MID-TERM REVIEW

Energy Efficiency in Steel Re-Rolling Mills

Government of India
United Nations Development Programme
Global Environment Facility

FINAL VERSION

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LIST OF ABBREVIATIONS

APR-PIR	Annual project report – Project Implementation Review
BEE	Bureau of Energy Efficiency
CTA	Chief Technical Adviser
CO_2	Carbon dioxide
CII	Confederation of Indian Industry
CCE	Cost of conserved energy
DEA	Department of Economic Affairs
DST	Department of Science and Technology
DSIR	Department of Scientific and Industrial Research
DPR	Detailed Project Report
DIC	Documentation and Information Cell
DEMs	Domestic Equipment Manufacturers
EMC	Energy Management Centre
ESCO	Energy Service Company
EMS	Environment management system
FIs	Financial Institutions
FR	Financial Report
GEF	Global Environment Facility
GDP	Gross Domestic Product
GHG	Greenhouse gas
IIM	Indian Institute of Metal
ICICI	ICICI Bank Ltd.
IDBI	Industrial Development Bank of India
IRP	Integrated Resource Planning
IMWG	Inter-Ministerial Working Group
IREDA	Inter-Renewable Energy Development Agency
M A&F	Manager Administration and Finance
MTPY	Million Tonnes Per Year
MEPS	Minimum Energy Performance Standards
MoEF	Ministry of Environment & Forests
MNES	Ministry of Non Conventional Energy Sources
M&E	Monitoring and Evaluation
MEC	Monitoring and Evaluation Cell
NISST	National Institute of Secondary Steel Technology
NO_x	Oxides of nitrogen
NPC	National Project Coordinator
NPD	National Project Director
NPP	National Project Personnel
SO_x	Oxides of sulphur
PCRA	Petroleum Conservation Research Association
PAC	Project Advisory Committee

PATSER	Programme Aimed at Technological Self-Reliance
PM	Particulate matter
PMC	Project Management Cell
PSC	Project Steering Committee
QOR	Quarterly Operation Report
SMEs	Small and Medium Enterprises
SMP	Standard Maintenance Practice
SOP	Standard Operating Practice
SDF	Steel Development Fund
SRRMs	Steel Re-rolling Mills
TA	Technical Assistance
TIRFAC	Technology Information Resource and Facilitation Centre
TP	Technology Package
TPF	Third Party Financing
ToR	Terms of Reference
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
US$	United States dollar

Note:

1 US$ = 40 Indian Rupees (2007)
1 lakh = 100,000
1 crore = 10,000,000

EXECUTIVE SUMMARY

Steel re-rolling is one of the most important segments of the steel industry, as it constitutes an unavoidable link in the total supply chain of iron and steel. The secondary steel production constitutes approximately 57% of the total steel production in India. It mainly takes place in steel re-rolling mills (SRRM) that usually are family-run small and medium enterprises (SMEs) with 75% of units in the small scale**.** The SRRM sector is comprised of about 1,200 (working) re-rolling mills. The SRRM sector grew with 6% annually during 1997-2002. With no major large steel plant additions planned in the near future, the share of secondary is expected to grow in the near future, also because the sector has some competitive edge due to flexibility in production for meeting low-tonnage requirements in various grades, shapes and sizes to serve niche markets.

Direct energy use in the SRRM sector includes heating fuels and electric energy. Indirect energy use is accounted by the use of energy-intensive raw materials. The SRRM units are characterised by the use of outdated and low-investment technologies and practices. In general, there is low awareness about energy efficiency and many companies lack the in-house engineering and technical manpower to absorb energy-efficiency measures in their process and to operate high-end technologies. There is lack of experience in accessing external funds, while financial institutions are reluctant to lend for 'new' energy-efficient technology. Few manufacturers provide energy-efficient equipment suitable for the smaller SRRMs and have ignored the need for customised information. The small SRRMs have not been actively supported so far by the Ministry of Steel or other institutional services. There is insufficient institutional capacity at the national, regional and local level and lack of business support networks that can promote the implementation of energy efficiency.

The above-mentioned barriers hamper the widespread application of energy-efficient technologies and practices. In order to lower some of these barriers, the United Nations Development Programme (UNDP) launched a technical assistance project with the Ministry of Steel, called 'Removal of Barriers to Energy Efficiency Improvement in the Steel Re-Rolling Mill Sector in India'. The project has a contribution from the Global Environment Facility (GEF) of US$ 6.75 million and a Government contribution (through the Ministry's Steel Development Fund) of US$ 7.28 million. It is expected that private sector will raise funds for energy-efficient investments.

The Project Document mentions the following seven programme outcomes:

1) *Establishment of benchmarks* for energy-efficient and/or environmentally friendly technology packages, called 'EcoTech Options & Packages' by reviewing the techno-economic and commercial status of the EcoTech packages and development of labels, standards and benchmarks for equipment, devices and processes used in the SRRMs;
2) *Strengthening of institutional arrangements* for long-term sustainability of the project objectives has been built in to the project design. This includes improved utilization of existing institutions, facilities and resource persons as well as development of business and commercial networks (business support system) and encouraging cooperative procurement of technologies and services;
3) *Effective information dissemination* by means of establishment of a database on current and new development in technology, their sources and investment requirements, projects in progress, market trends, resource personnel as well as the development of communication channels including web based EE- Net for information dissemination on technology markets, funding schemes;

4) *Enhanced stakeholders' capacity*, including assessment of capacity building needs of major stakeholders to facilitate implementation and absorption of advanced EE technologies in the SRRM sector (mapping of clusters) as well as developing and implementing a capacity building strategy;
5) *Establishing technical and financial feasibility of EcoTech options and technology packages.* The technology packages would be demonstrated in 30 sample units spread across 5- geographical clusters to demonstrate techno-economic viability.
6) *Innovative financing mechanism such as ESCOs* would be introduced for the first time in the industry that has a high risk-perception and development of 'investment portfolios' with the banks is envisaged;
7) A self-sustained *Technology Information Resource and Facilitation Centre (TIRFAC)* would be set up that would continue to provide various technical assistance services to the SMEs in the post- project period. TIRFAC would consist of two components, namely a Software Centre and a Hardware Centre.

The above-mentioned *programme components* are supplemented by an *investment component* (outcome 8) which would involve the development of 30 representative SRRM units as model for demonstration of the EcoTech options and technology packages. The financing for this component, valued at US$ 5.54 million, will not come from GEF but mainly through the industry's own resources supported by loans form commercial banks.

Project activities were initiated in September 2004. Setting up the PMC was completed by December 2004, while the TIRFAC Software Centre was set up. In line with UNDP guidelines, a mid-term evaluation (MTE) should take place halfway project implementation to examine its progress and achievements and provide recommendations on improving the project's performance where needed. Therefore, it was decided to field an evaluation mission to India. The valuation, by an independent international and national consultant, took place in June-July 2007. During the mission discussions were held with several key stakeholders. Also, a number of steel re-rolling mills around Mandi Gobindgarh were visited, enabling discussion with the beneficiaries of the project. This report is the output of the mid-term evaluation exercise.

Regarding **key accomplishments** of the project, the Evaluation Team notices that the project has been successful in creating awareness and by providing capacity building by holding workshops and technical trainings as well as some study tours (*Outcome 4*). The Evaluation Team feels that the project has achieved an increased awareness amongst SRRM units, although not equally in all Cluster areas. Progress regarding *Outcomes 7* and *Outcome 3* is halfway at the time of the Evaluation Team's mission. The TIRFAC Software Centre was set up (by December 2005) and the Centre's Information and Knowledge unit is just being set up, while the project's Newsletter has only recently been published (May 2007).

On the other hand, under *Outcomes 1* (benchmarks) and *Outcome 6* (ESCOs and financing) no notable progress has been made. Under *Outcome 2* (institutional arrangements), some networking has been taken place with organizations that work in the technology area, notably with technological institutes in India and China, but less so with organizations in the commercial sphere, i.e. private sector associations, domestic equipment manufacturers, consultants and banks.

Investments in fuel consumption and process improvements by the SRRM units are the real indicator for *outcome 5* (technical and financial feasibility) and the *investment component.* Unfortunately, while the project document aims at having investments in 20 out of 30 sample

units, only nine units have been supported so far and only a few units are contemplating investments.

The budget expenditures reflect the slow rate of implementation; of the combined GEF and Ministry of Steel co-financing, only 11% has been spent.

Regarding project design and project execution, the Evaluation Team has the following **observations**:

Project design

- The project seems *over-budgeted.* On the positive side, the Evaluation Team acknowledges that the Government contribution is real cash money (unlike other GEF projects where the national contribution usually is in-kind or when cash it is no new money, but already budgeted or provided by other donors). Nonetheless, a budget total of about US$ 14 million seems too much money for technical assistance activities only.

- The project document does not provide any approach for *sustained regulatory and policy framework* for the project that could include policy instruments, such as fiscal incentives, carbon tax, subsidies, excise duty & custom duty exemption. In general, no proper sustainability and replicability plan has been prepared in the design document.

- The Evaluation Team has serious doubts about the feasibility of two project outcomes:
  - *ESCOs.* The concept of performance contracting does not seem to be applicable to the SRRM sector for a number of reasons explained in the main text.
  - *TIRFAC Hardware Centre.* Installation of the Hardware Centre seems to be quite ambitious programme. At this juncture going for investment (as part of the co-financing) for installation of demonstration unit at NISST for making the demonstration unit operational will be a challenging task. The sustainability issue of the project raises some questions. As this demonstration unit is not coming with a mill, the Evaluation Team asks itself what will happen to the end products ? How are the funds to be arranged for operation and maintenance of units as well as for the raw materials and manpower needed? The evaluation team has the opinion that the necessity of the Hardware Centre should be reconsidered and if felt essential, demonstration units may be installed with the collaboration of existing organization like CSIR Lab, IITs etc. Alternatively, this fund can also be gainfully utilised in implementation of energy efficient technologies in additional 40-45 model units, providing wider coverage of model units.

Project management and implementation

- With a large PMC as well as TIRFAC Software Centre being based in Delhi, project management seems quite top-heavy, with no permanently based staff in the Cluster areas, while the role of Resident Missions has been limited so far. This centralised structure hinders the effective outreach to the SRRMs in the various States of India.

- Regarding provision of technical assistance to the SRR sector, the PMC has followed a step-by-step approach in which a few units are approached and assisted. However, the commercial viability of EcoTech options and energy efficient technical packages is to be proved in the sector on a *visible scale* to improve the confidence level of investors. This is a 'critical' factor in widespread adoption of EE technologies especially when some technologies proposed under the project are new to the investor in the sector or first time

in the country. Clearly, the batch-wise approach by the PMC to convince the SRRM units has not been working. Many more units need to be more approached in parallel.

Sustainability and replicability.

- The sustainability will depend on the ability of the project to create a niche market for energy-efficient investments in the SRRM sector by bringing together industry associations, technology providers, domestic and international experts, government agencies and financial organizations (for marketing and dissemination of these technologies and development of financial mechanisms). However, such a business network, needed for longer-term sustainability, has not emerged yet.

- Technology information resource services and optimum solution design support will be provided by the TIRFAC Software Centre. At this point in time, however, it is not yet clear how the activities of TIRFAC will be sustained after the project's life.

- Some SRRMs are adopting EcoTech technologies even without the project's support. This proves that certain energy efficiency improvements have a replication potential in these times of rising fuel prices, but the project should put much more emphasis in creating awareness across the length and breadth of the country as part of an effective strategy for securing large-scale replication.

The Evaluation team feels therefore that the current *top-down*, *batch-wise* way of implementing activities and *technology-oriented* approach in implementing the project activities has to change towards a more *decentralised*, *parallel-wise* and *demand-oriented* approach for the project to become successful.

Important **recommendations** coming out of the evaluation study are:

Project management should be 'lean and mean'

- The PMC should be less top-heavy with, for example, having more staff based at the Resident Mission instead of sitting in Delhi. These regionally based staff should have the technical knowledge about the SRRM sector, but also have a commercial orientation to be able to convince the SRRM owners to effect energy-efficient investments

- The PMC should not act too much as consultant itself, but play more of a facilitating role by bringing together the various stakeholders (SRRM units, technology providers, consultants, technology institutions, consultants, banks, national and local authorities) at the national as well as regional (Cluster) level

- Similarly, the project has two committees, the Steering (PSC) and Advisory Committee. (PAC). In the same spirit of decentralisation, more 'advice' should be at the cluster level by setting up regional PACs, while at the national level, the 'decision-making' function of the PSC should be strengthened by adopting a culture of 'taking bold decisions' to speed up the project's implementation.

- A business plan should be formulated for the TIRFAC Software Centre, in particular looking at the sustainability of its operations after the project's end.

Project activities

- The mapping of clusters (assessment of technology, such as furnace type, production capacity, end products as well as current practices, needs and technological options) should be finalised as soon as possible, to be followed by updating the roster of technology providers, consultants and resource persons as well as by performing technology-wise benchmarking for each cluster. This mapping should include the establishment of a firm baseline of energy consumption and corresponding CO_2 emissions in the SRRM sector so that progress and project results can be monitored.

- Regarding technologies, a step-wise package of technology should be promoted, i.e. starting first with the 'low-hanging fruits' (low-cost technologies) such as good maintenance and operating practices and realising improvements in the existing furnace (better refractive lining, putting in automation and control system, etc.). As a next step, it can be considered the whole furnace can be replaced by a new more efficient pusher-type furnace with a recuperator (see Text Box 1 for a description of technologies). More expensive state-of-the-art technology packages (regenerative burners and walking beam furnaces) could be considered for the larger SRRM units. .Another option is switching to pulverised coal and coal gasification.

- SRRM units usually have good partnerships with the local suppliers of furnaces. It is suggested that local manufacturers should be encouraged to produce good quality equipment and the project should provide training and technology support to the domestic equipment manufacturers. Here, the opportunities could be investigated for cost reduction by local manufacturing (e.g., gasifiers) and, if not available locally, of developing capacity for local manufacturing.

- A massive campaign should be organised aiming at all the 1,200 SRRM units in the country by providing them with information about the project objectives and technical assistance services and financial incentives (such as the new support scheme of Rs. 30 lakhs or 25% of capital cost, whatever amount is higher). While it is good to aim at supporting at least pre-selected 30 model unit, let in a parallel approach support also (1) SRRMs that are not model units but have already implemented some energy efficiency improvements and showcase them as model unit if they want to, (2) support any SRRM that needs technical and/or financial support from the project.

- Some funds of the capacity building component may be used for providing special courses on operation and maintenance of 'new' technologies (at the technological institutes or polytechnics in each Cluster area). There is also a strong need for training of the supervisors working in the field of furnace operation, mill operation and maintenance activities; such training could be done in cooperation with the large steel manufacturing companies.

- Apparently, the ESCO concept will not work in the SRRM sector in India. A small study can be done on the potential of ESCOs, but if not favourable, the whole ESCO component could be dropped from the project and the associated GEF and co-financing funds used for other purposes.

- The Evaluation Team feels that there is need for serious review of the proposed Hardware Centre. This will need lot of effort for commissioning of such unit and financing its operation and its maintenance after the project's end. Instead, the SRRM companies can be used to showcase technology to their peers. Technology can be transferred, adapted or

developed in cooperation with domestic equipment manufacturers. If there is some need for funds to support research and demonstration (for adapting technology to the small production capacities of the SDRRM sector), this should be done in cooperation with existing self-sustaining technology institutes.

- Regarding replicability, the project's support scheme (Rs. 30 lakh or 25% of capital cost) would end with the project. In order to reach most of the 1,200 units, the Evaluation Team suggest looking into the option of establishing post-project financing schemes, such as a revolving fund for guarantees and/or soft funding with national funds at a reputed financial institution.

- Given the fact that most of the project's funds have not been used so far and that even more funds would become available by cancelling or reducing the ESCO and TIRFAC Hardware Centre components, we suggest that the project supports setting up such new schemes as well as by boosting the existing '30 lakh support' scheme and that such schemes are promoted as part of the massive promotion campaign

- The possibility may also be explored to provide relaxation in custom & excise duty for equipment, spares, instrumentation related to energy efficiency improvement in SRMM and related pollution control equipment or other fiscal incentives. Regarding coal, it should be studied if higher-grade coal can be provided by the coal suppliers. Such a policy formulation / fiscal incentives component has not been included in the project's design, but some activities in this respect should be considered to be included.

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1. INTRODUCTION

1.1 Background

The energy linkages to environment are widely known through the global warming and associated impacts of climate change. India is currently world's seventh-largest consumer of energy, sixth-largest source of greenhouse gas (GHG) emissions and second-fastest growing source of GHG emissions. The emissions are expected to grow at a rate of 5% between 1990 and 2010. However, per capita energy consumption and emissions have remained relatively low. The low per capita emissions (0.3 tonnes of carbon per person) are due to the large population. The industrial sector accounts for over 50% of the total emissions, which is likely to grow five-fold by 2020. Out of the total energy consumption in industrial sector of India, approximately 65% is attributed to the most energy intensive industries, namely fertilizer, iron and steel, aluminium, cement, paper and pulp and that can be regarded as major consumers of energy and contributors to GHGs. The Government has introduced various energy policies and measures with active participation of these industries, including steel. However, the interventions by the Ministry of Steel have mostly been limited to the large-scale integrated steel plants

Steel re-rolling is one of the most important segments of the steel industry, as it constitutes an unavoidable link in the total supply chain of iron and steel. The secondary steel production constitutes approximately 57% of the total steel production in India. It mainly takes place in steel re-rolling mills (SRRM) that usually are family-run small and medium enterprises (SMEs) with 75% of units in the small scale**.** According to comprehensive Survey on "Steel Rerolling Industry", carried out by the Organization of Development Commissioner of Iron & Steel (DCI&S), the SRRM sector is comprised of 1,200 (working) re-rolling mills. The SRRM sector grew with almost 5% annually during 1966-1996 and with 6% annually during 1997-2002. With no major large steel plant additions planned in the near future, the share of secondary is expected to grow in the near future, also because the sector has some competitive edge due to flexibility in production for meeting low-tonnage requirements in various grades, shapes and sizes to serve niche markets.

Direct energy use in the SRRM sector includes heating fuels (furnace oil, coal or, where available, natural gas) and electric energy. Indirect energy use is accounted by the use of energy-intensive raw materials. The energy cost in the SRRMs is estimated at 15-25% of overall production cost. The SRRM units are characterised by the use of outdated and low-investment technologies and practices. In general, there is low awareness about energy efficiency and many companies lack the in-house engineering and technical manpower to absorb energy-efficiency measures in their process and to operate high-end technologies. The cyclic nature of steel industry has forced SMEs to look for short-term objectives rather than long-term energy efficiency solutions.

Investments in SRRMs are largely financed with their own funds. There is lack of experience in accessing external funds and going through the paperwork needed for loan applications, while financial institutions are reluctant to lend for 'new' energy-efficient technology.

The deployment of energy efficient technologies in the sector is furthermore hampered by large variation in inputs and product-mix and their small capacities. Few manufacturers

provide energy-efficient equipment suitable for the smaller SRRMs and have ignored the need for customised information.

Up to now, these small SRRMs had not been actively supported so far by the Ministry of Steel or other institutional services. There is insufficient institutional capacity at the national, regional and local level and lack of business support networks that can promote the implementation of energy efficiency.

The above-mentioned barriers hamper the widespread application of energy-efficient technologies and practices. Therefore, the Ministry of Steel wanted to initiate a programme to address the viability of energy efficiency improvements. Assistance was sought from UNDP to support such a programme. Its primary objective would be to facilitate removal of barriers to energy efficiency and energy conservation in this sector and thus reduce greenhouse gas (GHG) emissions. The project would seek to

UNDP assists the Government of India through a range of technical assistance programmes to provide inputs to national policies and strategies for promoting environmentally sustainable solutions. These programmes include clean technology demonstration, supporting the development of national strategies and action plans, and the strengthening of national and regional institutions. UNDP is one of the implementing agencies for the Global Environment Facility (GEF) which makes funding available for climate change mitigation and adaptation, biodiversity, land degradation and other global environmental problems

During the project's preparation phase (supported with GEF PDF B funds), the project has conducted a comprehensive survey of 90 units (selected from different geographical areas) to identify the potential for energy efficiency improvements. A set of "EcoTech options" were identified in the area of combustion and in the area of the rolling mills and electrics. One aim of the project also is to try out and establish the commercial viability of the EcoTech options on a visible scale to improve the confidence level of investors in this conservative, but competitive, business sector. A summary of important energy efficiency options in the SRRM sector is given in Text Box 1.

1.2 Project objectives and strategy

The project 'Removal of Barriers to Energy Efficiency Improvements in the Steel Re-Rolling Mill Sector in India' was presented to the GEF Secretariat and approved by the GEF Council in May 2003. The project has a contribution from the Global Environment Facility (GEF) of US$ 6.75 million and a Government contribution (through the Ministry's Steel Development Fund) of US$ 7.28 million. It is expected that private sector will raise funds for energy-efficient investments, valued at US$ 5.54 million, while the Ministry of Environment and Forest is expected to contribute US$ 1 million[1].

This project **goal** (environmental objective) is to increase end - use energy efficiency of SRRM sector and to reduce associated emissions of greenhouse gases (GHG).

The project's **objective** is to accelerate the penetration of environmentally sustainable energy efficient technologies, ultimately leading to large-scale commercialization of energy-efficient technologies and practices in the sector.

[1] In addition, the project document mentions leveraged financing by government agencies (IREDA, PATSER, Technology Development Board) of US$ 5.52 million and financial institutions (SIDBI, EcoFund of ICICI) and commercial banks of US$ 5.77 million.

Major thrust of the project is on promotion of sustainable and viable energy efficient (EE) technologies in a market-driven manner. This would be achieved through reduction of transaction cost of EE technologies, opening up innovative channels for financing of EE investments in the SRRM units, development of human resources at local, regional and national level, facilitating communication among institutions and assistance to SMEs in the sector to develop market - based bankable energy efficiency projects.

The expected seven **outcomes** of the projects are:

1) *Establishment of benchmarks* for energy-efficient and/or environmentally friendly technology packages, called 'EcoTech Options & Packages' by reviewing the techno-economic and commercial status of the EcoTech packages and development of labels, standards and benchmarks for equipment, devices and processes used in the SRRMs;
2) *Strengthening of institutional arrangements* for long-term sustainability of the project objectives has been built in to the project design. This includes improved utilization of existing institutions, facilities and resource persons as well as development of business and commercial networks (business support system) and encouraging cooperative procurement of technologies and services;
3) *Effective information dissemination* by means of establishment of a database on current and new development in technology, their sources and investment requirements, projects in progress, market trends, resource personnel as well as the development of communication channels including web based EE- Net for information dissemination on technology markets, funding schemes;
4) *Enhanced stakeholders' capacity,* including assessment of capacity building needs of major stakeholders to facilitate implementation and absorption of advanced EE technologies in the SRRM sector (mapping of clusters) as well as developing and implementing a capacity building strategy;
5) *Establishing technical and financial feasibility of EcoTech options and technology packages.* The technology packages would be demonstrated in 30 sample units spread across 5- geographical clusters to demonstrate techno-economic viability.
6) *Innovative financing mechanism such as ESCOs* would be introduced for the first time in the industry that has a high risk-perception and development of 'investment portfolios' with the banks is envisaged;
7) A self-sustained *Technology Information Resource and Facilitation Centre (TIRFAC)* would be set up that would continue to provide various technical assistance services to the SMEs in the post- project period. TIRFAC would consist of two components, namely a Software Centre and a Hardware Centre.

The above-mentioned *programme components* are supplemented by an *investment component* (outcome 8) which would involve the development of 30 representative SRRM units as model for demonstration of the EcoTech options and technology packages. The financing for this component will not come from GEF but mainly through the industry's own resources supported by loans form commercial banks. The introduction of risk-guarantee scheme on a limited scale is envisaged as well. The model units have been selected based on techno-economic criteria and in proportion to the distribution pattern of the industry in five geographical clusters. These units provide a platform for validation of technology packages and assumptions made in context of investments, returns and paybacks. It would facilitate establishment of techno-economic feasibility of the packages and EcoTech options. These select units would also assist PMC in the process of benchmarking and capacity building through development of 'best practices', standard operating and maintenance practices as well as field training of energy managers, etc. The investment component also includes strengthening the manufacturing base for EE devices through financial and technical support to domestic equipment manufactures (DEMs).

Box 1 Energy-efficient technologies (EcoTech options) in the SRRM sector

Steel re-heating and rolling to finished shape is an energy-intensive process. The SRRM uses age-old pusher-type furnaces that used to be coal-fired. There is a wide variety of designs. A majority of re-heating furnaces in the SRRM sector now use fuel oil, because in case of lump coal fired systems control of furnace temperature is difficult to achieve, while the process requires uniform temperature distribution within the heating furnace. Also, the scale loss in material is quite high, around 2-4%. Fuel consumption is in the range of 42-45 litres per tonne and scale loss is around 2-2.5% (i.e., 2-2.5 kg of material per tonne of output).

Standardising operating and management practices is a first low-cost step for energy efficiency by reducing delays in the steel re-rolling process. Major energy saving measures in the furnace includes:

- Installation of high-efficiency *recuperators.* In pusher-type furnaces the air is heated to about 350-550 ^{o}C. The major part of energy loss from any furnace is through waste gases. The recuperator allows recovery of the heat from the gas for pre-heating the air in the furnaces and thus fuel savings of about 15% (of 6 litres per tonne of product) can be obtained. Investment cost are about Rs. 8 lakh;
- *Automatic controls* of the furnace zone temperature and furnace pressure will reduce fuel consumption and give better rolling and running time. Using oxygen sensor and microprocessor-based technology, some 5-10% fuel savings (3-4 litres per tonne) can be achieved. Investment cost is about Rs. 20 lakh.;
- Change of the *furnace lining*, ceramic fibre veneering, and high emissive coating provide additional fuel savings. This will cost some Rs. 9.5-10.5 lakh, leading to savings of 2.5-3.5 litres per tonne.

Thus, *revamping and modernization of existing pusher furnaces* will cost around Rs. 20 lakh, energy savings in the order of (4-5 litres of fuel per tonne and has a payback period of 5 months. Furthermore, reduction in scale loss is 0.5%. Older furnaces could be replaced completely with a *new energy-efficient pusher furnace*, which will cost around Rs. 120-145 lakhs with annual energy savings in the order of 127-192 lakhs, thus the payback period is 1.2-1.5 years. Fuel savings are around 6 litres per tonne and scale loss reduction of 1-1.5%.

With the prices of petroleum products, including furnace oil, hiking over the past years, many SRRM units are interested in having *more efficient oil burners* that will cost Rs. 5.5 lakh and lead to oil savings of 2 litres per tonne. Applying *variable drives* in the fuel oil pumps lead to savings in electricity of about 0.75 kWh per tonne and scale reduction of 2 kg per tonne at an investment cost of Rs. 10 lakh.

In areas were natural gas is not available as an alternative, other SRRMs want to switch to clean coal technologies, i.e. *pulverised coal firing or coal gasification*. A producer gas furnace will cost Rs. 40-70 lakh with a payback period of about 1 year and 2 month, because of reduced coal consumption (50 kg per tonne of output) and scale loss of about 5 kg per tonne of output.

Walking hearth (for stock thickness of up to 200 mm) and walking beam-type furnaces (if exceeding 200 mm and for capacity requirements higher than 50 t/hr) have distinct advantages over the pusher-type furnaces in that these top and bottom-fired (pusher-type furnaces are usually top-fired) and can handle a wide variety of billets of different length, width and thickness. Total investment cost is higher, about 200-250 lakhs (for capacity up to 20 t/hr), but fuel savings are higher also. Fuel consumption will be about 30-32 litres per hour and scale loss will be 0.6-0.8%. In a walking hearth furnace combustion air is heated to 650^{o}C. More energy (25%. i.e., 8.5 litres per hour) can be saved if the billets and ingots can be charged into the furnace in hot condition and this also increase furnace productivity with 15%. The cost a thermally insulated storage facility and handling crane, etc. will be around Rs. 40 lakhs.

In addition to these combustion EcoTech options, the efficiency of the rolling mills itself can be improved, by applying crop length optimization (improving roller guides, spindles and couplings, installation of roller and tilting tables) and antifriction roller bearings and using computerised roll pass design as well as by using energy efficient motors. Payback period is around half a year.

1.3 Evaluation methodology and structure of the report

The project started in 2004 and is planned to end by mid-2008. In accordance with regulations of the UN Development Programme (UNDP) and the Global Environment Facility (GEF), a Mid-Term Evaluation (MTE) has to be carried out under the responsibility of the implementing agency, i.e. UNDP, of which the results are presented in this report. The purpose of the evaluation is to analyse and assess the achievements and progress made, identify factors that have facilitated or impeded the achievement of outcomes and the effectiveness, efficiency, relevance, impact and sustainability of the project. The evaluation is expected to result in recommendations for the remaining period of the project as well as lessons learned and recommendations in general.

During the mission, the external evaluation mission drew up a table of contents that covers the issues to be addressed as mentioned in its Terms of Reference (see Annex A) and follows the structure of this report:

- Introduction (project description and evaluation method)
- Findings on project progress
  - Project's performance in terms of results (achieving objectives and outputs by means of realised activities and inputs used) and impacts, quantitatively and qualitatively measured by indicators (as set in the project document and the annual project review documents)
  - Description of project impacts
  - Evaluation Team's assessment of the project design and execution
- Conclusions and recommendations
  - Conclusions taken into account sustainability and replicability issues
  - Lessons learned and recommendations

The mission team, consisting of two independent evaluators, Mr. Jan van den Akker (Owner and Senior Consultant, ASCENDIS, Netherlands) and Mr. Rajesh Kumar Singh (Senior Manager, Bhilai Steel Plant, SAIL) were fielded to India from 25th June'07 to 5th July'07 to undertake the MTE. During the mission, extensive discussions were held with representatives from UNDP India, Ministry of Steel (MoS), Project Management Cell (PMC), model unit owners, equipment suppliers other stakeholders.

The Evaluation Team adopted the following methodology of evaluation:

i) Review of project reports (project documents, project operation manual, project monitoring and evaluation manual, technical feasibility reports, bankable feasibility reports, APR-PIRs (annual project implementation reviews), audit reports, minutes of meeting of the Steering and Advisory Committees) as well as other background information .

ii) Meetings with the main project partners and stakeholders in India at national level (Ministry of Steel, PMC Office, UNDP Office), Cluster Level (model units, NISST officials), equipment suppliers, consultants etc..

The report is divided into four sections. This first section provides general background of the project, purpose of evaluation, project implementation setup, partners/stakeholders and evaluation methodology. The next section dwells on findings from the reports and from interactions with stakeholders. These findings are described within the logical framework design of the project, as given in the Project Document. In the third section, conclusions from the observations and findings are discussed in the context of project objectives. These also pertain to sustainability and replicability of project and lessons learnt. The fourth section also generic recommendations for the further direction of the Project.

1.4 Project set-up and project partners

The Ministry of Steel (MoS) is the project executing agency according to the national execution (NEX) modality. The UNDP Country Office in Delhi carries out project implementation oversight. The management structure of the project is depicted in Figure 1.

The *Project Steering Committee (PSC)* is the highest-level body, headed by the Secretary, Ministry of Steel as Chairperson. The members of the committee drawn from various cross-sectoral ministries, such as the Ministry of Finance, Ministry of Power, Bureau of Energy Efficiency (BEE), Ministry of Coal, Planning Commission, Ministry of Petroleum and Natural Gas, Ministry of Non Conventional Energy Sources (MNES), Ministry of Environment & Forests (MoEF), Department of Science and Technology (DST), Department of Scientific and Industrial Research (DSIR), and UNDP. The PSC is to provide guidance and support to the project as well as to monitor its progress. It sets policy guidelines and approves the annual budget and work plan. It also evaluates and approves changes or plans recommended by the Project Advisory Committee. Another important function is to select the National Project Director (NPD) from MoS and to designate his power.

The *Project Advisory Committee (PAC)* is a subcommittee of the PSC focussing on project implementation. The PAC is headed by the NPD and includes members from the Ministry of Steel, technical experts from Consultancy organizations, large public and private sector steel plants, R&D institutions, Technology Development Board, Programme Aimed at Technological Self Reliance (PATSAR), IREDA, SIDBI, ICICI, representatives of industry associations, and state government officials. The PAC includes a core group of 6 members with the right to include additional members if and when necessary. It can set up specialised task forces, subcommittees, etc. Tasks include interactions with the various stakeholders,; periodic monitoring of project implementation; advising on technical, commercial and project management issues; formation of subcommittees and task forces for the appointment of experts, project personnel, awarding of subcontracts, setting functional guidelines and milestones for the project's activities, recommend annual work plan and budget.

The PAC has established three subcommittees, namely the (1) Appointments Committee (engaged in the selection of project personnel and domestic and international experts), the (2) Technical Committee (reviewing issues regarding the EcoTech options, technology options and benchmarking, technology sourcing and TIRFAC) and the (3) Procurement, Contracts and Commercial Committee (dealing with the procurement of equipment, services, allocation of subcontracts and assignments to experts).

The MoS nominates a senior official (not below the rank of Joint Secretary) from MoS as the *National Project Director (NPD)*, who also acts as the Member Secretary of the PSC. The NPD oversees overall project implementation, provides guidance for project implementation and facilitates approvals of co-financing (Government, GoI) funds. He/she is empowered to revise the allocation of powers to project functionaries as per GoI and UNDP norms and is responsible for providing information and inputs to PSC and for organizing PSC meetings.

The *National Project Coordinator (NPC)* heads the Project Management Cell (PMC). He/she is supported by about 14 experts and staff at PMC and TIRFAC. The NPC is directly involved in overseeing the PMC and responsible for project implementation, procuring goods and services, selecting experts and consultants, signing Memoranda of Understanding (MoUs) with organisations for technical support; coordination with all stakeholders and for managing the funfs received from UNDP/GEF and Ministry of Steel (through its Steel Development Fund) as well as for periodic reporting (to PSC, PAC and progress reports).

Figure 1 Project implementation structure

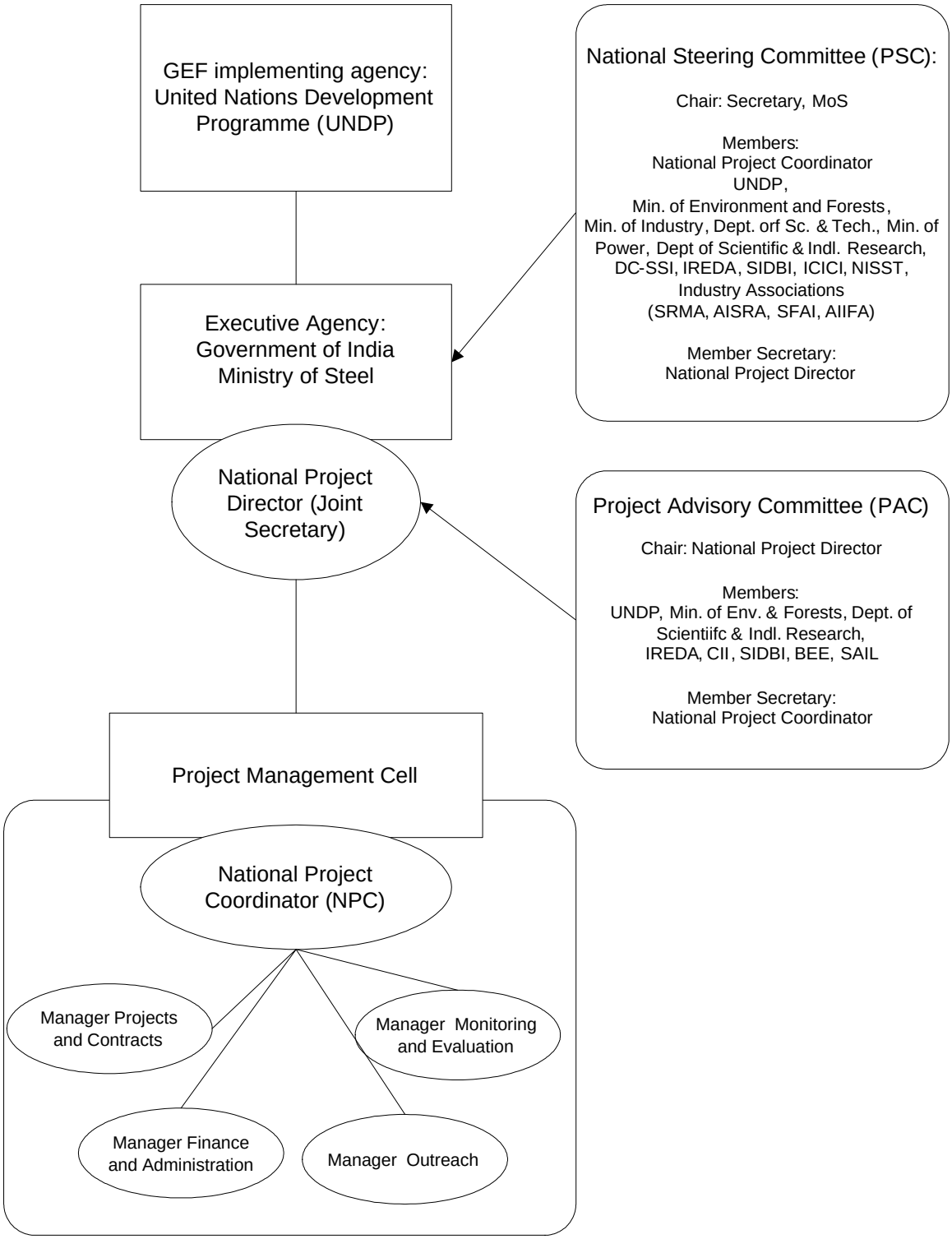

Figure 2 Geographical clusters of the Steel Re-Rolling Project

Clusters and states covered:

Mandi Gobindgarh (Punjab, J&K, Himachal Pradesh
Kolkata (West bengal, Orrissa, Andhra Pradesh, Jharkhand, Bihar)
Nagpur (Chattisgarh, Maharashtra, Gujarat, Andhra Pradesh)
Chennai (Kerala, Karnataka, Pondicherry, Tamil Nadu)
Delhi (Delhi, Uttar Pradesh, Rajasthan, Haryana)

Resident missions in Chennai and Delhi to be established

The project will be implemented in 13 states, as indicated in Figure 2. *Resident Missions* will be set up that will be the principal representative of the PMC in each Cluster area. Main functions are networking with all stakeholders in the Cluster (such as Pollution Control Boards, energy and utility suppliers, academic and R&D institutions, industry associations, equipment manufacturers, consultants and service providers) and to solicit their involvement in the project's activities. The Missions will also assist in the assessment of technology status and capacity building needs (cluster mapping).

2. FINDINGS

Implementation: assessment of achievement of outcomes and outputs

For each of the three outcomes, as mentioned in paragraph 1.2, this section assesses the progress in the implementation of the project's outcomes and outputs, following the format as given in the 'strategic results framework' of the UNDP Project Document.

2.4.1 Outcome 1 Benchmarks for EcoTech Options and Packages established

Table 1 Outputs, indicators and budget of outcome 1

Outputs	**Indicators**
1.1 Energy and environment labels, standards, and benchmarks including investment norms of EE options and technology packages developed.	• Industry complies with energy-cum-environment performance norms bench marked against 'best-practice' norms achieved in respect of similar technologies in India or abroad* and validated through actual performance of EMUs after one year of their stabilization. • Techno-economic viability including cost recovery (CCE, IRR, Payback, BEP, etc.) is established. • Energy labels and standards developed by end of third year. • Information modules (1c) developed and disseminated by the end of 18 months of the start of the project.
1.2 Standardized methods and tools for design, engineering and implementation of Ecotech solutions in the SRRM sector designed.	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
315	69	0	0

Outputs 1.1 and 1.2

All activities are still pending. One reason given for the delay is that the Steel Re-Rolling Mills (SRRM) sector in India is quite unique in the world, consisting of family-run small-sized enterprises that use outdated and low-investment technologies (as mentioned in the Introduction). Only China and maybe some other countries in the world have these type of secondary steel enterprises. Therefore benchmarking against steel industry abroad is not possible as most countries will only have larger and more capital-intensive steel plants.

Pending

It has been proposed that benchmarking for EcoTech options are established after the assessment and cluster mapping of technology resource and capacity building needs has been carried out. The following activities need to be undertaken then:

- Review report on techno-economical status of energy-efficient and clean technologies used in the SRRM sector;
- Based on the performance of the 30 model units (see Outcome 5 and 8), set benchmarks and standards for equipment and devices used in the steel industry, demonstrate techno-

* duly adjusted to input/output and other related conditions of operations (scale of operation, etc)

economic viability, develop minimum energy performance standards (MEPS) and design manuals and best practice norms;

- Development of energy labels, standards[2] and tools for design engineering and implementation of EcoTech solutions;
- Preparation of information modules and technology manuals for financing institutions, government and policy makers, and industry partners.

2.4.2 Outcome 2 Strengthened institutional arrangements

Table 2 Outputs, indicators and budget of outcome 2

Outputs	**Indicators**
2.1 Networks of association of private and public institutions and companies, bilateral and multilateral organizations, financial institutions providing technical, financial and market inputs	• Job contracted to specialist agency/organization, preferably, international with sufficient experience in the line. Completed successfully by the end of 3rd year. Job as includes establishment of business support networks and development of internationally linked institutional capacity. • Hardware facilities namely prototype development, technology testing and calibration along with software facilities put in operation by the end of 3rd year. • Design, standards and implementation manuals put in practice during the same period.
2.2 Business networks through self-financed association of multi-disciplinary experts including successful entrepreneurs	
2.3 International institutional arrangements to facilitate technology transfer	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
427	67	2	7

Outputs 2.1, 2.2 and 2.3

Resident Missions have been established in three out of the five geographical clusters, namely Mandi Gobindgarh (at NISST), Bhubaneshwar (at BPNSI) and Raipur (at CREDA).

Regarding technology development and transfer:

- A MoU with he Central Fuel Research Institute (CFRI, situated in Dhanbad, under the Ministry of Science and Technology) is under finalisation for selection of appropriate technologies in the area of coal gasification and pulverised coal.
- In principle, an agreement has been reached on cooperation in the area of high-temperature air combustion (HTAC) technology (regenerative burners) with the Central South University in Changda, China.
- Discussions with the China Iron and Steel Association are ongoing for transfer of clean technologies from China for the SRRM sector.
- In India, the PMC formed a consortium in November 2005 with M/s Encon Thermal Engineers and M/s Pyramid Control Systems for the design of an energy-efficient re-heating furnace for the SRRM sector (producing 15-18 tonnes per hour).

[2] Norms for domestic equipment manufacturers vis-à-vis international standards, minimum energy performance standards (MEPS) and average standards for equipment and devices

Regarding networking, a proposal from the Federation of India Chambers of Commerce is under consideration. Contacts have been established with gasifier technology providers.

However, apart from above-mentioned activities, one cannot say that the formation of 'associations' of "lead" industrial SRRM units participating in the project along with technology providers, financial institutions/banks, design and engineering firms/institutions and independent experts/consultants has really taken off yet. The Resident Missions are supposed to promote the development of such associations, but activities have been quite slow so far.

Planned activities
Other activities are still pending:

- Establishment of Resident Missions (RMs) in the South and West clusters (target date is October 2007).
- Report on activities of institutions
- Supporting forums and events that bring together various stakeholders (SRRM sector, technology provider, financial institutions/banks, design and engineering firms and independent consultants)
- Establishment of a multi-disciplinary network/association of experts and stakeholders
- Establish a roster of stakeholders and experts

2.4.3 Outcome 3 Effective information dissemination

Table 3 Outputs, indicators and budget of outcome 3

Outputs	**Indicators**
3.1 Establishing database (knowledge bank) on current and emerging EE technologies including sources of supply and investment costs, expert analysis, projects, markets, opportunities, and related stakeholders.	• Report identifying information needs, information sources, dissemination channels and MIS finalized by end of 1st year. • System design, data collection, alliances and mechanism established by end of 2nd year. • Information dissemination channels & access procedures operational zed by end of 3rd year.
3.2 Disseminating information through newsletters, technical bulletins, website and expert presentation	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
179	46	24	1

Outputs 3.1 and 3.2

A contract for establishing the knowledge bank has been awarded to M/s Tech Solutions and is currently under construction. The knowledge bank (with info on current and emerging technologies, suppliers and manufacturers, expert analysis, case studies, standards, benchmarks, etc.) will be accessible through a web portal. The contract for the database system and website has been awarded to M/s Comm-IT. The information dissemination and knowledge centre that manages the knowledge bank is part of the Software Centre of

TIRFAC in New Delhi (see Outcome 7). Personnel for the information and knowledge centre have been appointed.

Regarding output 3.2, a newsletter is being published since May 2007 on a quarterly basis.

Planned activities
Pending activities are building the comprehensive knowledge bank and web site (target date is September 2007), collect the data and go live on Internet and cater to the audience in India and broad (through the Internet).

2.4.4 Outcome 4 Enhanced stakeholder capacity

Table 4 Outputs, indicators and budget of outcome 4

Outputs	Indicators
4.1 Carrying out capacity needs assessment of the major stakeholders to implement and absorb advanced EE technologies in the sector (cluster mapping)	• Technology, resource and capacity building needs of each cluster mapped in first year time bound action plan. • Master plan for capacity building activities is finalized and documented by 13th month. • 5 cluster workshops for units/DEMs/consultants on 'new' technologies and technology management each year • 10 Workshops for unit owners/managers on cooperative management practices and procurement processes in each of 5 clusters over 5 years. • Standard Operating Practices (SOP) and Standard Maintenance Practices (SMP) developed in third and fourth year • 'Best Practices' program developed in second year and workshops conducted in third and fourth year. • Three exposure visits to developed countries for DEMs/local consultants. • 5 interaction and policy-oriented workshops for central/state govt. institutions on complex SME issues and constraints. • 3-week training program and curriculum developed by the end of first year for developing Energy-cum-Investment Managers. 5 programs, one in each cluster, conducted in 2nd, 3rd, and 4th year. • Pilot programs for local govt., administrators, and planners focusing on energy efficiency and greening of environment conducted in each cluster beginning second year. • Workshops on evaluating of EE technologies and projects for financing/banking sector.
4.2 Identified specific capacity buildings needs and master plan for capacity building activities.	
4.3 Conducting training programs/workshops in EE Technologies and Technology Management including cooperative procurement of EE technologies in clusters, engineering and implementation support	
4.4 Methodologies and tools for energy management developed; Best practices programme is developed and implemented	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
698	652	92	16

Outputs 4.1 and 4.2

The mapping of the technology resource, energy efficiency issues and capacity building needs has recently been initiated and is carried out by the Petroleum Conservation Petroleum Association (PCRA, under the Ministry of Petroleum and Natural Gas) and should be finalised by July/August 2007.

Output 4.3

Inception workshops were held at New Delhi, Nagpur and Coimbatore during September-November 2004, in which some 150-200 participants from industry, consultants, domestic equipment manufacturers (DEMs) and financial institutions participated. Awareness workshops have been held at the cluster level in Raipur, Bhubaneswar, Kolkata, Mumbai (2006).

Technical training to cater to the various level of manpower in the SRRM units has been organised. Workshops on 'lean management, 5S and waste minimization' were held at Kolkata, Mandi Gobindgarh and New Delhi. Evaluation of roll-pass design already in use by SRRM unit has been provided using roll-pass design software from M/s H B Wicon (Sweden) and training was organised in New Delhi in June 2007.

A study tour to major steel was organised in India as well as a study tour to China.

Planned activities:

Output 4.3: At least one international study tour is planned for domestic equipment manufacturers (DEMs) and consultants. An additional 4 awareness workshops are planned for the second half of 2007 as well as technical trainings (80 man.days) that cover all the 5 Clusters for SRRM owners/managers (on management practices and procurement processes) and for SRRM units, DEMs and consultants (on 'new' technology and technology management). Development of training materials (audio-video) ands project awareness promotional CDs is targeted for July-October 2007.

Training of officials from local administration, state and central government is pending as well as the 3-week comprehensive training programme for 'energy-cum-investment' managers.

Also, the capacity building for suppliers, banks, consultants and other stakeholders need to be further strengthened by means of 2 workshops a year on innovative financing.

Output 4.4: Development of standard operating practices (SOPs) and standard maintenance practices (SMPs) in 4 model units is planned (target date: September 2007). More workshops on lean manufacturing and 5S are planned for as well as compilation of case studies on "Best Practice" concept yet to be started. Compilation of 'best practice' case studies and implementation of 'best practices' in 2 SRRM units will be followed by documentation of the results and disseminated to industry through a training workshop. Also, pending is the development of at least two steel re-rolling units in the SME segment as 'Green Mills' for demonstration of ISO 14000/EMS.

Based on the cluster mapping results, the master plan for capacity building activities needs to be finalised, in which the design of training programmes/workshops on energy-efficient technologies, technology management and co-operative procurement needs to be strengthened.

2.4.5 Outcomes 5 & 8 Feasibility of EcoTech options and technology packages established; energy-efficient investments in sample units

Table 5 Outputs, indicators and budget of outcomes 5 and 8

Outputs	Indicators
51 Design of implementing 5 technology packages in 30 sample mills – 23 on one-to-one basis and 7 through ESCOs.	• EcoTech Packages implemented and operationalised in 30 units: 3 units in 1st year, 4 in 2nd year, 9 in 3rd year, 8 in 4th year and 6 in 5th year. • Multiplication strategy package wise developed and recommended in successive years in accordance with successful implementation of packages as above (developing financial linkages and modeling of EE options, energy and environment analysis of non-sample units, development of an investment pipeline. • Documenting implementation experience for model units and lessons learned; disseminating the lessons learnt to wide range of stakeholders.
5.2 Energy-environment assistance to non-cluster units and replication strategy	
8.1 Implementation and commissioning of sample units, (including facilitation of linkages with banks and providing soft financing)	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
427	1094	44	0

Outputs 5.1 and 8.1

As mentioned in the Introduction, the project has identified several EcoTech options for re-heating furnaces and re-rolling mills, including coal gasification technology (see Text Box 1). For demonstration of the services offered and of the feasibility and effectiveness of these technology improvements, 10 medium-sized SRRM units were chosen as 'model units' that can be emulated and replicated:

- De-bottlenecking study of the steel re-rolling process (with little or minimal investment) and detailed analysis of opportunities in energy efficiency, productivity and capacity improvement;
- Development of a technical and financial plan (TFP) based on the above analysis and technology to b adopted, investment plan, rate of return, cost-benefits, etc.;
- Development of a Bankable Feasibility Study (BFR) for submission to banks or financial institutions;
- Detailed engineering and design for the recommended technologies
- Technical support during implementation.

So far, implementation of 5S and waste minimization is under final stage in 4 SRRM units in the North Cluster.[3] Project development agreements were signed with the above-mentioned 9 units[4] in May 2005, which were followed by detailed technical analysis, TFPs and BFR were finalised by June 2006. Detailed designs were done for a number of these SRRM units, but

[3] BSPL, DISL, Vive and LSRM

[4] Pavai Alloys & Steel, Trichy Steels, Peekay Steels, Ludhiana Steels, Kamdhenu Steels, Rathi Steel, Dhiman Iron and Steel, Bhambri Steel, Ramesh Steel

only a few units have taken an investment decision, others are still contemplating; some have dropped out, or have modified their plans[5].

Pending:

PMC has now approached 30 other re-rolling mills to select more model units and currently the data of 8 units is being evaluated to be developed into TFPs and BFRs (target date: December 2007). In order to encourage greater participation of funding agencies in implementation of energy efficiency projects, suitable linkages will be developed and techno-economic modeling of the EcoTech option will carried out for capacity building as also to provide an analytical tool to the funding agencies for appraisal and monitoring of investment projects.

Output 5.2

The activities are still pending.

Output 8.1

The original target, however, was to have EcoTech packages implemented and operationalised in at least 16 model units by the third year of the project (i.e., by 2007); but little progress has been achieved regarding real investment. From the co-financing budget, the project provides a subsidy of 5% on the interest of loans for EcoTech investments (currently, bank interest rates for loans hover around 13%).

2.4.6 Outcome 6 Innovative mechanisms: ESCO and third-party financing

Table 6 Outputs, indicators and budget of outcome 6

Outputs	**Indicators**
6.1 Developing mechanisms of performance contracting involving identified ESCOs and technology providers and strengthening capacity of ESCOs for implementing EE investments in SRRM sector	• Development of 'performance contracting' mechanism • Performance capability of ESCOs specific to the needs of re-rolling mills enhanced by the end of 2nd year • Operationalisation of 5 ESCOs (from 3rd year) and demonstration of EcoTech packages in 7 SRRM units through the ESCO route between 3rd and 5th year.
6.2 Developing institutional linkages among existing ESCOs, technology providers and industry	
6.3 Evaluating the market potential through demonstrating ESCO concept in 7 mills	

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
381	134	0	0

[5] E.g. Bhambri Steels has gone ahead with installation of a conventional design furnace (20 tonnes per hour capacity) although with certain changes suggested by PMC. Energy-efficient designs for reheating furnaces have been developed and sent to 3 SRRM units and are under process for 6 units

Planned activities:

Outputs 6.1-6.3

All activities need to be initiated. It appears that existing ESCOs[6] are not interested in venturing into the SRRM sector due to high risk perceptions nor are SRRM units (usually family owned) owners interested in having 'outsiders' peek in the accounts of their companies. The original milestone was to have ESCOs operating in the SRRM sector by the third year of the project (i.e. in 2007). Since the ESCO and third financing are significant for reducing risks of investment on the part of SRRM industry, it is essential to estimate the market potential based on successful implementation of the project. The study is to be carried out to assess the market potential and methodology for implementing ESCOs. If the study shows potential for performance contracting, awareness cum close interaction needs to be established between ESCOs and SRRM units.

2.4.7 Outcome 7 TIRFAC and project management

Table 7 Outputs, indicators and budget of outcome 7

Outputs	**Indicators**
7.1 Setting up and functioning of a project management and coordination unit for implementing project activities; establishment of its M&E system 72 Reporting to funding agencies as per the pre-determined progress indicators for various activities in the project; Documenting lessons learnt for all project activities and their objective vis-à-vis outputs. 73 Establishing Technology Information and Facilitation Centre (TIRFAC)	• PMC set up in 10 weeks after project approval by GEF Council. • Annual Work plan approved by PSC and job order issued which coincides with 'zero' date of the project. • Master plan for project activities is finalized and documented in first 10 weeks. • Monitoring and Evaluation Plan along with reporting procedures finalized and PMC staff appointed at the end of 6th month. • Monthly/quarterly/annual performance review formats prepared for adoption by all project constituents at the end of 6 months. • Software and hardware centres of TIRFAC set up at the end of 2nd and 3rd year respectively.

Budget (in Rs. Lacs = 100,000 Indian Rupees)			
Budget planned		Budget spent	
GEF	Co-financing	GEF	Co-financing
427	1094	44	0

Outputs 7.1-7.3

The Project Management Cell was set up by the Ministry of Steel by December 2004 and consists of the National Project Coordinator (PMC) and Managers for Projects & Contracts, Finance & Administration, Monitoring & Evaluation and Outreach. A Monitoring and Evaluation system (M&E) has been set up with a Manual (elaborated by Ernst & Young); progress results are reported in the annual work plan and budget (AWPB) and APR-PIR. Also

[6] Examples of ESCOs in India are Thermax, EPS, INTESCO ASEA, ELPRO ENERGY CENTER, SEETECH INDIA, DCM and 3EC

a Project Operations Manual (POM)[7] has been formulated. The Evaluation Team doubts however if the M&E system is actually used as an effective tool for adaptive management, i.e. to effect changes during the course of the project's implementation in response to external factors.

The Technology Information Resources and Facilitation Centre (TIRFAC) is planned to consist of two arms – the Software Centre, set up at the Jawahar Dhatu Bhawan premises if IIM, Delhi, and the Hardware Centre, to be set up at NISST, Mandi Gobindgarh.

Resources available at the TIRFAC- Software Centre include a CAD design station, training hall and the recently purchased roll pass design software (purchased from M/s Wycon of Sweden). In the near future, the IT infrastructure for the Information Dissemination and Knowledge Management Centre will be housed here. Trainings have been given to various units, apparently receiving good response.

Pending activities:

The idea is that the TIRFAC will provide a range of services to the SRRM sector on a self-sustaining basis. Some services are being provided, such as design of energy-efficient furnaces, rolling mills and organizations of seminars and workshops. Other services are planned to be added, such as web-enabled information dissemination and knowledge management, publication of the quarterly newsletter, evaluations of roll-pas designs, technical support in the installation of re-heating furnaces, recuperators and roller guides and technical trainings and development of resource persons.

The Hardware Centre is proposed to be set up at NISST campus at Mandi Gobindgarh. The basic design and layout has been developed and the Centre is supposed to be set up by December 2007. Various technology packages would be showcased at the Hardware Centre, including walking hearth furnace, high-tech coal gasifier, various combustion systems and burners, combustion measuring equipment and facilities, cooling water circulation system. Tenders were floated for the construction and civil engineering of the buildings as well as for setting up the technology packages, but these have met poor response so far.

2.5 Implementation: assessment of the project's impacts

In view of the delay in project implementation, as described in the previous paragraph, it is difficult to quantify the project's impacts at this stage, as investments in the EcoTech packages still has to take place.

Envisaged impacts are:

- Energy savings in the SRRM sector by implementing energy efficiency measures (EcoTech packages as mentioned in Text Box 1);
- Quantitative improvements in material use efficiency (scale loss and yield improvement);
- Reduced CO_2 emissions due to decreased fuel consumption (oil or coal) in the steel re-rolling process and due to reduced electricity consumption;
- Number of SRRM companies that implement energy-efficient technology;
- Expansion of technology support system for the SRRM sector (i.e., expansion of business of provider of energy-efficient technology and of advisory services);
- Increase in financing and financing mechanisms for the SRRM sector;

[7] The Project Team has alerted the Evaluation Team on a few discrepancies in the POM and suggested amendments are given in Annex C

2.6 Project relevance and country drivenness

The steel re-rolling mill (SSRM) sector is unique to India. The secondary steel production constitutes approximately 57% of the total steel production in India and is an unavoidable link in the overall supply chain of steel in the country. Thus, the SRRM sector is also a major consumer of energy and contributor to greenhouse gas emissions.

The sector consists of about 1,200 enterprises which are mainly small-sized (75%) and medium-sized. Unlike the large-scale integrated steel plants, the SRRM sector has not been actively supported by the Government regarding energy efficiency improvements.

The SRRM sector faces a number of barriers to improvements in their operation and in energy efficiency in particular, such as using 1) Outdated technologies and practices, 2) low information and awareness levels, 3) inappropriateness of generic energy efficiency technologies developed, 4) lack of incentives to cater to small scale energy efficiency projects, 5) lack of experience in accessing external funds, 6) high investment costs of energy efficiency technologies and 7) low research and engineering base and other institutional linkages.

The UNDP/GEF steel re-rolling project provides a comprehensive approach to deal with these barriers, commonly found in the SRRM industry in particular and small and medium-sized enterprises (SMEs) in general. The five-year project aims at developing, demonstrating, market and disseminating commercially proven energy-efficient technologies in the SRRM sector. The program also tries to build an infrastructure for market transformation through the organization of the industry, capacity building and the formation of financing mechanisms (ESCO, bank). The approach seems appropriate to reduce or remove some of the barriers found in this industry for energy-efficiency improvement, although certain design elements are questionable (as will be explained in the next Sections) and implementation has been quite lagging.

2.7 Financial planning and delivery of counterpart inputs

Table 1 gives an overview of the budget allocation per outcome and actual expenditures so far. Project operation did not really start until December 2004 with the establishment of the Project Management Cell (PMC). We notice that of the total project budget of Rs. 654 million (= US$ 14.03 million) only 11% has been spent of the past 2.5 years. This rate of expenditure is extremely slow.

Having had discussions with the main project participants, some stakeholders and based on analysis of existing documents (see Annex B.2), the Evaluation Team feels that this is indicative for four aspects:

1) The PMC performs its activities as such in a cost-effective way;
2) The PMC does too much of the consultancy work itself, which would otherwise have been done by consultants or subcontracts and charged to the budget accordingly;
3) In terms of design, the project has simply been over-budgeted;
4) The slow expenditure rate is simply indicative for the slow pace of implementation.

Table 8 Planned budget and actual expenditures of the project

	Activities	5-year budget		Calender years								Total (Rs. Lakhs)		US$		Budget Total (US$)
				2004		2005		2006		2007						
		GEF	Co-fin	GEF	Co-fin	GEF	Co-fin	GEF	Co-fin	GEF	Co-fin	GEF	Co-fin	GEF	Co-fin	
1	Benchmarks for EcoTech Options & Packages Established	315.0	69.0													
2	Strengthened Institutional Arrangements	427.0	67.0					0.7	16.9	0.8		1.5	16.9	0.0	0.0	0.0
3	Effective Information Dissemination	179.0	46.0			2.0	0.6	7.4	0.7	14.3		23.7	1.2	0.1	0.0	0.1
4	Enhanced Stakeholder Capacity	698.0	652.0	17.3	9.3	5.3	1.4	56.3	4.7	12.9	0.2	91.7	15.5	0.2	0.0	0.2
5	Feasibility of ET options	427.0		2.6	0.3	35.6		4.6		0.8		43.6	0.3	0.1	0.0	0.1
6	Innovative Mechanisms (ESCO financing)	381.0	134.0											0.0	0.0	0.0
7a	TIRFAC	174.0	908.0	0.1	13.6	19.5	53.4	15.6	27.7	7.5	21.0	42.6	115.6	0.1	0.3	0.4
7b	PMC and M&E	435.0	260.0	25.5	0.2	73.1	38.7	60.0	23.4	21.0	10.4	179.6	106.1	0.4	0.2	0.7
8	Investment Projects in Sample Units		1,094.0											0.0	0.0	0.0
	Total (Rs. Lakh = 100,000)	3,308.0	3,230.0	45.6	56.7	135.4	94.0	144.5	73.4	57.2	31.5	382.7	255.7			0.0
	Total (US$ million)	6.75	7.28	0.10	0.13	0.31	0.21	0.32	0.16	0.13	0.07	0.89	0.59	0.89	0.59	1.5
														13%	8%	11%
	Exchange rate (US$/Rs.)	49	44	45.3		44.1		45.3		43.1		43.1				

Discussion with PMC staff gave indeed a strong indication that the PMC does not spend money just for the sake of meeting budget expenditure targets. While such financial prudence is laudable, the Evaluation Team also believes that the PMC has been acting too much as consultant itself rather than acting as a facilitator in a programme in which consultants and external experts can be subcontracted.

Especially with regards to outcome 5, the PMC seems to have been bogged down increasingly over time in providing detailed advice and negotiations with a few model units. A first phase of giving technical advice in various rounds to a few SRRM units (the first 9 model units that signed up) was still relatively fast, then slowed down a bit (first technical analysis, followed by TFP and BFR), slowing down more (detailed designs) and eventually progressing at a snail's pace (subsequent negotiations about what technology to employ and its financial consequences), while the SRRM unit owners involved seem to postpone the actual decision regarding the energy-efficient investment even more.

2.7.1 Assessment of the implementation approach in achieving outcomes and outputs

The problem of slow expenditure rate (only 11% has been spent over the past 2.5-3 years) reflects the slow pace of implementation. The Evaluation Team acknowledges that the project has been successful in creating awareness and by providing capacity building by holding workshops and technical trainings as well as some study tours. The Evaluation Team feels that the project has achieved an increased awareness amongst SRRM units, although not equally in all Cluster areas.

On the other hand:

- In two outcomes (number one, benchmarking, and number six, ESCO financing) no progress has been made at all.
- In outcomes 5 and 8 (technical assistance to the model units), progress has been slow also. Relatively quickly, 9 model units signed a 'project development agreement' by

May 2005, resulting in TFPs and BFRs by June 2006, but then the pace slows down increasingly and the moment of taking a real investment decision in energy-efficient technology by the SRRM unit owner is postponed more and more, resulting in re-negotiations, re-visits, while the clock keeps on ticking. Up to now, real investments have only taken place in one or two units (although some more maybe close to taking such a decision). Only, recently the PMC has approached more units (other than the first nine).

- Outcome two (institutional arrangements) shows mixed results. Some networking has been taken place with organizations that work in the technology area, notably with technological institutes in India and China, but less so with organizations in the commercial sphere, i.e. private sector associations, domestic equipment manufacturers, consultants and banks.
- Progress regarding Outcome 3 is halfway at the time of the Evaluation Team's mission: the Information and Knowledge Centre is just being set up and a Newsletter has only recently been published.

Worryingly, the Evaluation Team is surprised that after 2.5 years some essential activities, (needed to establish a firm baseline) have not been carried out yet or have only been initiated recently, such as:

- The mapping of clusters (output 4.1 of outcome 4), i.e. doing a basic assessment of technology resource, energy efficiency opportunities and capacity building needs. This is only just being carried out, but should have been one of the first activities. If been done initially, this would have cleared the way for carrying out the activities of the first project outcome of 'benchmarking';
- With respect to outreach in the Cluster areas, the Resident Missions should have been established at a much earlier stage of the project to be able to provide local assistance services. As a consequence, many activities of PMC have focussed on the Northern Cluster around Mandi Gobindgarh (Punjab)[8] only.
- Info gathering on technologies, providers and manufacturers, resource persons and experts should also have been undertaken in the first years. On the other hand, the Evaluation Team acknowledges that certain technologies, such as coal gasification, have only recently taken off in India with the rising cost of petroleum products; many SRRMs now want to shift to coal as fuel and show an interest in coal gasification, but before did not show such interest.

One reason given for the slow take-up of energy-efficient technologies is that the beneficiary SRRM units prefer to take a 'wait-and-see' approach:

- The steel market in India is booming and production rising; thus, many units are quite profitable and with energy cost being only part of the production cost there is less urgency to invest in energy-efficient and clean technology (despite their favourable rates of return); some may fear that changing their steel production line implies idle time and thus revenue foregone due to reduced sales of re-rolled steel in that period;
- There has been some confusion in the past with some units that expected that the GEF project would fund (part of) the investment;
- Most units are family-run businesses, in which not always consensus can be reached in the family management on the need for new technology requiring high investment; especially smaller SRRM are not interested in expensive state-of-the-art technology even if the cost of investment can be recovered quickly. Many SRRM units seem to be reluctant to do investments of over Rs 10 million (1 crore);

[8] Although admittedly with some justification, since probably one-third of India's SRRM industry is located in the Punjab area

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

The following summarises the findings of the evaluation. Each of the points discussed below has been dealt with in more detail in the previous chapter 2.

3.1.1 Project design

As discussed under 'relevance' (section 2.2.1), the project document adequately describes the problem of the small and medium-sized enterprises in the SRRM sector. Stakeholders are adequately identified and a large number of stakeholders are grouped together in the PSC and PAC.

Although admitting having the advantage of hindsight, the Evaluation Team feels that that in terms of 'strategy' and 'management arrangements' there are several *flaws in the project design* that are one reason for the low budget expenditures:

- *The project design seems over-budgeted.* The Evaluation Team wonders how the budget in the Project Document was calculated. To give one example, US$ 2 million is budgeted for workshops (see Table 2); even if organising one workshop would cost US$ 20,000, this implies 100 workshops to be organised! Similarly, travel cost are $ 1.33 million; now assuming that travel would be 30% of the cost of international and national experts then travel cost should be half this amount only. In general, US$ 14 million (GEF and co-financing) seems quite a lot of money for technical assistance activities

- *Project management*
  With a large PMC as well as TIRFAC Software Centre (the PMC with **X** staff and TIRFAC with **X** staff) being based in Delhi, management seems quite top-heavy, with no permanently based staff in the Cluster areas, while the role of Resident Missions has been limited so far. This centralised structure hinders the effective outreach to the SRRMs in the Cluster areas.

Table 2 Planned project budget per budget line

	UNDP/GEF	Ministry of Steel
Personnel cost	402,783	56,432
Domestic experts	500,726	959,511
International experts	203,193	0
Travel of experts	1,025,653	306,383
Subcontracts	2,558,513	445,638
Training and workshops	1,313,023	693,840
Equipment cost	79,768	2,012,649
Missions for monitoring and evaluation	280,318	314,312
Assistance to model units	0	2,430,000
Miscellaneous	386,023	61,295
Total	6,750,000	7,280,060

Expected investments by industry: US$ 5,540,000

- The project document does not provide any approach for *sustained regulatory and policy framework* for the project that could include policy instruments, such as fiscal incentives, carbon tax, subsidies, excise duty & custom duty exemption. The future growth of the SRRMs and their development pattern has not been studied in the design stage. In general, no proper sustainability and replicability plan has been prepared in the design document.

3.1.2 Project execution

The project has already completed its half life. MoS and PMC have been quite successful in creating mass awareness amongst stakeholders about the project. During the interaction of stakeholders, it was widely appreciated by the various stakeholders that Govt has taken such an important initiative. PMC has also helped in designing the furnaces, preparation of feasibility reports, conducting the energy audits, implementation of 5 S, roll pass designing, installation of automatic control system at furnace etc.

The knowledge about the basic objective of the project for reduction of GHG emissions through adoption of energy efficient technologies has been penetrated to the grass root level in the northern sector. The capacity building effort has not reached effectively in the other Cluster areas. Resident Mission has not been even established in all regions and, in general, manpower is not sufficient at resident mission level. Within the PMC, there does not seem to be a good work plan and lack of leadership so far. Hence, activities have not been properly planned (e.g. the technology and needs assessment in the clusters of outcome 4 should have been one of the very first activities) and not implemented by PMC staff in a coordinated way.

While the project can indeed show results in terms of awareness raising and capacity building, other activities have stalled, notably the provision of technical assistance and support to model units. While the SRRM sector consists of over 1,200 units, only 9 units have been approached (less than 1%) by the project so far in a timeframe of 2.5 years and only one has actually invested.

The PMC has worked diligently in developing designs, technical studies (TFPs) and bankable proposals (BFRs) for first 9 model units. However, from discussion held by the Evaluation Team with the SRRM units visited, it emerged that these TFP and BFR documents were often modified/altered by the unit owners after their finalization or sometimes the BFR prepared through PMC were acceptable to mill owners. Some of them are either withdrawn or they have kept the project in abeyance. Under these circumstances, PMC should have identified more and more model units so that reliance on couple of units could have been avoided.

Instead, the PMC has followed a step-by-step approach: once investments in the units have taken place and can be showcased, only then a number of other units are taken up by the PMC, followed by another group of units, etc. until the target of 30 units has been reached. The strategy seem to assume that once some awareness has been created and technology has been showcased in a few model units that SRRM units will happily line up in front of the PMC's doorstep. However, the commercial viability of EcoTech options and energy efficient technical packages is yet to be proved in the sector on a visible scale to improve the confidence level of investors. This is a 'critical' factor in widespread adoption of EE technologies especially when some technologies proposed under the project are new to the investor in the sector or first time in the country. Clearly, the *batch-wise approach* by the PMC to convince the SRRM units has not been working. Many more units need to be more approached in *parallel.* And why limit to a few 'model' units, whether 10 or 30, if the SRRM 'universe' in India consists of over 1,200 units? A competitive environment should be created amongst potential units for becoming model unit.

Implementation of ESCO concept seems to be unsuccessful in this project. They are often not maintaining the transparency in their bookkeeping. There is strong resistance by the unit owners about sharing of information related to their mill with other (competitor) units. Instead, the role of local suppliers and individual discussion between technology supplier and unit owner was more practical and acceptable. Accordingly, PMC has recently initiated couple of such kind of workshops and results are now becoming visible.

Industries seem to be willing to adopt the technologies even in absence of the financial support, provided they are convinced about the technologies. Some of the progressive units already have changed their furnaces or are in the process of installing the new furnace. Units are agreeable to change their furnaces by new pusher type furnaces using furnace oil or coal gasifiers. Higher-end technologies, such as walking beam furnaces and regenerative type burners, are not viable and suitable to the smaller mills (however, larger mills may adopt these technologies).

The PMC effort for providing consultancy about technology issues, and conducting design exercise on their own has proven to be an arduous task to them. Recently, PMC has now switched over to consultancy mode to facilitation mode, which is quite appropriate. The Evaluation feels therefore that the current top-down, batch-wise and technology-oriented approach in implementing the project activities has to change towards a more decentralised, parallel-wise and demand-oriented approach for the project to become successful. This is described in detail in the next chapter on 'recommendations'.

3.1.3 Sustainability and replicability

The project is expected to sustain the market impacts it seeks to deliver. Much will depend on the willingness of the SRRM units to invest in the energy-efficient technologies. This sustainability will depend on the ability of the project to create a niche market for energy-efficient investments in the SRRM sector by bringing together industry associations, technology providers, domestic and international experts, government agencies and financial organizations (for marketing and dissemination of these technologies and development of financial mechanisms). However, such a business network, needed for longer-term sustainability, has not emerged yet.

Capacity building coupled with long-term support to technology innovation through involvement of research, design and development institutions both within India and outside the country will further enhance the sustainability. Technology information resource services and optimum solution design support will be provided by TIRFAC. At this point in time, however, it is not yet clear how the activities of TIRFAC will be sustained after the project's life.

The project document recognises the importance of a replication strategy to reach the SRRM units beyond the 30 model unit the project focuses on. Some SRRMs are adopting EcoTech technologies already with or without the project's support. Thus, these technologies have the replication potential, but the project should put much more emphasis in creating awareness across the length and breadth of the country as part of an effective strategy for securing large-scale replication, as will be discussed below.

3.2 Recommendations for the project

Project management

- Project management should be 'lean and mean', i.e. the PMC should be less top-heavy. For example, instead of having all the staff based in Delhi, there should be at least one PMC staff, based (on a contractual basis) at each Resident Mission. These persons should not only have technical knowledge about SRRM, but have a strong commercial affinity. In other words, they should go around, interact with the SRRM units, technology providers and banks, bring them together as part of a massive campaign to approach the SRRM sector (see further). Also the PMC needs at least one leading person that assists the Project Coordinator with the commercial aspects of the project and provides linkage to the Resident Missions. Close monitoring of the project and regular meetings with the Resident Missions needs to be carried out.

- PMC staff has lost valuable time by getting stuck in providing detailed advice and negotiations with a few SRRM model units. PMC should not act as a consultant, but play a facilitating role as 'honest broker' by providing linkage between SRRM units, technology providers, banks (if necessary supported by the technological institutes in the Cluster areas).

- Within the PMC there cannot be five managers; there should be one manager/coordinator that provides leadership and vision and be open to changes in project setup and activities to respond to the needs of the SRRM units (adaptive management). A detailed work plan and expenditure plan should be drawn up for the remaining period 2007-2010.

- There are two parallel Committees, the Steering and Advisory Committee. While there is nothing wrong with bringing more stakeholders on board, again these are bodies based in Delhi, bringing in national-level stakeholders. Instead, local PACs could be organised so that stakeholders at the Cluster level are more involved in providing advice on issues and options in their Cluster area. The national PAC could meet less then. The PSC should meet more often instead and adopt a culture of stronger decision-making in order to speed up project implementation.

Project outcomes and activities

- Components 1 and 4 can be merged into one outcome 'SRRM technology and needs assessment and benchmarking'. Since the Evaluation Team things these are essential activities that gives a basic overview of the sector, they should be carried out without delay:
  - Proceed with the cluster mapping (assessment of technology, such as furnace type, production capacity, end products as well as current practices, needs and technological options) for each Cluster area
  - Do a mapping of technology providers (domestic equipment manufacturers and importers) and make a rosters of consultants and resource persons
  - Perform technology-wise benchmarking for each cluster and, if needed, re-tailor the EcoTech and other technology packages according to the beneficiaries' needs
  - The baseline level for GHG emission in each sector/cluster or technology wise needs to be defined immediately as well as other environmental benefits of the improvements in energy-efficiency (such as SOx, NOx, PM reduction) so that the improvements can be systematically evaluated and documented.

- In component 5 the strategy should change:
  - From focussing on a few model units by rapidly expanding to another 30-40 units, maybe aiming at serving 75 units with technical assistance and financial support (see outcome 6). Units that have implemented recent innovations (but are not part of the 10-30 pre-selected model units) should be checked on their energy efficiency improvements and should be asked to come forward to serve as 'model unit', providing them with some compensation.
  - Instead of promoting the state-of-the-art technologies first (such as walking hearth or walking beam furnaces), a step-wise package of technology should be promoted, i.e. starting first with the 'low-hanging fruits' (low-cost technologies) such as adherence to SOP//SMP and realising improvements in the existing furnace (better refractive lining, putting in automation and control system, etc.). Where possible, the whole furnace can be replaced by a new more efficient pusher-type furnace with a recuperator (see Text Box 1 for a description of technologies). A second option is switching to pulverised coal and coal gasification. As a last step, more expensive state-of-the-art technology packages (regenerative burners and walking beam furnaces) could be considered for the larger SRRM units. The technologies need to be developed at the local level, so that the cost should be minimized. If indigenous technologies are not adequate, then, PMC should promote technology transfer from countries like China (before considering these technologies should be vetted by the Central Pollution Control Board)[9]. Both indigenous and imported technology options imply that local expertise amongst suppliers is developed for manufacturing, installation and maintenance of systems.
  - Regarding the domestic equipment manufacturers (DEMs), SRRM units usually have good partnerships with the local suppliers of furnaces. It is suggested that local manufacturers should be developed to produce good quality equipment and the project should provide training and technology support to those suppliers/DEMs.

- In other to reach wider coverage of model units, a much more aggressive approach is needed (outcomes 3 and 4)
  - A massive campaign should be organised aiming at all the 1,200 SRRM units in the country by providing them with information about the project objectives and technical assistance services and financial incentives (such as the 30 lakh scheme), energy-efficient (EcoTech) technology options and their cost and benefits, addresses of suppliers and consultants,, experiences with energy-efficient and clean technology investments in innovating SRRM (model) units, by means of advertisements through the media (newspaper, local radio and TV) not only in English and Hindi, but in local languages as well. This campaign should involve associations and manufacturers' organizations.
  - Instead of focussing on SRRM units only, more support should be given to and training should be organised for domestic equipment providers and consultants. Here, the opportunities could be investigated for cost reduction by local manufacturing (e.g., gasifiers) and, if not available locally, of developing capacity for local manufacturing.
  - Most of the employees working in the SRRMs are illiterate. Some funds of the capacity building component may be used for providing special courses on operation and maintenance of 'new' technologies (at the technological institutes or

[9] The Central Pollution Control Board and State Pollution Control Board should be informed about the project. Recommendation letter may be issued by CPCB/SPCB about the proposed energy efficient and clean technologies (pusher type furnaces, gasifiers, pulverized coal combustion, walking beam etc) along with performance guarantee parameters.

polytechnics in each Cluster area). There is also a strong need for training of the supervisors working in the field of furnace operation, mill operation and maintenance activities; such training could be done in cooperation with the large steel manufacturing companies.

- Regarding component 7, the Evaluation Team feels that in such a new demand-oriented strategy (as described above), there is no need for a new Hardware Centre (as part of TIRFAC):
  - The installation of demonstration unit at NISST and going for huge investment at this juncture would not really give fruitful results. This will need lot of effort for commissioning of such unit and financing its operation and its maintenance after the project's end would be another issue which has not been addressed.
  - The SRRM companies can be used to showcase technology to their peers and innovating SRRM at the project's 'model unit' and in fact at any innovating unit that is willing to adopt and demonstrate energy-efficient technology
  - Technology can be transferred, adapted or developed in cooperation with domestic equipment manufacturers. In fact, there is some need for funds to support research that specifically targets adapting technology to the small production capacities of the SDRRM sector (between 5-50 tonnes per hour). If there is a need to demonstrate certain technology, this should be done in cooperation with existing self-sustaining technology institutes, such as NML, CSIR, IIT, etc, rather than setting up a new institution.
  - In absence of TIRFAC hardware centre, alternatively, this fund can be allocated for implementation of energy efficient technologies in additional 40-45 units.

  Since the Hardware Centre would not come with a mill, so it will not be able to raise funds by selling steel products. Moreover, the requirement of manpower and raw materials would make TIRFAC unsustainable unless full MoS funding would continue until after the project's life. Also for this reason it is better to split the hardware and the consultancy/software functions of TIRFAC. The basic idea is that TIRFAC (Software Centre) would be sustained through subscription and service charges. At this stage it is unclear how this would be implemented in practice. The Evaluation Team suggests having an assessment of the market and need of services by industry and having a business plan formulated for the post-project TIRFAC Software Centre.

- Component 6 can be cancelled as the ESCO concept will not work in the small SRRMs on India. Instead, the financial mechanism of the project should be expanded:
  - As said before, financial support should not only be for pre-selected model units, but to any willing SRRM on a 'first come, first served' basis;
  - The current scheme includes a 5% interest support (as part of the co-financing of the project). Recently, it has been suggested to change this scheme to capital cost support (many of the family-run SRRMs will not apply for a loan, but will organise the funds for investment themselves); under the new scheme support up to Rs. 30 lakhs or 25% of investment cost will be provided
  - It is suggested that, as apart the massive campaign,

The manufacturing sector like coal, power, oil, and gas, steel are one of the major GHG-emitting sources in the country. As a part of GHG reduction in the supply chain, these industries may consider supporting the SRMM through providing subsidies/ preferences in the sale of coal[10], oil, gas, electricity, steel items etc. A consultant may be appointed to assess

[10] There is scarcity in the supply of good quality coal (grade – A/B) for the SRRMs. Normally; these coals are used by the power plants. SRRMs are compelled to use high ash content coal which results in higher coal

the possibility to provide the support through fiscal incentives and/or from the input providers of SRMM.

Regarding replicability, the project's support scheme (Rs. 30 lakh or 25% of capital cost) would end with the project. In order to reach most of the 1,200 units, the Evaluation Team suggest looking into the option of establishing post-project financing schemes, such as a revolving fund for guarantees and/or soft funding.

Given the fact that most of the project's funds have not been used so far and that even more funds would become available by cancelling or reducing the ESCO and TIRFAC Hardware Centre components, we suggest that the project supports setting up such schemes as well as by boosting the existing '30 lakh support' scheme and that such schemes are promoted as part of the massive awareness campaign.

The possibility may also be explored to provide relaxation in custom & excise duty for equipment, spares, instrumentation related to energy efficiency improvement in SRMM and related pollution control equipment. Certain standards could be introduced through legislation. Such a policy formulation / fiscal incentives component has not been included in the project's design, but some activities in this respect should be considered to be included.

Road map

Recently, a new Project Coordinator was appointed[11] who is aware of the project's problems and has demonstrated commitment to the project's objectives. The Evaluation Team hopes that the new Project Coordinator will be given all the support needed by the implementing organisations, UNDP and Ministry of Steel to implement the necessary changes in the project's management, as discussed above, and the continuity of leadership is maintained.

The Evaluation Team has drawn up a list of activities that should be implemented during the second half of 2007 in order to speed up the project's implementation:

August 2007:

1. Take decision in next PSC meeting about the recommendations letter from CPCB & MoS for adopting EE technologies like gasifiers, pulverised Coal combustion, RHFs, Automatic control system etc.; Include agenda point for providing coal linkage/preferences to SRRM for good quality coal
2. Take decision on TIRFAC hardware centre in next PSC.

September 2007:

3. Definition of energy efficiency technologies acceptable for SRRM sector
4. Communication to all the 1,200 units about the UNDP/GEF Steel Re-Rolling project and services offered (e.g., by means of advertisement in the newspapers, radio, etc.)
5. Invite application for empanelment of consultants, suppliers, DEMs, experts (national & international)
6. Prepare good leaflets or booklets about the PMC support and technology
7. Organise meetings in the 5 clusters for units, DEMs, Suppliers, experts
8. Provide support to DEMs/Suppliers/consultants (Training, consultancy, technology transfer) create win-win situation, use them for due-diligence study, documentation, audits, technical solution provider etc

consumption for gasifiers/pulverised coal combustion. Thus, the basic reasons of promoting energy efficiency technology are defeated.

[11] Ms. N. Vijaya Lakshmi replaced Mr. S. Dewan earlier this year

9. Appoint a Consultant for monitoring and evaluation of projects in consultation of PMC

October 2007:

10. Finalise the list of consultants, suppliers, DEMs, experts (national & international)
11. Finalise list of new model units (about 50), divided into two categories (those who need financial support and without financial support)
12. Devise methodology for inclusion of 'non-project' units as model unit after completing the monitoring and verification of their energy-efficient investment by PMC & independent consultant/expert

November 2007:

13. Strengthen Resident Missions with additional manpower; Restructuring of PMC
14. Take decision on initiation of excise and custom duty exemption for EE technologies, instrumentation spares
15. Organise visit and interaction of proposed units to the identified completed units
16. Appoint consultant for study on providing fiscal incentives (by Nov'07 and complete the study by Feb'08). Take the recommendations in the PSC in 2008.

December 2007:

17. Prepare the benchmarking document
18. Knowledge management, website, booklets, CDs

In 2008:

19. Selection of two best mills- ISO 14001 & LCA (Mar'08, completion by : Dec'08)
20. Best practices Manual (June'08)
21. Organise training, workshops (Recurring)
22. Organise field visits to India and abroad (every year)
23. Organise training programmes at TIRFAC software centre
24. Sustainability Plan (Dec'08)

3.3 Lessons learnt and recommendations for UNDP and GEF

One lesson learned is that care should be taken when designing large projects that aim at market transformation by reaching out to numerous private sector players, in this case the 1,200 SRRM units in India. Most of them do indeed face barriers to improving their operations in general and regarding energy efficiency improvements in particular. But not all barriers are of equal importance or can immediately be addressed. Similarly, options for lowering the barriers may work on paper, but in practice may not be attractive to the private sector for a number of reasons. This asks for carefully design of the project during its initiation and asks for alertness and readiness to change by the management, once certain options do not seem to work. There is sometimes a tendency to focus too much on technology, but in the end the private company's owner is interested not only in technology but how it can cost-effectively help his company to perform better.

ANNEX A. TERMS OF REFERENCE OF THE EVALUATION

MID TERM EVALUATION
UNDP-GEF Project: Energy Efficiency in Steel Re-rolling mills

Background / Introduction

Steel production is an energy and waste intensive process and there are more than 1200 small scale steel re-rolling mills in India. In India, the production of 1.0 Ton of crude steel from iron ore generates about 1.2 Ton of solid waste, 2.5 Ton of carbon dioxide and other pollutants. The small scale steel re-rolling mill sector constitutes an unavoidable link in the overall supply chain of steel in the country. The sector largely consists of small and medium sized enterprises (SME) with 75% of units being in the small scale. The mills have grown haphazardly with low-skill labour force, outdated, low-investment, high production cost technologies and practices largely financed with their own funds. The direct energy use in this sector includes heating fuels (furnace oil, natural gas and coal), and electrical energy and is estimated at 25-30% of overall production cost. Indirect energy use is accounted by the use of energy intensive raw materials. The energy losses would thus comprise direct losses and indirect losses through scale loss and low yields.

This project seeks to reduce greenhouse gas (GHG) emissions by providing technical assistance to the small and medium-sized (SME) steel-rerolling mills in India to enable adoption of energy efficient and environmentally friendly technologies. These practices have not been widely adopted in India due to information and knowledge barriers, combined with inertia and uncertainty on the part of a conservative, but competitive business sector. The project strategy seeks to involve the initial penetration of "low-risk", high efficiency technology packaged in 30 selected model SME units, thereby increasing industry's confidence in and access to these technologies. The project will establish a centre for providing training, information and capacity strengthening on a sustained basis. It will develop institutional linkages with energy-service companies for providing off-the-shelf technologies from international equipment vendors. These initiatives will be supported with government subsidized credit.

In accordance with UNDP/GEF M&E policies and procedures, all projects with long implementation periods (e.g. over 5 or 6 years) are strongly encouraged to conduct mid-term evaluations. In addition to providing an independent in-depth review of implementation progress, this type of evaluation is responsive to GEF Council decisions on transparency and better access of information during implementation.

Objective of mid-term evaluation

The objectives of this evaluation is (a) to identify project design issues, (b) assess progress towards the achievement of objectives, (c) identify and document lessons learned (including lessons that might improve design and implementation of other UNDP/GEF projects), and (d) to make recommendations regarding specific actions that might be taken to improve the project. It is expected to serve as a means of validating or filling the gaps in the initial assessment of relevance, effectiveness and efficiency obtained from monitoring. The mid-term evaluation provides the opportunity to assess early signs of project success or failure and prompt necessary adjustments.

This evaluation is initiated and managed by the UNDP India office in close cooperation with the Ministry of Steel, which is the executing agency. The Project Management Cell is expected to provide assistance and support to the evaluators by arranging for meeting with stakeholders including, other government agencies, research institutions, banks, industry and industry associations.

Scope of the evaluation

The scope of the evaluation is closely related to the 4-fold objective which is (a) to identify project design issues, (b) assess progress towards the achievement of objectives, (c) identify and document lessons learned and (d) to make recommendations regarding specific actions that might be taken to improve the project.

(a) Project Design Issues

Does the project document clearly define?

1. The problem to be addressed by the project.
2. The project strategy.
3. Linkages among objectives, inputs, activities, outputs, expected outcomes and impact.
4. How useful are the outputs to the needs of the direct beneficiaries? Do the outputs contribute to the achievement of the objectives of the project?
5. Identification of stakeholders, nodal agencies and operational partners.
6. Implementation and management arrangements.
7. How adequate are the quantity and quality of project inputs relative to the targeted outputs?

How relevant is the project to:

1. The development priorities of the Government of India?
2. The UNDP/GEF area of focus?
3. The expectations of the stakeholders?
4. The needs of the beneficiaries?

(b) Progress towards achievement of objectives

Implementation Efficiency / Effectiveness

1. How well has the project been using its resources (including human and financial) to produce outputs and carry out activities?
2. How timely have the project inputs been deployed in relation to the annual work plans?
3. What is the project status with respect to planned outputs in terms of **quantity, quality and timeliness?** What factors impede or facilitate the production of such outputs?
4. To what extent are local expertise (by gender) and indigenous technologies and resources used?

Results/ Impact

1. What results and impacts have been achieved by the project as compared to the Objectives? Please note that the indicators as described in the project log frame should be used to assess results/ impacts.
2. Have mechanisms been put in place to ensure the sustainability of project results?
3. What has been the impact of the capacity building efforts?
4. How successful has the project been in maintaining interest of the private sector, which is a key stakeholder in the project, relevant research institutions and banking sector?

Institutional arrangements

How appropriate are the execution and implementation modalities?

1. How well was the project managed?
2. How adequate are monitoring and reporting mechanisms?
3. How adequate is the support provided by the UNDP country office?
4. Is there adequate government commitment to the project?
5. Do the stakeholders have a sense of ownership of the project?
6. What efforts are being made by the host institution to ensure the participation of different stakeholders in the implementation process? and
7. What is the extent of their participation?
8. Are there any conflicts of interest among stakeholders? If yes, steps taken to resolve them.

(c) Lessons Learned

The team will record any significant lessons that can be drawn from the experience of the project and its result, in particular anything that worked well and that can be applied to other projects and anything that has not worked so well and should be avoided in future.

(d) Recommendations

The evaluation team should come up with recommendation on how to improve the efficiency, effectiveness, impact and management arrangements of the project. The implementation of the project has slowed due to a boom in the steel industry, though this increases the demand and thus the profit margins, it also results in an increase in energy consumption and the urgency to introduce efficiency measures. Due to this surge in demand, industry's interest in the project has waned and it is important to develop an innovative approach to increase industry involvement. The project also has difficulty in identifying the best-practices, best available technologies and service and technology providers from other parts of the world. The project would benefit from international experience related to small industries energy efficiency initiatives.

Products Expected from the Evaluation

The team should produce an evaluation report with findings, assessment of performance, lessons learned, recommendations, description of best practices, and an "action list" of particular importance for the project

At the end of the three week evaluation, the consultants will submit the draft evaluation report to UNDP. Based on the comments on the report by UNDP, the consultants will finalize and submit the final version of the report (size: approx. 20 pages) to UNDP, New Delhi within two weeks of receipt of comments from UNDP.

Methodology or Evaluation Approach

The evaluation approach will combine methods such as documentation review (desk study); interviews; and field visits. All relevant project documentation will be made available to the team by the project management team, facilitated by UNDP. After studying the documentation the team will conduct interviews with all relevant partners including the beneficiaries, i.e. small scale steel rolling mills. Validation of preliminary findings with stakeholders will happen through circulation of initial reports for comments or other types of feedback mechanisms.

Throughout the period of the evaluation, the consultants will liaise closely with the UNDP Resident Representative, the concerned agencies of the Government, any members of the international team of experts under the project and the counterpart staff assigned to the project. The consultants can raise or discuss any issue or topic it deems necessary to fulfil the task, the consultants however is not authorized to make any commitments to any party on behalf of UNDP or the Government.

Evaluation Team

The evaluation team will be composed of one international and one national consultant. The consultants should not be associated with the project in any way and must not be serving as Government officials. The international consultant will act as team leader and is responsible for delivering the final report. The national consultant will report to the international consultant.

As a minimum the team should have the following qualifications:

- Experience with evaluations of GEF funded climate change projects
- Experienced in project cycle management
- Knowledge of the industrial energy efficiency in India and, preferably, comparable experience in other developing countries
- Understanding of the small and medium scale enterprises, preferably the iron and steel or secondary steel sector

Implementation Arrangements

The total duration of the evaluation will be 20 working days starting from mid-June 2007. After 15 working days a draft final report should be submitted to UNDP India latest by mid July 2007. After receipt of comments the remaining 5 days should be spent on addressing the comments, revising and finalizing the report. As the Ministry of Steel, the project team, industry association and associated financial institutions are based in New Delhi, all the information will be available locally. It is expected that the evaluation team will visit the resident missions in Mandi Gobindgarh and Bhubaneshwar and 3-5 model units in North cluster and at least 1 model unit each in the East and South clusters.

ANNEX B. ITINERARY OF THE EVALUATION TEAM AND LIST OF DOCUMENTS

B.1 Mission schedule and list of people met

24/06	• Arrival of Mr. J.H.A. van den Akker (international consultant) in Delhi
25/06	• Discussions with Ms. Preeti Soni and Mr. Sunil Arora at UNDP • Visit to TIRFAC Software Centre
26/06	• Arrival of Mr. Rajesh Kumar Singh (national consultant) • Meeting at PMC; discussions with Mr. G Madan (manager, M&E) and Mr. G Mishra (manager, P&C)
27/06	• Discussion and reporting
28-29/06	• Field visit to Mandi Gobindgarh and Ludhiana o Bhambri Steels Pvt. Ltd. o Vivek Re-Rolling Mills o Ludhiana Steel Mills o Dhiman Iron and Steel Industries o National Institute of Secondary Steel Technology (NISST)
30/06	• Discussion and reporting
02/07	• Discussions and review of reports at PMC • Reporting
03/07	• Meeting with gasifier equipment provider (Dev Knitfab) and consultant (Encon Thermal Engineers)
04/07	• Presentation of preliminary findings at UNDP; discussion with Ms. Vijaya Lakshmi (project coordinator) and UNDP team • Discussion with PMC and TIRFAC project team; • Meeting with Mr. Kumar A. Singh Deo (national project director)
05/07	• Departure of Mr. Van den Akker and Mr. Rajesh Kumar Singh from Delhi
13/07	• Visit by Mr. Rajesh Kumar Singh to Raipur (meeting with units, suppliers and PCRA)

B.2 List of reviewed documents

1. UNDP Project Document
2. GEF Project Brief
3. PR leaflet with information on the project
4. Paper on 'Energy Efficiency Improvements in Re-Rolling Sector, Data Gathering and Analysis of EcoTech Options'
5. APR-PIR (annual project implementation review), 2006 and 2007
6. Powerpoint Presentation by Mr. Mishra (PMC) on project progress
7. Project Progress Review, May 2007
8. Annual work plan and budget, 2007-07-24
9. Project Operational Manual
10. Project Monitoring and Evaluation Manual (elaborated by Ernst & Young)
11. Management Audit Report 2005 (by Lochan & Co)
12. Audit Follow-Up Plan 2005
13. Management Audit Report 2006 (by Lochan & Co)
14. Project Steering Committee Minutes of Meeting (September 2006, October 2005, February 2005, April 2004)
15. Project Advisory Committee Minutes of Meeting (March 2007, August 2006, December 2005, June 2005, December 2004).

ANNEX C. DISCREPANCIES IN THE PROJECT OPERATIONS MANUAL

Sl. No.	Page & Paragraph reference in	Relevant Extract from the Manual	Our Comments
1	Page 5, Paragraph 3.2.1.	PSC will be the apex level body with the following constitution …….. Members: Concerned ministries, Industry associations ……	Representatives of Industry Associations participating in the decision making process of the project as members of PSC may lead to conflict of interest. It may be appropriate to have representatives of Industry Associations as invitees attending PSC meet
2	Page 7, Paragraph 3.4.1.	Members: Representatives of …….. Industry Associations / Lead Units	Representatives of Industry Associations participating in the decision making process of the project as members of PAC may lead to conflict of interest. It may be appropriate to have representatives of Industry Associations as invitees attending PAC meet
3		PAC comprises essentially of a 6-member core group with a right to include additional members from among a list of 7 subject matter experts as may be necessary	Who all constitute the core group is not defined. The list of 7 subjects experts of which are to be inducted is not furnished
4	Page 8, Paragraph 3.4.3.	For meetings, the quorum will consist of at least 3 members of the core group including a representative from the UNDP office	Who all constitute the core group is not defined.
5	Page 8, Paragraph 3.5.1.	NPC shall notify a second person in line of co	The Project Document, which constitutes the agreement between the Ministry of Steel and the UNDP does not provide for a position of 'Manager (Projects & Contracts)'. The functions of Manager (Projects & Contracts), as provided for elsewhere in the POM, o
6	Page 11, Paragraph 4.3.	Cheques will be issued with signatures of any	It would have been appropriate to authorize lower level functionaries to sign cheques of smaller amounts upto a specified limit. Under the current arrangement, considerable amount of time of NPC is consumed in signing cheques of small amounts. This time
Sl. No.	**Page & Paragraph reference in the POM**	**Relevant Extract from the Manual**	**Our Comments**
7	Page 12, Paragraph 4.4.	The Authorization matrix (Delegation of Power) is	There are several shortcomings in the scheme of delegation of powers. Even petty expenses require the approval at a level not less than that of NPC. No delegation has been provided for certain categories of required expenditure. There was no need to de
8	Page 13, Paragraph 4.7	The Project document may be revised at any time by the PSC. However this would first have consent of PAC.	PAC is a sub-committee of PSC. It is not correct to require the PSC to have prior approval of PAC.
9	Page 24, Paragraph 6.9	The contract of the employee may be terminated a	The clause is discriminatory and may not stand the test of law. The employee also needs to be provided with an option to pay his pay and allowance for the period of one month or for the period by which his notice of resignation falls short of one month.
10	Page 24, Paragraph 6.10	Confidential Report (CR) to be performance orient	The procedure prescribed here is not in line with the industry practice. As a correct practice, NPC will be the Controlling Officer for Managers wheras below manager level, the concerned Manager will be the Controlling Officer