BDC - BFG Dry Cleaner	Steel Plantech	F26				●					●	
	S-3	Waste Plastics Injection System for Blast Furnace	Steel Plantech	F26				●					●	
	S-4	Top-Pressure Recovery Turbine Plant (TRT)	KHI	F30				●					●	
	S-5	Coke Dry Quenching (CDQ)	NS Engineering	E				●		●				●
	S-6	Coal Moisture Control (CMC)	NS Engineering	E				●		●				
	S-7	Rotary Hearth Furnace (RHF)	NS Engineering	E				●		●				
	S-8	CDQ - Coke Dry Quenching Process	Steel Plantech	F26				●					●	
	S-9	Reheating Furnace with Regenerative Combustion system for Steel works	NS Engineering	E				●		●				
Petrochemicals	P-1	Tanker Vapor Recovery System (TVR)	Nippon Oil	F18				●			●			
	P-2	Bio Hydro-fined Diesel(BHD)	Nippon Oil	F18				●			●			
	P-3	Production Technology of Sulfur-free Gasoline	Nippon Oil	F18				●			●			
	P-4	Modified Sulfur Concrete	Nippon Oil	J		●								●
	P-5	Energy-Saving Urea Synthesis Process	TEC	P					●		●	●		
	P-6	High-Efficiency Ethane & LPG Recovery Process	TEC	P					●		●	●		

9-3 Proposed Technical Assistance programs to IREDA in relation to the JICA finance scheme

Based on the analysis of the Japanese practices, past donor assistances to IREDA and the interview surveys to the Donors and IREDA, the JICA study team identified following technical assistance programs could be considered as useful to facilitate the effective implementation of the JICA finance scheme.

(i) Introducing and updating the list of targeted equipments
(ii) Demand survey for potential EEC projects
(iii) Support for examining loans for EEC projects
(iv) Advisory Services for ESCO development
(v) Collaboration with CGTMSE
(vi) Awareness Campaign
(vii) CDM related activities
(viii) Environmental Rating (to be decided)

9-3-1 TA for IREDA

(1) **Applying Japanese experiences**

(a) Introducing and updating the list of targeted equipments

In Japan, the Japanese government, through the Development Bank of Japan (DBJ), has been providing policy loans with preferential interest rate for the companies' new and renewal investments for the plants and equipments, which are qualified to achieve the required level of energy-saving effects. In order to facilitate this loan, the list, which contains the information on the qualified specifications of the targeted equipments, has been shared among DBJ officers who are not necessarily having expertise in the EEC technologies, to judge the eligibility of the loan.

The list has been updated regularly, after being reviewed by the relevant government officers (e.g. Ministry of Economy, Trade and Industry), business groups which represents the equipment manufacturing companies, and other experts, so that the list could always accommodate up-to-date, and high-demanded technologies, which is in line with the Government's relevant policies (such as tax reduction policies for the equipments accommodating new EEC technology, etc). In addition to that, as the list includes the information on the energy saving effects, it is very easy for DBJ to track the energy savings effects as a whole, or, by the type of the equipments.

When JICA extended a line of credit to Small Industrial Development Bank of India (SIDBI) in November 2008, for financing energy savings investments in micro, small and medium enterprises, JICA reviewed the Japanese experience and introduced the equipment list system to the JICA scheme. The list of eligible equipment is revised by the local consultant and the latest one is uploaded in the SIDBI website (http://www.sidbi.com/energysaving.asp).

Throughout the courses of the study, the JICA study team explained the benefits of accommodating the eligible equipment list, especially for EEC sector, to IREDA. As IREDA is going to expand its business line to EEC sector and requires extensive support for enhancing EEC lending, IREDA agreed with the Team's suggestion to include the support of finalizing / updating the list of eligible equipment list which include the information on the overall energy-saving equipments and their advantages, specifications, benchmarks of energy savings (expected effects), referring to the list used by the JICA assistance to SIDBI.

(b) Environmental Rating

The JICA study team suggested IREDA to introduce the environmental rating system which

DBJ has been conducting for the companies conducting business in the field of new energy, including wind-power / biomass /solar power generation, etc, since 2004.

The purpose of conducting environmental rating is to provide preferential interest rates on financing according to clients' environmental initiatives, based on the evaluation of environmentally responsible management. The ratings for the organizations are endowed based on the answers through the interviews for the screening sheet containing 120 questions in 3 main categories[64] and 15 sub-categories[65], prepared from a neutral standpoint, based on the exchange of information with the United Nations Environment Program (UNEP) Finance Initiative and the Ministry of Environment of Japan.

IREDA shows its interest in pursuing adopting environmental rating, and currently in review internally.

(2) **Capacity development for IREDA**

The World Bank implemented 12 TA activities through the "Second Renewable Energy Project" as explained in the previous section of 9-1. Of which, the assistance for IREDA was provided in standardization of project appraisal formats; developing pre and post project monitoring and verification protocols for some of the energy intensive sectors including sugar, cement and steel sectors and marketing EE schemes.

In addition to that, the project assisted IREDA in undertaking a set of three strategic consultancy studies with aimed at developing a strategic vision and addressing some key challenges faced. The three studies were:

(i) Strategy and action plan for adapting to the changing business environment
(ii) Resource mobilization plan
(iii) Reviewing system and procedures of IREDA for its lending operations and developing a suitable action plan for organizational restructuring.

The key recommendations of the first two studies (please note that the information of the third study was not shared to the JICA study team).

[64] Including overall management, environmental consideration in specific business activities, quantitative performance
[65] Including governance, compliance, partnership, disclosure, capital investment, product development, supply chain, product recycling, GHGs, resources, water, chemical substances, etc

Table 9-M Key Recommendations and Actions taken from First Two Strategic Change Consultancy Studies (Extract)

Strategic consultancy recommendations	Actions taken by IREDA
Financing of medium and large hydropower projects (above 25MW9 under consortium financing arrangements. Financing other large renewable energy projects under consortium financing arrangement with other banks and financial institutions	- IREDA is discussing the funding of large hydropower project under co-financing arrangement with IL&FS - IREDA is funding RS 3,620 million wind power project for Tata power - IREDA is planning to explore the funding of more wind power IPP projects with some developers - IREDA is planning to finance co-generation projects with sugar cooperatives under a consortium financing approach
Form a consortium with banks and financial institutions for project financing to increase market reach and market share	- IREDA has signed a MOU with PTC India Ltd. And PTC India Financial Services. Together the three entities would provide full financial and commercial solutions to RE developers including financing, investment and power off-take. - IREDA has signed an MOU with the Power Finance Corporation (PFC) to facilitate consortium financing of RE and EE projects (especially medium and large hydropower projects) - IREDA is co-operating with Tata Power on 85.4 MW wind project along with private sector operations arm of the ADB. - IREDA has signed partnership agreement with IDFC to explore joint implementation of RE programs.
Streamline delivery processes for customer retention. For example, easier appraisal process for repeat customers - cutting down on avoidable steps and offering competitive and flexible lending terms. Regular feedback and interaction.	- Study on reviewing systems and procedures, and organizational restructuring is currently underway. - Credit risk rating system developed by CARE for rating IREDA customers and offering risk-based terms of lending has been implemented. A credit risk rating cell has also been established.

Source: Implementation Completion and Results Report, Second Renewable Energy Project, the World Bank, September 2008

The World Bank assesses the performance of their IREDA's TA program as satisfactory, with the IREDA's technical officers having strong skills, due to the high quality of supervision support by IREDA technical officers, as well as adoption of recommendations from the strategic change consultancy, which has improved IREDA's prospective in the future. For the TA for IREDA's capacity development in association with prospective JICA project, the WB proposed JICA to consider including IREDA's portfolio management to mitigate its overall risks considering IREDA's plan to uplift its threshold for the hydropower projects and active participation for the consortium finance.

ADB reckons IREDA officers are having sufficient capacity to screen the loans compare to the commercial banks. Even though ADB understands that the time for screening the loans takes much longer than the commercial banks, which is a major complaint from the customers, ADB regards this problem unavoidable considering the nature of IREDA as a governmental organization and the loan officers being understaffed. ADB expressed its expectation for JICA to provide IREDA some capacity building measures for project formulation and loan screening in the field of RE and EEC.

In April 2009, KfW published a report, titled "Report on Design of Technical Assistance", to design a comprehensive TA measures for IREDA. As a part of KfW's ongoing assistance (Sustainable Energy Program), KfW commissioned Frankfurt School of Finance and Management to prepare the report, titled "Report on Design of Technical Assistance", which contains the analysis on the present state and existing business model, processes and procedures, as well as recommendations for the design of TA for IREDA[66]. Based on the report published in April 2009, KfW suggested IREDA to consider and prioritize the TAs promptly required for IREDA. Due to the financial limitation, KfW intends to concentrate the area of support in order of IREDA's priority; however, KfW hasn't received any concrete answer yet.

In order to provide effective TA, it is considered that JICA could undertake the EEC related areas such as strengthening the capacity for examination and promotion of EEC loans, which KfW does not cover, in order to generate a synergetic effect.[67]

Considering these above analysis and suggestions, the JICA study team has discussed with IREDA on their capacity development. In the course of discussions, IREDA showed its intention to ask JICA to cover the activities relating to EEC projects, including demand survey and loan examination, financial support and risk control measures for development of ESCO, and ask KfW to strengthen IREDA's overall risk management activities.

In compliance with expected increase of the workload, IREDA has already engaged itself to ambitious plan of human resource management. Staff increase is expected to bring the total number of employees, from 112 employees as of March 2009, 121 employees as of July 2009, 135 employees as of September 2009, reaching to 175 employees as of March 2011. Appraisal related sections are allocated greatest number.

[66] Broad objectives of designing TA measures suggested by KfW are summarized as follows;
1. To improve IREDA's project risks and related aspects including early identification, monitoring, settlement or introduce remedial measures, 2. To improve upon existing "Risk Based Financing" approach and methodology, 3. To develop approaches to tap new market segments and customers groups, 4.To develop new/ improve existing financial products e.g. "Non-recourse finances", ESCO finance, 5. To integrate CDM benefits into IREDA's financing conditions, 6. To develop concept to introduce international social and environmental standards.

[67] During the meeting with the JICA study team, KfW suggested that half of JICA TA resources might be allocated to develop the eligible list of EEC equipment, and the rest should be used to strengthen the EEC related loan operation, especially, strengthening the capacity for examination and promotion of EEC loans. KfW also proposed to have a JICA expert to be stationed at IREDA in the beginning stage of the JICA facility to make the facility running effectively.

9-3-2 TA for Demand Side Management

(1) **Assistance to accelerate ESCO development**

(a) Advisory Services for ESCO development

The effective implementation of Demand Side Management (DSM) requires a partnership between ESCO and companies that are determined to save power. In India, there are several ESCO companies, however, those ESCOs face number of marketing and financial barriers, due to low consumer awareness and little penetration of the concept, which made ESCO build little track record, which results in lacking of interest by bankers to finance ESCO project. In addition to that, ESCO's potential customers are usually with weak financial conditions and little collaterals, therefore ESCO should take credit risks which commercial banks are unwilling to take.

In order to facilitate the activities of ESCO, it is advisable to have strong institutional support, enabling policies and legislations, utility driven DSM programs and incentives and rebates from the government or the regulatory bodies, as Japan experienced. In that regard, it could be considered to send a Japanese expert to engage in ESCO development activities.

(b) Collaboration with CGTMSE

In order to remove financial barriers for ESCOs, it is important to provide alternative financial measure to strengthen their financial condition. The JICA study team, therefore, contacted the Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE), to explore the possibility whether the CGTMSE could extend its guarantee to ESCOs, in addition to the SMEs which could be financed through the prospective JICA finance scheme, and shared the idea with IREDA, who is currently discussing with CGTMSE.

In order to facilitate the financial institution to extend loan to ESCO, IREDA currently requests CGTMSE to consider 1) raising the maximum cap amount, from current 65 lakh Rs to 5 crore Rs in line with the definition of SMEs by Ministry of Micro, Small and Medium Enterprises, considering IREDA's minimum lending amount (2 crore Rs), 2) raising the guarantee coverage rate to 75%, uniformly, since, under certain conditions, the current coverage ratio is only up to 50%.

As JICA may provide another technical assistance to strengthen the operating foundation of CGTMSE, it would be considered as efficient for JICA to include the reconsideration of eligibility criteria of CGTMSE, especially for its guarantee provision for ESCOs, or the projects under prospective JICA financing scheme, under its planned TA program for CGTMSE.

(2) **Awareness Campaign**

IREDA has been publishing a bimonthly Bulletin on Energy Efficiency for creating awareness about energy efficiency and conservation (EEC) in the country. A publicity campaign has been conducted through various media for corporate image building and to create awareness and market for EEC Products/Services. In addition to IREDA, there are several EEC awareness campaign activities being held nationwide for industrial sector, commercial sector, domestic sector, agriculture sector, educational institutions, and to the clusters by the government entities such as BEE together with the donors including WB/ GEF and USAID, and by some industrial associations such as PCRA and CII. However, the World Bank, through their experiences of the "Second Renewable Energy Project", pointed out that the level of existing campaign is not sufficient to create mass awareness on efficient utilization of energy and stimulate demands for the EEC related investments.

Besides the collaboration with the above-described organizations, IREDA should take account of cooperation with both UNIDO who is actively engaged in EEC promotion activities and The Association for Overseas Technical Scholarship, Japan (AOTS) who has long been offering training service to managers and engineers of developed countries including India.

UNIDO is currently conducting "Country Program of Cooperation between the Republic of India and UNIDO 2008-2012". Through this program, UNIDO targets EE and RE promotion and improvement for 12 SME clusters (1. Ceramics: Khurja, Morbi, Thangar, 2. Hand tool: Jalandhar, nagaur, Tumkur 3. Foundries: Belgaum, Coimbatore, Indore, 4. Brass: Jagadhari, Jamnagar, 5. Dairy: Gujarat). UNIDO is interested in JICA's activities on RE & EE promotion, and is willing to seek the opportunity to collaborate in the future. Cooperation with UNIDO who has a strong network with clusters will bring synergy effect to JICA and help clarify concrete sector and/or regional targets for its new loan program promotion.

Total number of Indian managers and engineers trained in the AOTS program amounts to 7,437. There are 8 associations of the alumni all over India. Among these, Chennai association is the biggest and the most active in keeping networks. AOTS in New Delhi suggested to JERI team that it could ask the Chennai association to circulate information of JICA EEC loan through its alumni network. Southern India including Chennai and Bangalore is the area where automobile companies including Nissan and its related industries have been growing rapidly and the Japanese government expresses its plan to support consolidation of industrial infrastructure there. If JICA takes Southern India as one of the important target areas and makes collaboration with AOTS, it will become a very important part of strategies for the promotion of EEC by

JICA. JICA should further develop relationship and collaboration with AOTS.

The suggested contents of the awareness campaign would be as follows:

(i) Importance of energy saving attitude and activities
(ii) Financial and other benefits of energy saving activities
(iii) Financial scheme (Introduction of JICA supported financial scheme to IREDA)
(iv) Consultation with individual companies regarding actual / potential plan of energy saving investments / activities

(3) Demand survey for potential EEC projects

Demand survey should be implemented in several methodologies. First it can be done in bottom-up approach. IREDA already has the project pipeline of its customers, which should be empowered by collaboration with other companies and organizations. Collaboration with companies strongly armed with RE and EEC technology, especially Japanease companies should be conducted. They have the list of their own current and potential customers, some of whose industries are out of IREDA's outreach, and some of which are promising projects for equipment finance and project finance for IREDA. IREDA should request those Japanese companies to share their market research result, thereafter picking up some promoters, jointly visiting the potential customers where IREDA collects project information and provides explanation of their financial products as well as free consulting of funding and investment. Collaboration with AOTS and UNIDO is also worthy of consideration, where IREDA taps those organizations' beneficiary companies, thereafter may collect project information as well. It is noteworthy that potential customers' requests such as streamlined procedure, less interst rate, less collateral, etc. should seize key for IREDA loan's marketing.

Second, in terms of drop-down approach, based on the connection with 'gateway' companies which IREDA contacted as above, some clusters and sectors should be selected for cluster-wide and sector-wide approach. At the same time IREDA's connection with regional investment promotional authority should also be mobilised. Then consultants will be consigned to conduct the study. It is important to first contact 'gateway' companies and then select clusters and sectors with great potential, in order to keep the study business-oriented.

Chapter 10 Proposal for ODA projects

10-1 Overview

On 25th of September 2009, Japanese Prime Minister Hatoyama who attended the Group of 20 financial summit in Pittsburgh told Indian counterpart Manmohan Singh that Japan is ready to offer support to India on climate change, underlining the importance of increasing efforts to counter global warming. Singh expressed his gratitude on Japan's ODA contribution to India. He also revealed hope that Japan will support proposals for massive infrastructure projects such as one linking Delhi and Mumbai, as well as projects for counter global warming. Both of them agreed to further deepen mutual partnership.

We already wrote about the hurdles, the solutions and our proposals on the new Japanese ODA Loan, based on our research and analysis in each Chapter. Here we will refer to two topics in response to the above-described Prime Minister meeting. The one is Japanese support by the collaboration between public and private sector and the other is further assistance in the area of the environmental / social safeguards and CDM.

10-2 Collaborative support by Japanese public and private sector

India expects Japan to support its critical issues such as climate change and consolidation of infrastructure in Delhi-Mumbai and Chennai-Bangalore area. These are issues that collaboration of Japanese public and private sector will bring effective assistance to India. In the case of climate change, not only cooperation among Japanese governmental organizations such as JICA, JETRO, AOTS and ECCJ but also one between these public institutions and Japanese private organizations including JASE-W and JCI (Japan Consulting Institute) will make Japanese support more useful and efficient, which will concurrently enhances Japanese presence in India.

Though each of these Japanese organizations is already involved in projects and programs in its own related areas, they don't necessarily make enough cooperation in order to increase effectiveness of their activities. Further promotion of exchange of information among them and mutual cooperation of their activities are desirable to add more values to their contributions in India. JICA could play a certain role in coordination of these Japanese stakeholders. For example, it should take a lead in introduction and formation of PPP (Public Private Partnership) type projects in the field of climate change.

10-3 Further Support in Climate Change

In the area of the environmental / social safeguards, EIA scheme is established already in India

and the attention is paid to the environment through EIA scheme in the industrial sector. However, the attention to the social aspect is not sufficient and the wind power generation and SPV power generation projects, of which the further diffusion is expected in the future, are not covered by EIA scheme. Therefore, it is reckoned that the supplementary scheme to check these items by the financial institutions is necessary. In IREDA also, the unified system for environment/social safeguards is not established. Therefore, to establish and disclose IREDA's own management scheme to pay attention to environment and society will lead to playing the social responsibility as a financial institution. In this process, the technical assistance could be applied based on the various relevant institutions in Japan.

For CDM, it can be estimated from the registered project numbers of UNFCCC that the projects are actively formulated. However, more than half of these projects are for new energy and the projects related to EEC are relatively a few. Especially, it became clear that EEC project using small scale CDM is not implemented in India.

For future development of EEC through CDM, it will be highly effective in India to establish the scheme to finance and provide technical assistance mainly to SMEs and promote EEC and reduce CO^2 in the industrial sector as a whole in addition to promotion of EEC and reduction of CO^2 in the large scale companies.

Together with the above situation, it was found out that the officer in charge of CDM in MoEF considers that the energy consumption in the building and housing is very few. Considering the economic development in India in the future, the nation wide large scale EEC projects will be promoted to certain extend, but EEC measures for the building/housing will become necessary as the economy grows. While Japanese knowledge regarding the measures for these issues could be provided, EEC measures using small scale CDM by SMEs of buildings/housings will be essential in the future. Considering these background, it is important to prepare for the international framework expected after 2013.

Indian stakeholders including IREDA strongly expect further contributions by Japan in environmental / social safeguards and CDM areas based on Japanese experience, knowledge and know-how.