UNITED NATIONS DEVELOPMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY
PROJECT BRIEF ANNEXES
INDIA

Removal of Barriers to Energy Efficiency Improvement in the Steel Rerolling Mill Sector

Annex A. INCREMENTAL COST

Broad Development Goal

The development goal of the project is to increase end-use energy efficiency in the steel rerolling mills and thereby reduce greenhouse gas (GHG) emissions. The project will attempt removal of key identified barriers to accelerated adoption of EcoTech options / low cost integrated technology packages by steel rerolling mills.

Baseline

Despite virtual absence of small and medium capacity mills in the industrialized world, the demand of steel from rerolling mills in India is expected to continue and even grow faster in the coming 20 years. The sector has a large aggregate capacity and contributes roughly 35% of total steel production. It serves the *niche* market in meeting low volume requirement in various steel grades, sizes and shapes to a variety of customers. In spite of recession experienced in the steel industry, the sector had an average growth rate of about 6.0% in the last two years. According to an estimate by the Joint Plant Committee of Government of India, annual demand of steel products from rerolling mills will rise from a current level of around 10.0 million tonnes per annum to 12.5 million tonnes by 2007, 16.5 million tonnes by 2012 and to nearly 29.0 million tonnes by 2022.

In pre-economic liberalization era, this sector developed under a sheltered market economy without competition from the outside world. As a result, the industry grew in haphazard fashion adopting old and conventional technologies. The price protection and product reservation policies took away incentives for technological upgrades. This situation was compounded by the subsidized energy price regime and resulted in the high energy consumption norms in this sector. The economic liberalization policy adopted in 1990 has reduced the protection accorded to this sector. This, coupled with rapid expansion of capacity in expectation of rise in demand and the downturn in world economic growth, has affected the demand for steel and profit margins of industry. The competition has brought home the urgency of energy efficiency improvements in the sector to cut costs and remain competitive. The pressures of market forces, policies, power shortages, capital shortages, technical deficiencies, and environmental degradation have created opportunities for large scale adoption of EE technologies.

Though the prime moving force for adoption of advanced technologies exists, the process is both difficult and complex given the SME nature of the mills. The process requires these SME mills to move from low-tech to high-tech, which is challenging given that these EE technologies have been developed for higher scales of operation in the industrialized countries and the continuing biased nature of EE market against the SMEs. Further, many barriers that hinder the process are low energy costs relative to the material costs, lack of need based financing approaches and mechanisms, absence of effective market transformation strategies specific to the SME sector, lack of information, limited institutional and industrial capacity, low priority and bounded rationality, high transaction and hidden costs and limited commercial experience.

The Government of India has introduced policy measures for energy efficiency and conservation including the recent enactment of Energy Conservation Act, 2001. In the past, efforts were made through various programs, policies and incentive schemes to help industry adopt energy efficiency measures. A number of institutions promote and implement energy efficiency projects through demonstrations, such as the Petroleum Conservation Research Association (PCRA). But these efforts have not adequately addressed the needs of the small and medium sector and the key barriers continue with little significant gains.

In the above context, in the absence of the proposed GEF project, the technology upgrades and adoption of energy efficient measures in this sector will continue to be slow. The sector is presently on a slow learning curve. The lack of demonstrable examples of technologies, high cost of processing information and lack of resources to adopt technology (ies), all would result in the current low rate of technology adoption.

In order to develop the baseline for the sector and to identify units for demonstration of environmentally sustainable and cost effective EE technologies, a sample of 249 mills were considered out of a total of 1200 units. Out of 249 units, 90 units were visited and subjected to preliminary energy, process and technology audits. Finally, 27 units were selected as front rank units to work as sample units for demonstrating commercial application of advanced EE technology packages. Out of 27 units, 20 were selected for comprehensive energy studies by international consultants; MECON and SAILCON with support from international experts were hired for this purpose. The PDF experience highlighted that even those units, which are the best in the sector, need a lot of handholding in adopting advanced EE technologies. These units have the best efficiencies in the sector and are the leaders. It is expected that in the absence of this project the rest of the units will follow the leader and achieve the norms achieved by them over the next 10 to 20 year period. The cumulative production from this sector, over the next 20 years (2003 – 2022) would be 358 million tonnes. In the absence of global environmental considerations, the baseline would represent this production to achieve EE norms as met from the existing capacity. The estimated cost of the baseline is approximately US $ 64.41 million.

Table A1: Baseline Survey of 249 Rerolling Mills

Parameter	**First Rank Units (Selected)**	**Second Rank Units**	**Third Rank Units**	**Total**
No. of Units surveyed	27*	63*	159*	249
Capacity (million tonnes per annum)	1.25	2.3	4.75	8.30
Specific fuel consumption (MJ/tonne)	2385	2510	2600	2540
Iron Loss (kg/tonne) & (MJ/tonne)	21.6 (121)	22.8 (128)	23.7 (133)	23 (130
Power (MJ/tonne)	1170	1220	1250	1230
Yield (%)	92.7	91.7	91.0	91.5
Energy Consumption (MJ/tonne)	3676	3858	3983	3900
CO_2 emission rate (kg/tonne)	315	331	341	334

*mills actually visited; ** Mills studied by a team of multi-disciplinary experts.

Global Environmental Objective

The global environmental objective of the project is to reduce the present and future GHG emissions through widespread adoption of low GHG emitting technologies in the steel rerolling sector of India. The proposed project is seen to be beneficial both for the industry and the economy as a whole and can be sustained in the long run once the barriers are removed. The project is consistent with the GEF Operational Program No 5, "Removal of Barriers to Energy Efficiency and Energy Conservation".

GEF Alternative

The GEF project aims at accelerated penetration of low GHG emitting technologies in the steel rerolling sector. It thereby leads to reduction in the consumption in the fossil fuels and ultimately reduction in the GHG emissions. The steel rerolling sector has so far been reeling under technological regression and has not ventured into adoption of integrated energy efficient technology packages. The GEF alternative is designed to improve the energy efficiency of steel rerolling sector in India, largely through the transfer of low GHG emitting technologies both from within India and from international sources through application of advanced designs, process and production techniques and associated capacity building.

Under the project case, five technology packages have been proposed based on mill size, configuration and type of fuel used, in the areas of combustion, rolling mill and electric. The packages evolved from a range of EcoTech options available to the SRRM sector. These packages were further modified to apply at the unit-centered interfaces in order to provide balance-of-system. Of these packages, which are found to be the low-cost integrated type, there are four in the oil / NG category and one in the coal category. These packages are outlined below:

- **Technology package 1:** High Efficiency Recuperator in conventional Pusher Hearth Continuous Oil Fired Furnaces with customized packages. EcoTech options proposed would be High Efficiency Recuperator, Automation & Control, VVVf Drives, PF Correction, EE Drives, EE Lighting.
- **Technology Package 2:** Change of Oil fired pusher hearth to oil fired walking beam furnace with high efficiency recuperator and customized packages. EcoTech options proposed are Walking Beam Furnace, High Efficiency Recuperator, Automation & control, VVVf Drives, PF Correction, EE Drives, EE Lighting.
- **Technology Package 3:** Change of Oil fired pusher hearth to gas fired walking beam furnace with REGEN burners. EcoTech options comprise Walking Beam Furnace, REGEN Burners, PF Correction, EE Drives, EE Lighting.
- **Technology package 4:** a) Lump Coal Pulverized Coal Firing with Recuperator & Customized Package with EcoTech options, namely, High Efficient Recuperator, Automation & Control, VVVf Drives, Lump to Pulverized Coal Firing, PF Correction, EE Drives, EE Lighting; b) Lump Coal to Producer gas fired with High Efficiency Recuperator & Customized Package with EcoTech options Producer Gas Firing, High Efficiency Recuperator, Automation & Control, VVVf Drives, PF Correction, EE Drives & Lighting.
- **Technology Package 5:** Hot Charging in Composite Mills (Both oil & gas fired) with EcoTech options, namely, Hot/Warm Charging, High Efficiency Recuperator, REGEN Burners, EE Drives & Lighting, PF Correction.

The common elements of the technical packages in the Combustion (Furnace) consist of Improved Refractory Lining, Ceramic Fiber Veneering, High Emissivity Coating, and High Velocity/ Oil Film Burners. In the area of Rolling Mill & Electric, the EcoTech options would be Crop Length Optimization, Roller Guides, Roller Bearing, Spindle & Couplings, Tilting Tables, Drop Tilters, and Repeaters.

Table A2 summarizes the payback estimated for the technical packages along with their market and energy savings potential.

Table A2: Payback, Market and Energy Savings Potential by Technology Package

Proposed Packages	*Estimated Market Size: 2008–2012 (%)	Energy Saved (GJ/tonne)	Pay back (year)
Technology Package 1	28	0.712	1.78
Technology Package 2	20	0.949	2.04
Technology Package 3	14	1.033	1.54
Technology Package 4a	13	2.887	4.10
Technology Package 4b	11	2.178	4.18
Technology Package 5	14	1.05	1.5
Total	**100**	**1.3**	

* *Assuming total production from the SRRM sector during 2008-12 to be 74.1 million tonnes and the share of production using the proposed technical packages to be 36.4 million tonnes.*

Table A3 shows the "win-win" nature of the proposed packages. On the total life cycle cost basis, the alternative project case scenario becomes the least cost option. The cost of barrier removal activities is provided in the incremental cost matrix (Table A1). The proposed project would have two components: the "Program Component" that would be funded in part through the GEF, and the "Investment Component". The incremental costs associated with both of these components are described in detail below.

I) Investment Component

The Investment component is sub-divided into three areas i) Feasibility of EcoTech options, ii) Establishment of Technology Information Resource Facilitation Centre, iii) Strengthening manufacturing base of domestic energy efficient equipment suppliers.

i) Feasibility of EcoTech Options

The cost of proposed technology packages is estimated at US $ 17.01 million. The industry is seen to have a strong willingness to pay if the EE investments have paybacks within two to three years. However, there is reluctance to meet the high up front costs. The investment support is expected to guarantee the stipulated EE performance levels and promote sustained EE investments in future if all other barriers are removed.

Table A3: Incremental Cost Analysis of the "Investment Component" (US$Million/year)

Energy Efficiency Improvement	Baseline Scenario (B)	Alternative Scenario (A)	Energy Benefits (I)	Incremental Cost (A-I)-B
Technology Package-1				
(No. of units =10, capacity = 0.484 mill. Tonnes)				
Capital	17.83	20.56		
O&M, Material and Energy Cost	123.89	121.25		
Sub-total 1	141.72	141.81	2.64	-2.55
Technology Package-2				
(No. of units=3, capacity = 0.367 mill. Tonnes)				
Capital	14.84	19.07		
O&M, Material and Energy Cost	94.39	91.11		
Sub-total 2	109.23	110.18	3.28	-2.33
Technology Package-3				
(No. of units = 2, capacity = 0.245 mill. Tonnes)				
Capital	10.3	13.14		
O & M, Material and Energy Cost	62.30	59.74		
Sub-total 3	72.56	72.88	2.56	-2.24
Technology Package-4A				
(No. of units = 7, capacity = 0.226 mill. Tonnes)				
Capital	7.29	10.58		
O&M, Material and Energy Cost	57.03	55.38		
Sub-total 4A	64.32	65.96	1.64	0.00
Technology Package-4B				
(No. of units = 4, capacity = 0.196 mill. Tonnes)				
Capital	6.34	8.35		
O&M, Material and Energy Cost	48.29	47.81		
Sub-total 4B	54.63	56.16	0.48	1.05
Technology Package-5				
(No. of units = 4, capacity = 0.245 mill. Tonnes)				
Capital	7.84	9.73		
O&M, Material and Energy Cost	62.94	60.80		
Sub-total 5	70.78	70.53	2.14	-2.40
All Technology Packages				
(No. of units =30, capacity = 1.763 mill. Tonnes)				
Capital	64.41	81.42		
O & M, Material and Energy Cost	448.82	436.09		
Total	513.23	517.51	12.74	-8.46

Taken as a whole, all technology packages at 60 % capacity operation in first year, 70 % in second year and 80 % from third year onwards over life-cycle of 10 years, adoption of EcoTech options/packages is expected to result in energy consumption norm of 2804 MJ/ tonne of production, which is 31.5% lower as compared to the baseline (4090 MJ/ tonne). It will also result in 1.84% point increase in yield, from 92.33 in the baseline to 94.17%. The combined effect of these improvements will result in about 33 % decline in CO_2 emission per tonne of production, from around the 360 kg/tonne level in the baseline to about 240 kg/tonne level in EcoTech practice. Besides GHG reduction, the project will provide additional environment benefits through reduction in TSP (PM-10) emissions, and reduction in SO_2 and NO_X emissions. Assuming that the baseline and the GEF alternative scenario provide the same level of steel output, the GEF alternative would be associated with lower material and energy bills.

ii) Establishment of Technology Information Resource Facilitation Centre
Recognizing the inherent weakness of the industry with regard to technology absorption and transfer; design, development and implementation; development of customized EE solutions, and innovation support, high transaction and hidden costs, the Technology Information Resource and Facilitation Centre (TIRFAC) is proposed. The non-technical assistance costs of the centre to financed by the Steel Development Fund (SDF) are estimated at US $ 1.95 million. It is proposed to have modern prototype and hardware facilities and it would provide all the energy services required by the SMEs in the sector. It will network with financial institutions, ESCOs, environmental regulators, and industry for mobilizing resources and creating demand for its services in the areas of design and development, problem diagnosis and solution design and undertaking technology-based EE innovations. The revenues from these services, and membership fees from the industry and other institutions will help to sustain the Centre. The feasibility of the Centre has been studied for its long-term sustainability.

iii) Strengthening manufacturing base of domestic energy efficient equipment suppliers
The third part of the investment component is complementary in nature. It aims to strengthen the manufacturing base of the EE equipment / facilities in the country. In addition to the institutional support from TIRFAC, the domestic equipment manufacturers (DEMs) are proposed to be financed by IREDA to strengthen the existing manufacturing base for EE equipment / facilities. The cost of these improvement systems comes to approximately US $ 2 million.

II) Program Component

A number of barriers prevent the technology packages from being successfully disseminated, transferred and absorbed by the steel rerolling sector and, therefore, the project proposes to address them through a Program. The Program Component of the project case includes the costs of barrier removal activities and is outlined in the incremental cost matrix (see Table A4), the costs of which are shared by the SDF:

- Activity - 1, Benchmarking for EcoTech Options and Technical Packages, is unlikely to occur without this project intervention. Therefore, its costs of US $ 0.85 million are considered to be mostly incremental. As a result, GEF's contribution to this activity is US $ 0.70 million out of the required US $ 0.85 million.
- Activity – 2, Strengthening Institutional Arrangements, is considered largely incremental in nature for which GEF is requested to pay US $ 0.95 million out of a total of US $ 1.10 million.
- Activity – 3, Developing Effective Information Dissemination Program, is also considered to be mostly incremental in nature. GEF's contribution to this activity is US $ 0.40 million out of required US $ 0.50 million.

- Activity - 4, Enhancing Stakeholders Capacity, is incremental in nature as no structured arrangements for capacity building of major stakeholders exist. The contribution from GEF is sought to be US $ 1.55 out of the required US $ 3.00 million.
- Activity – 5, Establishing Feasibility of EcoTech Options and Technical Packages, has an investment component (US $ 17.01 million to be purely financed by the domestic resources as mentioned above). The Program Component of Activity – 5 includes 'Developing financial linkages and guidelines for support to pilot testing of packages in sample mills', 'Verifying techno-economic viability of the packages including cost recovery, performance and the impacts', 'Documenting implementation experience for developing model implementation practice', 'developing pipe line investment projects' and 'Disseminating the lessons learnt to wide range of stakeholders'. This activity is unlikely to happen without this project therefore is incremental in nature. It is, however, proposed to be carried out on a cost-shared basis with the industry. Therefore, the GEF is requested to contribute US $ 0.95 million out of an estimated total of US $ 2.20 million.
- Activity – 6, Establishing Innovative Institutional Mechanisms, builds on developing mechanisms of performance contracting, strengthening capacity of the ESCOs, developing institutional linkages and evaluating the market potential through demonstration of ESCO concept in sample mills is entirely new to the steel rerolling sector and therefore entirely incremental in nature. A contribution of US $ 0.85 is sought from GEF out of the total required US $ 1.15 million.
- Activity – 7, Establishment of TIRFAC, involves setting up of a project management and coordination unit for implementing project activities, developing work-cum-implementation and monitoring plan for activities in the Techncial Assistance component and establishing Technology Information Resource and Facilitation Centre, requires a GEF contribution of US $ 1.35 million out of a total requirement of US $ 2.10 million.

Costs

The total costs of the project intervention come to US $ 31.86 million. The baseline costs are estimated at US $ 64.41 million and the proposed alternative, including both the Investment and Program Components are estimated at US $ 96.27 million. The Program Component, which involves the cost of removing the barriers necessary to make the technology packages sustainable, is US $ 10.90 million, including M&E costs. With the GEF Alternative, global environmental benefits would be generated by collecting, inventorying and sharing information on SRRM sector in a network with global access that would facilitate informed decision making. Implementation of the GEF alternative would develop activities of a regional scope that would not have been possible under the baseline scenario. During and after the project, India would be able to consider the transboundary environmental issues and the development of a regional information network, which would help to monitor the EE and protect depleting energy resources of the country.

System Boundary

This project design adopts the concept of an inner and outer system boundary. Division is important when one considers the project design, which address components both inside the SRRM sector and also outside of the domain (or simply referred to as external dependencies). The common goal, however, is reduction in GHG emissions. In the former category, the project will address all components of SRRM sector, developing core competence of the industry through building up awareness and knowledge base, HRD, technology management and other capacity building programs delineated in the project design. In the latter category, the project will develop indigenous capacity of technology providers and service providers for manufacturing EE equipment, and develop integrated design and development facilities to enable the industry to adopt the equipment / technology, at any point in the chain of development. On external front, the project will address capacity building needs of domestic financial sector to fund technology-based development projects, develop institutional mechanism for addressing information asymmetry in the sector and information dissemination, provide institutional support for access to capital and build up technical capacity and capability of SMEs in this sector. The major demand of technology(ies) would emerge from user-centered interfaces, where diverse principal-agent relationships exists. The institutional mechanism would prevail upon to provide quality, cost competitiveness and time-to-market applications.

It is, however, stated that no fixed boundary conditions can ever be applied for technology-based projects, particularly in the age of technology. Technologies are continuously upgraded and redefined. The project design would adopt an analysis model to upgrade and to modify the boundary conditions in real-time. (This can be illustrated through the difference in boundary conditions that were set out in the PDF document versus the current Project Brief).

In terms of project impacts, though the system boundary is the SRRM sector the issues being addressed in this project are of national importance and are relevant for other energy intensive small and medium enterprise segments. Therefore, the learning from this sector will provide important feedback into the small and medium enterprise (SME) segment in general in the Indian economy.

Domestic Benefits

The annual benefits on an average of $ 4.5/tonne accrue to the mill owners through adoption of technology packages. The domestic benefits also arise from reduction in TSP emissions (PM10 emissions). The PM10 emissions make up around 30-35% of TSP and are reduced proportionally. TSP reduction, which is correlated to the average annual production rate of the SRRM sector, translates to a reduction in dust concentration of between 0.2 and 0.5 micro-gm/m3 in various geographic clusters. Although the amount is small, these regions are relatively highly populated (~ 0.25 million inhabitants and higher), therefore the benefits of reduced soiling (roughly 1.0 $ / person / micro gm-TSP); reduced morbidity, and reduced asthmatic cases (roughly $3.5 /person/micro gm-PM10) would be expected.

Table A4. Incremental Cost Matrix

Components	Baseline	Alternative	Increment
Global Environmental Benefits	Marginal decline in GHGs due to marginal improvements in energy efficiency gains. GHG emissions per tonne of production reduce by 2.91% by the year 2008. Cumulative CO_2 emissions will be 111 million tons over 20 years.	GHG emission in sample units will decline by an average of 32%. The overall impact on the sector would be a decline of GHG reduction per tonne of production by about 33% over a period of 20 years. Cumulative emissions will be 73.94 million tons.	Cumulative saving of CO_2 reduction will be 36.76 million tons over a period of 20 years.
Domestic Benefits	The adoption of low cost low risk technological options without major changes in process will result in marginal energy efficiency improvements. Also associated emissions will reduce with conservation of iron resource.	Introduction of technology options resulting in energy efficiency improvements of 31.5% in 30 sample mills. Over 70% of units expected to adopt these technologies over 20 years. Institutional mechanism bridges information gaps laying foundation for continual improvements in energy efficiency, as new technologies are commercialized/replicated.	Energy efficiency improvements of the order of 31.5% are expected. Creation of infrastructure and capacity for continual technological upgrades. Creation of models that could be replicated in other small and medium enterprises.
Program Component – ***Costs of removal of barriers to energy efficiency improvement in the steel rerolling sector (funded by the GEF and Govt. Counterparts)***			
1. Benchmarking for EcoTech options and technical packages established and validated.	There is no provision for Benchmarking EE norms and standards for equipment /devices manufactured in the country. Sale of equipment or technology is governed primarily by cost factor. ***Cost: 0***	Developing energy and environment labels, standards, and benchmarks including investment norms (techno-economic and cost recovery) of EE options and technology packages. Designing standard methods and tools for design engineering and implementation of EcoTech solutions. Developing information modules for financing institutions, government and policy makers, and industry partners. ***Cost: USD 0.85 million***	Benchmarking and development of standards would lead to establishment of minimum energy performance standards (MEPS). Design and operational manuals will be prepared and disseminated to industry for wide spread adoption of advanced technologies. ***Cost: USD 0.85 million*** ***GEF: USD 0.70 million*** ***SDF: USD 0.15 million***
2. Strengthened Institutional Arrangements	Lack of institutional capabilities to provide support to advance of EE technologies, appropriate funding products and mechanisms from domestic financial institution, connectivity at the institutional level for joint developments and technology transfer etc. The industry associations lack technology orientation and have no relation with institutional agencies that could support market transformation leading to adoption	Developing networks of association of private and public institutions and companies (domestic and international), bilateral/ multilateral organizations, banks and financial institutions to provide technical, financial and market inputs to the sector and securing policy and administrative support. Establishing self-financed business networks through self-financed association of multi-disciplinary experts, including successful entrepreneurs aimed at dissemination of experience and providing support.	In the absence of institutional arrangements and business support network, the entire activity is incremental in nature. This would facilitate development of research, design and technology development alliance, joint ventures and cooperation for technology transfer, as well as establishment of long term institutional framework and connectivity.

Components	Baseline	Alternative	Increment
	of EE technologies. ***Cost: 0***	Developing internationally linked institutional capacity (joint ventures, technical cooperation, etc) aimed at facilitating technology transfer. ***Cost: USD 1.10 million***	***Cost: USD 1.10 million*** ***GEF: USD 0.95 million*** ***SDF: USD 0.15 million***
3. Effective Information Dissemination Program Developed.	There is no formal mechanism for collating, evaluating and disseminating information on resource personnel/experts, institutions, technologies, markets and financing products. SRRM industry in SME segment has no source of information for techno-economic parameters, operating experience and risks associated with adoption of new technologies. Technology and service providers often provide incomplete information without SOPs/SMPs and performance norms. ***Cost: 0***	Establishing worldwide database on EE technologies (sources of supply and investment costs, expert analysis, projects, markets, opportunities, and related stakeholders). Disseminating information through newsletters, technical bulletins, website and expert presentations, including regular briefs to industry on markets, new funding schemes and new technological developments. ***Cost: USD 0.50 million***	An information system with communication facilities to collect, store, retrieve and disseminate information to all stakeholders is an incremental activity for the sector. ***Cost: USD 0.50 million*** ***GEF: USD 0.40 million*** ***SDF: USD 0.10 million***
4. Enhanced Stakeholders' Capacity	The industry and various stakeholders utilize informal channels for building capacity. Slow build up of capacity in normal process adversely affects technology adoption and absorption. The operating personnel in industry lack experience and expertise to operate high-end technologies. Banks and FIs lack appreciation, expertise to appraise, finance and monitor EE projects. Local administration/Government agencies experience are unable provide the requisite support to EE project due to lack of appreciation an exposure to needs of SME segment. ***Cost: 0***	Assessment of capacity needs of stakeholders to implement and absorb advanced EE technologies followed by time-bound action plan. Conducting training programs / workshops in EE technologies and technology management including cooperative procurement of EE technologies in clusters, engineering and implementation. Developing Standard Operating Practices (SOP) and Standard Maintenance Practices (SMP). Facilitating absorption and assimilation of "Best Practices". Training of trainers program for developing industrial and institutional in-house capacity such as development of Energy-cum-Investment managers. Training local, state and central level banks, state financial institutions, manufacturers and suppliers of services, and local/regional consultant through special pilot programs. Institutional collaboration / tie-ups with clusters to facilitate new EE projects. ***Cost: USD 3.0 million***	Dedicated capacity building programs covering training workshops, development and implementation of SOPs/SMPs and dissemination of "Best Practices" will strengthen capacity and capability of the SRRM sector to undertake EE projects. Since no structured arrangements for capacity building exist, all activities proposed are incremental in nature. ***Cost: USD 3.0 million*** ***GEF: USD 1.55 million*** ***SDF: USD 1.45 million***

Components	Baseline	Alternative	Increment
5 Technical and financial feasibility of EcoTech options and technical packages established.	Under the existing circumstance the industry is likely to adopt energy efficiency measures implemented by a few industry leaders and would be financed through own resources. These attempts will be in piecemeal manner and restricted to low-investment, low-risk options. ***Cost USD 0 million***	Developing financial linkages and guidelines to support pilot testing of packages in sample mills. Verifying techno-economic viability of the packages including cost recovery, performance and the impacts. Documenting implementation experience for developing model implementation practice. Disseminating the lessons learnt to wide range of stakeholders. Developing pipeline investment projects. ***COST: USD 2.20 million***	Exposure of the industry to E^4STs is entirely new and therefore incremental in nature. The activity undertaken in this component will reduce the risk perception with respect to these technologies and help in restructuring the sector close to the international boundaries with regard to energy and environmental efficiency norms. This would lead to expanded investments in EE. ***Cost: USD 2.20 million*** ***GEF: USD 0.95 million*** ***Industry: USD 1.25 million***
6. Innovative institutional mechanisms established	No ESCOs in operation. Since the technologies adopted are low costs and from local sources, ESCOs do not find opportunities in this sector. Lack of familiarity on both sides also restricts its possibility. ***Cost: 0***	Developing mechanisms of performance contracting involving identified ESCOs and technology providers. Strengthening capacity of the ESCOs for implementing identified technical packages for the mills. Developing institutional linkages among existing ESCOs, technology providers and industry. Evaluating the market potential through demonstrating ESCO concept. ***Cost: USD 1.15 million***	ESCO operation demonstrated and information disseminated in the sector will result in development of a new funding mechanism with least risk for SRRM sector. ***Cost: USD 1.15 million*** ***GEF: USD 0.85 million*** ***SDF: USD 0.30 million***
7. Technology Information Resource and Facilitation Center Established.	The implementation of Energy Efficiency Bill and other economic measures for EE improvement do not have specific focus on SRRM sector. No dedicated institution caters to SRRM sector for evaluation of technology, RD&D, unbiased information resource on technology integration and techno-economic feasibility. Information on technology and its economic viability is available from vendors or other users only. ***Cost: 0***	Setting up project management and coordination unit for implementing project activities. Developing a comprehensive work-cum-implementation and monitoring plan for activities in the TA component. Establishing Technology Information and Facilitation Center. ***Cost: USD 2.10 million***	Since the institutional arrangements and business support network is totally missing for the sector, the entire activity proposed to be established in alternate scenario will be incremental in nature for the SRRM sector. ***Cost: USD 2.10 million*** ***GEF: USD 1.35 million*** ***SDF: USD 0.75 million***
SUB TOTAL (Program Component)	***USD 0 million***	***Cost: USD 10.90 million***	***Cost: USD 10.90 million*** ***GEF: USD 6.75 million*** ***SDF: USD 2.90 million*** ***Industry: USD 1.25 million***

Components	Baseline	Alternative	Increment
Investment Component – ***Costs of feasibility of EcoTech options, establishment of Technology Information Resource Facilitation Centre (TIRFAC) and strengthening manufacturing base of domestic energy efficiency equipment suppliers (Funded by non–GEF resources)***			
1. Feasibility of EcoTech options	The sector has a strong willingness to pay if the EE investments have paybacks within two to three years. However, there is reluctance to meet the high up front and start-up costs. Market size for EE technologies and EcoTech will remain limited due to high perceived technical and financial risks by industry. Industry is likely to adopt energy efficiency measures in a piecemeal manner and restricted to low investment-low risk options. ***Cost: USD 64.41 million***	Implementing 5 technology packages in 30 sample mills 23 on one-to-one basis and 7 through ESCOs. ***Cost : USD 81.42 million***	Demonstrating the viability of technical packages including cost recovery to improve confidence, facilitate removal of barriers associated with limited commercial model experience in the minds of the stakeholders, lower risk perception. ***Cost USD 17.01 million*** ***GEF: USD 0.00 million*** ***SDF: USD 2.43 million*** ***Industry: USD 3.29 million*** ***FIs/DST: USD 11.29 million***
2. Establishment of Technology Information Resource Facilitation Centre	No dedicated institution caters to SRRM sector for evaluation of technology, RD&D, unbiased information resource on technology integration and techno-economic feasibility. Information on technology and its economic viability is available from vendors or other users only. ***Cost: USD 0***	Establishment of Technology Information and Facilitation Centre with most modern hardware, prototype and software facilities specific to the needs of the steel rerolling sector. ***Cost: USD 1.95 million***	The centre is the first in the country to facilitate SMEs in the sector in technology transfer / absorption, design development / implementation, development of customized EE solutions and providing R&D and Innovation support ***Cost: USD 1.95 million*** ***GEF: USD 0.00 million*** ***SDF: USD 1.95 million***
3. Strengthening manufacturing base of domestic energy equipment suppliers	EE investments have behaved in an 'incoherent' manner with a serious gap in capacity of DEMs to provide well designed standard EE equipment / services to the industry. DEMs do not have facilities to provide well engineered, designed and customized EE solutions at the user-centered interfaces. The situation has created an abundance of low-cost energy intensive alternatives in the market ***Cost : 0***	In addition to institutional support from TIRFAC, the activities comprise strengthening of manufacturing base for energy efficient furnaces, mill equipment and accessories and electrics through import of design software, institutional and / or collaboration tie-ups. ***Cost: USD 2.00 million***	Since strengthening of manufacturing base of DEMs, specific to the needs of the SMEs in the sector is totally new in the country, therefore considered as incremental in nature. ***Cost: USD 2.00 million*** ***GEF: USD 0.00 million*** ***SDF: USD 0.00 million*** ***FIs: USD 1.00 million*** ***Industry: USD 1.00 million***

Components	Baseline	Alternative	Increment
SUB-TOTAL (Investment Component)	***Cost: USD 64.41 million***	***Cost: USD 85.37 million***	***Cost: USD 20.96 million*** ***GEF: USD 0.00 million*** ***SDF: USD 4.38 million*** ***FIs/DST: USD 12.29 million*** ***Industry: USD 4.29 million***
GRAND TOTAL (Program Component + Investment Component)	***Cost: USD 64.41 million***	***Cost: USD 96.27 million***	***Cost: USD 31.86 million*** ***GEF: USD 6.75 million*** ***SDF: USD 7.28 million*** ***FIs/DST: USD 12.29 million*** ***Industry: USD 5.54 million***

Annex B. Logframe Matrix

STRATEGY	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
Overall Project Goal (Impact)			
To reduce GHG emissions in the steel rerolling mill (SRRM) sector in India.	o Compliance with established energy & environment efficiency norms of EcoTech options & technology packages adopted. o 'Progress Ratio' measurement study after every 2 years. o Beginning first year EcoTech coverage increases to 25% by end of fifth year.	o Annual statistical progress report of Ministry of Steel (Office of the DCI&S). o 'Green' Balance Sheets of SRRM Units (by TIRFAC) o Baseline & EcoTech study reports (by TIRFAC) o Bi-annual cluster reports and Annual country reports	Ministry of Steel (EA) sets up an internationally linked self-financing institutional capacity and maintains the required human and financial resources.
Project's Goal (Outcome)			
To improve energy efficiency in the SRRM Sector by expanding private sector investments in 'win-win' nature of low GHG emitting technologies (EcoTechs).	Share of EcoTech increased to 25% (3 million tons) by end of the project period resulting in cumulative energy saving of 9 PJ and 0.88 million tonnes of reduction in CO_2 emissions.	o Bi-annual and annual study reports of TIRFAC based on regular field studies. o Collection of data from secondary sources	o Market demand, Policy and regulatory framework sustained. o Adequate availability of semis (raw material used for rerolling) o Required equity / credit is available.
Outputs / Components			
1. Benchmarks for EcoTech options and technical packages established and validated			
o Industry compliance to energy-cum-environment performance benchmarks or 'best-practice' norms. o Energy and environment labels, standards, and benchmarks including investment norms of EE options and technology packages developed by end of third year. o Standardized methods and tools for design, engineering and implementation of EcoTech solutions designed. o Information modules for FIs, govt, policy makers, and industry developed.	o Actual performance of sample units validated after one year of their stabilization o Techno-economic viability including cost recovery (CCE, IRR, Payback, BEP, etc.) is established. o Standard design and implementation manuals prepared and distributed o Information modules (1c) developed and disseminated by the end of 18 months of the start of the project. o Feedback from FIs, government and policy planners and industry. o	o Evaluation report of 'Best-practice' norms o Report on verification standards by experts' panel. o Results documented for sample units o Performance report on continuous working of the technology packages in the sample mills. o Field visits and monitoring and evaluation reports o National standard evolved.	o Technology sources are available. o Sources are keen to build up the market by tailoring technologies to match size and configuration the mills o Local expertise for implementation is available. (This risk will be mitigated through capacity building)

STRATEGY	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
2. Institutional Arrangements Strengthened			
o Networks of association of private and public institutions and companies, bilateral and multilateral organizations, financial institutions providing technical, financial and market inputs to the sector within the legal framework of the nation are developed. o Business networks established through self-financed association of multi-disciplinary experts including successful entrepreneurs. o Institutional capacity to facilitate technology transfer developed.	o Contract completed by specialist agency / organization for establishment of business support networks and development of internationally linked institutional capacity successfully by the end of 3rd year. o Hardware facilities namely prototype development, technology testing and calibration along with software facilities put in operation by the end of 3rd year. o Design, standards and implementation manuals put in practice during the same period.	o Annual project implementation report by PMC.	o Means of communications available o Willingness to participate and collaborate remains high
3. Effective Information Dissemination Program Developed			
o Establishing worldwide database on current and emerging EE technologies including sources of supply and investment costs, expert analysis, projects, markets, opportunities, and related stakeholders. o Disseminating information through newsletters, technical bulletins, website and expert presentation.	o Report identifying information needs, information sources, dissemination channels and MIS finalized by end of 1st year. o System design, data collection, alliances and mechanism established by end of 2nd year. o Information dissemination channels & access procedures operationalized by end of 3rd year.	o Stakeholders survey of project impacts o Publications/case studies	o Competent task-specific expertise is locally available.
4. Stakeholders capacity enhanced			
o Carrying out capacity building need assessment of the major stakeholders to implement and absorb advanced EE technologies in the sector. o Identifying specific capacity building needs for preparation and implementation of a time-bound action plan for capacity building of the major stakeholders. o Conducting training programs/workshops in EE Technologies and Technology	o Technology, resource and capacity building needs of each cluster mapped with time bound action plan in first year. o Master plan for capacity building activities is finalized and documented by 13th month. o 5 cluster workshops for units / DEMs / consultants on 'new' technologies and technology management each year o 10 Workshops for unit owners / managers on cooperative management practices and procurement processes in each of 5 clusters over 5 years. o Standard Operating Practices (SOP) and Standard	o Annual Project Implementation Reports and Reviews (Short, Mid & Long-term). o Formal participants' satisfaction survey conducted at conclusion of each capacity building activity (Level I) o Formal participants' skill evaluation at conclusion of every capacity building	o Policy and administrative support at all levels due to involvement of ministry of steel. o Competitive training/ capacity building resources including modern software facilities are available

STRATEGY	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
Management including cooperative procurement of EE technologies in clusters, engineering and implementation support. o Developing Standard Operating Practices (SOP) and Standard Maintenance Practices (SMP) o Facilitating absorption and assimilation of 'Best Practices'. o Training of trainers' programme for developing industrial and institutional in-house capacity such as development of Energy-cum-Investment managers. o Training local, state and central level banks, state financial institutions, manufacturers, and suppliers of services and local/regional consultant. o Institutional collaboration/tie-ups with clusters to facilitate new EE projects.	Maintenance Practices (SMP) developed in third and fourth year o 'Best Practices' program developed in second year and workshops conducted in third and fourth year. o Three exposure visits to developed countries for DEMs / local consultants. o 5 interaction and policy-oriented workshops for central / state govt. institutions on complex SME issues and constraints. o 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. o Pilot programs for local govt., administrators, and planners focusing on energy efficiency and greening of environment conducted in each cluster beginning second year. o Workshops on evaluating of EE technologies and projects for financing / banking sector.	activity (Level II) o Independent Peer Reviews (IPRs) for capacity building efforts. o Action Taken Reports (ATRs) for capacity building activity plan.	
5. Technical and financial feasibility of EcoTech options and technical packages established			
o Developing financial linkages and guidelines for support to pilot testing. o Implementing 5 technology packages in 30 sample mills – 23 on one-to-one basis and 7 through ESCOs. o Verifying techno-economic viability of the packages including cost recovery, performance and the impacts. o Documenting implementation experience for developing model implementation practice. o Disseminating the lessons learned to wide range of stakeholders.	o 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. o Documentation of lessons learned in successive years as above. o Multiplication strategy package wise developed and recommended in successive years in accordance with successful implementation of packages as above.	o Progress report on implementation of demonstration units. o 'Best Practice' reports prepared by a Group of national and international experts based on demo units' operation.	o Acceptance of the project by major stakeholders. o Executing agency ensures implementation at minimum cost.
6. Innovative institutional mechanisms established			
o Developing mechanisms of performance contracting involving identified ESCOs (Thermax EPS,	o ESCOs identified. Performance capability of ESCOs specific to the needs of rerolling mills enhanced by the end of 2nd year	o Project completion reports by ESCOs as per agreement. o Annual Market Survey	o Availability of national & international ESCOs

STRATEGY	INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
INTESCO ASEA, ELPRO ENERGY CENTER, SEETECH INDIA, DCM. and 3EC) and technology providers o Strengthening capacity of the ESCOs for implementing identified technical packages for the mills o Developing institutional linkages among existing ESCOs, technology providers and industry o Evaluating the market potential through demonstrating ESCO concept	o Market transformation strategy developed and implemented at end of the 2nd year. o 5 ESCOs operationalised from third year. o Demonstration of EcoTech packages in 7 units through ESCO route between 3rd and 5th year. o A minimum of 90 % of EE solutions (EcoTech options/tech. Packages proposed under the project) become locally available at conclusion of the project.	Reports.	and their willingness to participate.
7. Technology Information Resource and Facilitation Centre Established			
o Setting up of a project management and coordination unit for implementing project activities o Developing a comprehensive work-cum-implementation and monitoring plan for activities in the TA component o Reporting to funding agencies as per the pre-determined progress indicators for various activities in the project. o Documenting lessons learned for all project activities and their objective vis-à-vis outputs. o Establishing technology information and Facilitation Centre.	o PMC set up in 10 weeks after project approval by GEF Council. o Annual Work plan approved by PSC and job order issued which coincides with 'zero' date of the project. o Master plan for project activities is finalized and documented in first 10 weeks. o Monitoring and Evaluation Plan along with reporting procedures finalized and PMC staff appointed at the end of 6th month. o Monthly / quarterly / annual performance review formats prepared for adoption by all project constituents at the end of 6 months. o Software and hardware centers of TIRFAC set up at the end of 2nd and 3rd year respectively.	o Job Order issued o Project Progress & Completion reports (PPR & PCR) plus mid-term Review and Action Taken Reports by Project Advisory Committee. o Annual Disbursement and Audit Reports	o Competent task-specific expertise is locally available. o Policy and administrative support available. o Financial resources (GEF and non-GEF) are available in time. o EA exercises financial discipline to ensure implementation of project at minimum cost.

Annex C. STAP Review

REMOVAL OF BARRIERS TO ENERGY EFFICIENCY IMPROVEMENT IN STEEL REROLLING (SRRM) SECTOR

Summary and General Review

The steel rerolling mill (SSRM) sector is unique to India, especially due its widespread application, and large number of small mills (1200). The proposal provides a comprehensive approach to deal with the multitude of barriers commonly found in industry and small and medium-sized enterprises (SMEs). A five-year program is proposed to develop, demonstrate, market and disseminate 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 proposed approach seems appropriate to reduce or remove some of the barriers found in this industry for energy-efficiency improvement.

However, specific elements of the proposal and program need additional attention to demonstrate the likelihood of success and improve the long-term sustainability of the approach. Below we discuss these aspects in detail. The most important elements that need improvement are:

- More information on the economic and technical characteristics (including distribution) of SRRM-sector is needed to devise an effective and efficient communication strategy.
- Development of a more plausible forecast of the long-term development within the sector, and the impact on program design.
- Improved assessment of the direct and indirect impacts of the proposed program on energy use, GHG emission reduction, local air pollution and air quality, as well as economic performance of the industry.
- Training of SRRM operators and managers needs to be clearly included as an integrated activity to achieve additional savings, and improve effectiveness of the program.
- Embedding of the program and organization into existing international standards (ISO), protocols (for evaluation) and existing experience in working with innovative SMEs.
- Embedding of the program in existing organizational structures of the SRRM-industry on a regional or local basis (if existent).
- Design of an effective and efficient communication and dissemination approach tailored to the specific needs of the SRRM-sector.
- Development of ways and means to ensure the sustainability of the market transformation effort through cost-reduction (after 5 years of establishing the program), partnering, market development and direction of the program efforts (e.g. market segment of the SRRM-industry).

Based on my understanding it will be possible for the proposers to adapt and improve the proposal taking into account my suggestions in the review report. This would strengthen the proposal considerably.

Scientific and Technical Soundness

The large number of SRRMs is a unique characteristic of the steel industry in India. Many of these plants have an extremely small capacity, especially when compared to the international iron and steel industry. Given this unique character, it is advisable that the proposal, or appendices, contain more detail on the sector and its future. The current proposal provides average data, based on an extensive survey in the five clusters of SRRMs. The survey is extremely valuable. However, the proposal does not contain any data on economic, environmental and product quality issues of the SRRM-sector. This is not only important to evaluate the co-benefits of the proposed technology packages, but also to evaluate the most successful direction and implementation of the proposed program (see also below under sustainability and stakeholder involvement).

Given that 75% of the 1200 plants are small-scale plants, there may be serious limitations to the product quality and the consistency of product quality of products of these small-scale plants. The scale of the plants is extremely small. For comparison electric furnaces in the SRRM sector have a heat size of a few tons, while modern electric arc furnaces have heat sizes of over 100 tons. Many of the rolling mills (not composite plants) have an even smaller production capacity. It would be good to provide a distribution of the sizes of the plants to get a better understanding of the industry and be able to better pinpoint the target group of the proposed program within the wider SRRM-industry (see also below under sustainability).

The program proposes the development of efficiency standard and benchmarks. While the standards can help to 'weed out' the inefficient and polluting smallest plants, the use and legal basis for the standards is unclear in the proposal (see also below under sustainability). Also, the use of benchmarks for the technical packages is unclear. This part of the proposal needs to be further developed and the expected use of standards and benchmarks needs to be clarified, and whether these are used with respect to *processes* or *technical packages*.

The program aims at the introduction of *technical packages*, but does not address process and energy management issues. Given the lack of specialized personnel within SMEs, training in 'best practice' management strategies and practices would be an important item to add to the program. Training should not be provided as a single event, but should be provided in the form of continuous learning. Providing a program of continuous training will also help to build an active network of plant operators and managers, contributing to the success of the overall program. It is advised that the proposed center (TIRFAC) would develop and provide the training material, and 'train the trainers'. The trainers need to be based and active within each of the clusters, making communication routes shorter and more effective.

The assumed growth scenario (until 2022) seems unlikely, given an increasing demand for higher quality products, and increasing economies of scale to compete on a national and global steel market.[1] Also, the current capacity utilization of the SRRMs seems very low (60% on average), underlining that future growth can for a large part be met by available capacity. It is unclear from the proposal how much new construction of SRRMs is expected, and how the project will influence the energy-efficiency of the new plants. The current proposal aims at existing SRRMs. However, SRRMs to be constructed (if the scenario in the proposal were correct) provide a low-cost opportunity and new capacity will actually be constructed. The assumed growth scenario is also important for estimating the expected savings (directly and indirectly) due to the program.

To sustain the results of the project it is advisable to focus on the segment of SRRMs that will survive long-term (see also below). This can be strengthened by emphasizing the use of international standards in the selection of mills for the demonstration projects. For example, companies that have an ISO 9000 certification, or will receive one, would be eligible for participation in the program. Furthermore, the project can work with participating SRRMs to foster the use of ISO 14000 and energy management systems.

[1] For example, many small inefficient and polluting plants that produced low-quality iron and steel also characterized the Chinese steel industry. In the past decade many, if not all, have been closed, and iron and steel plants have production capacities comparable to international facilities (even though the capacity of individual process (e.g. blast furnace, electric arc furnace, BOF converter) are still relatively small).

Although the quantitative basis for the assumptions in the proposal look reasonable, the proposers do often not clearly define the terms used in the proposal, which makes it hard to interpret the technical basis of the proposal:

- Generally, secondary steel production means the production of steel from secondary resources (= scrap). However, the authors seem to use the term to reflect both secondary steel production and SRRMs. However, only part of the SRRMs do melt steel in furnaces, while others may use ingots or billets. These ingots and billets may come from primary and secondary mills. Hence, SRRMs (without the composite mills) are a third segment of the market, and not necessarily part of the secondary steel market.
- The proposers claim that 75% of the 1200 units are 'small scale' the definition of small scale is never given. Is this less then 10,000 tonnes/year or more?
- The proposers use the terms ecotech and alltech, without proper definition of the terms. The International Iron and Steel Institute introduced the terms in the 1998 report "Energy Use in the Steel Industry".[2] In the IISI report ecotech represents a process that makes use of all proven energy saving technologies that are commercially attractive. The alltech process represents a process in which all proven energy saving technologies have been included. However, the proposers use it to define a set of energy-efficiency measures. From correspondence with the proposers it is clear that they used different economic criteria to select "ecotech" energy-efficiency improvement technologies (e.g. selecting all cost-effective measures using a 30% discount rate).[3]
- The proposers give average fuel use for the different clusters/regions by fuel in kg of coal and liters of oil, without specifying the energy contents of the fuels used. Using common international energy contents for coal (29.3 MJ/kg) would give an extremely high energy consumption of 7.5 GJ/tonne or rolled steel (compared to 5.06 GJ/tonne in Table 2). Given, the variation in coal quality in India it is recommended to provide energy consumption figures in accepted SI energy units.
- Does the electricity use provided in Table 1 include induction and electric arc furnaces? I assume not, and that solely the electricity in the rolling operations is included.

Hence, the proposers need to develop a clear set of definitions to provide a clearer basis for the assessments included in the proposal.

In this context it is unclear what the purpose is of the comparisons in Table 2. The Ecotech and Alltech (Europe) cases in Table 2 are assessments of best practices around the world (based on the 1998 report of IISI, see above), and not actual average energy consumption in section mills in Europe. The energy consumption figures for Japan seem to be for a hot strip mill, and not for section, bar or wire mills. Furthermore, the plants in Europe and Japan are typically large-scale facilities, and incomparable in size to the SRRMs.

A central element of the proposal is the establishment of a research and information center specifically for the secondary steel industry (TIRFAC) in India. International data collection: this is a sector specific for India, as steelplants in the rest of the world are typically of much larger scale, and even stand alone rolling mills are of much higher capacity. Only a few developing countries would face similar issues. Hence, technology available elsewhere in the world would

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[2] International Iron and Steel Institute, Committee on Technology. *Energy Use in the Steel Industry*. IISI, Brussels. Belgium, September 1998.

[3] From the technical appendix it can be deducted that the selected combustion measures all have a CCE (or payback period) far below the criteria set for selection. Only the packages developed for coal-fired furnaces come close to the criteria. This suggests that there may be more cost-effective opportunities available in the furnace.

need to be 'downscaled' for use in the small-scale SRRMs. How will TIRFAC collect international data, select and evaluate technologies specific enough for the SRRM situation? This justifies the research and testing facility to be housed in the center. Also, the institute should be housed in an appropriate organization and location, so that it can easily be integrated in existing networks of SRRMs throughout the five regional clusters.

Global Environmental Benefits (and Drawbacks)
The proposal does not provide an understandable estimate of the overall direct energy savings from the proposed program and estimates of the indirect savings due to dissemination and replication throughout the SRRM sector. In the current proposal a footnote estimates savings at 21 PJ over 20 years. This seems low, as the total potential (30% savings, 100% penetration at current production volume) would be equal to 17.6 PJ *annually*. Furthermore, the basis for a project cycle of 20 years is unclear. Burners and motors last shorter than 20 years, as will many other parts of the furnace (lining) and rollers of the section mill. The estimate given in a footnote is impossible to understand without further information, e.g. expected degree of implementation by furnace-type and package (directly and indirectly). The same holds true for reductions in CO_2 emissions, which are currently not estimated in the proposal.

Other Environmental Benefits
The proposal does not estimate other environmental benefits of the improvements in energy-efficiency. This is unfortunate, as these savings will be very important for local air pollution (e.g. SOx, NOx, PM) reduction. Although the GEF Operational Strategy focuses on climate change, these improvements in local and regional air quality are very important for local support of the program. Furthermore, improvements in working conditions and employee health are important co-benefits.

GEF Priorities
The project fits with the GEF priorities as defined in the Operational Strategy for Climate Change and the Operational Program for removal of barriers to energy efficiency and energy conservation. The proposed program will remove and reduce barriers to energy-efficiency improvement in an industry that traditionally is hard to reach with energy policy (SMEs). The proposed technical packages do meet economic criteria, and would lead to "win-win" solutions.

Evaluation
There is a clear need for improved methods of quantitative evaluation of the program results. While it is hard to quantitatively evaluate program elements such as dissemination and stakeholder participation, it is important to measure those elements that can be quantified, e.g. achieved energy savings at the 30 plants, sales of the technical packages and technologies, etc. For this purposes the proposers should develop a clear protocol, possibly following the International Monitoring and Verification Protocol (IPMVP). Furthermore, it is advised to have the evaluation done by an independent organization to ensure unbiased results.

While it is essential to have a representative Project Steering (PSC) and Project Advisory Committee (PAC), these should not be too large to reduce overhead, to reduce delays and complex decisionmaking structures. Furthermore, it seems strange to have large steel plants participate in the PAC for a project aimed at technology improvement in the SRRMs (a competitor). Participation of individuals from the steel industry with expertise essential for the project should be welcomed.

Replicability
The program initially will work with 30 of 1200 SRRMs in India, but a dissemination approach is developed to reach out to the other mills (see also below). The size of the industry would provide ample potential within the sector. Further replication outside of India will be limited, as SRRMs are a development typical for India. However, some of the concepts developed, and especially the combination of a number of approaches for barrier removal may be replicable in other sectors dominated by SMEs in India and other developing countries.

Sustainability
The sustainability of the proposed program will depend on the establishment of networks and an organizational structure that can survive without additional international funding after 5 years. The likelihood will depend on the effectiveness and efficiency of the program in reaching out to the SRRMs, achieving cost reductions for SRRMs, while demonstrating the overall gains for the Indian economy and (global) environment.

There are three elements in the proposal that need attention in evaluating the long-term sustainability of the program. First of all, the sustainability of the SRRM-sector is an important factor. As discussed above, it seems unlikely to me that the 900 small SRRMs can survive the next decades. I think that the Indian steel industry will follow similar development patterns as elsewhere in the developing world, and ultimately will focus on large integrated mills, and medium-scale flexible plants using scrap, DRI (direct reduced iron)[4] and smelt-reduction as inputs. The larger SRRMs may survive and develop into flexible secondary steel mills. Hence, for the sustainability of the program it is advisable to focus on the plants that are likely to survive in the developing Indian steel market.

Secondly, the sustainability of the ESCO market for industry in India is an uncertainty factor. Outside of India ESCO-activity in industry has been limited, and experience relatively recent. It is unclear from the proposal what the ESCO-experience is in Indian industry, especially with SMEs. This may need more research at the beginning of the project, to identify the most effective and successful ways to improve collaboration between ESCOs and SRRMs. As a backup strategy, the proposal includes working with banks. It may be attractive to actively identify ways to develop appropriate ways of financing energy-efficiency projects in the SRRM-industry by commercial banks.

Thirdly, the overall effectiveness and efficiency of the program has to improve to sustain the program. Because of high transaction costs, any energy-efficiency program with SMEs is likely to have higher costs than other industrial energy-efficiency programs. The specific costs of the program (based on estimated energy savings and submitted financing request), are \$1.3/GJ-saved (excluding cost-share industry), which are high. Part of the high costs is due to the actual cost of energy-efficiency demonstration projects (cost-shared with industry), and the start-up costs of an information and research center. Still, the program should search for effective ways to reduce the overall costs for future sustainability and replication.

Finally, it is important provide a sustained regulatory and policy framework for the program. The program may help to develop approaches that can successfully be adapted to policies, such as the development of minimum efficiency standards for SRRMs and specific product categories. Also, the approach in the project may help to develop similar approaches for other industrial sectors

[4] India is already one of the larger producers of DRI in the world, using mainly coal-based processes. DRI is used as a high quality iron-input in the electric arc furnace to produce high-quality steel. However, total DRI-production is limited to about 4% of total pig iron production.

dominated by SMEs. However, for this to happen the government needs to actively support the program with policy initiatives. The embedding of the program in a policymaking framework needs to be clarified and further developed.

Stakeholder Involvement
From the program proposal it is not possible to get a clear picture of the current level of organization within the industry on the regional and local level. To design the most effective and efficient communication and dissemination strategy it is important to use existing channels, as well as appropriate new networks. There are 4-5 clusters of SRRMs in different regions in India, and within each cluster mills seem to have comparable characteristics. What kinds of networks exist within the clusters? Are their networks of SRRMs and are there links to financing, consultants, or other technology and service suppliers? Similarly, how is the Ministry of Steel connected to the SRRMs, and what are the best ways to ensure collaboration between them (which historically has been very limited due to an emphasis on the large integrated producers)? In short, what is the best way to communicate with the SRRMs, as this is unclear in the proposal; it just mentions generic communication methods and provides no evaluation of the relative effectiveness and efficiency. The proposal states that a stakeholder participation of 75 at an earlier workshop was "overwhelming", although it is unclear how many of the participants were from 1200 SRRMs. Hence, I believe it is key for the success of the program to develop the most efficient and effective communication tools that fit the characteristics of the sector (SME, regional clustering, limited organization), and not to develop a separate or competing structure or organization. This needs a strong emphasis in the project and proposal.

Other important elements of stakeholder involvement are the involvement of ESCOs (and to communicate the program and successes throughout this industry) and of other (international) programs in India focusing on SMEs. For example, the UN Cleaner Production Program aims specifically at the introduction of innovative practices and technologies for cleaner production in SMEs. In India, the National Center for Cleaner Production is based in New Delhi, and collaborates with four other institutes throughout the country. Tapping into their experiences is essential to provide increased changes for success for working with SRRMs.

Capacity Building
The proposal is strong on the element of capacity building. The proposed program contributes to capacity building in the SRRM-industry, but very importantly, also in sectors of potential providers of services and technology to the SRRM-industry (ESCOs, banks, and technology suppliers). The establishment of the research and information center for secondary steelmakers can be an efficient way to establish indigenous technology assessment and development capacity. However, to be successful in transforming the SRRM-sector it needs to be clearly embedded in the industry and in a communication and dissemination strategy. There is no need for an additional research institute that has no connection to or impact on the industry. Hence, it should be carried by the industry. The proposal foresees future sustainability of the center through contribution of the SRRMs. It is very difficult to evaluate the likelihood of such a financing option without further information on the organizational structure of the sector. The potential for SRRMs to contribute to the center is also unclear, given the lack on financial information on the SRRM-industry in the proposal. Hence, this needs clear attention in the program and proposal.

Innovativeness
The project does not contain any new or innovative technical or policy approaches. However, the combination of the approaches in a single sector dominated by SMEs can be qualified as innovative. Some of the elements seem riskier (e.g. the use of ESCOs for SMEs in India) than others, and a comprehensive approach as proposed may reduce these risks.

ANNEX C1. RESPONSE TO STAP REVIEW

Responses to the STAP review are provided below in italics. Where possible, the Project Brief has been strengthened to reflect the guidance provided by STAP.

Summary and General Review
The steel rerolling mill (SSRM) sector is unique to India, especially due its widespread application, and large number of small mills (1200). The proposal provides a comprehensive approach to deal with the multitude of barriers commonly found in industry and small and medium-sized enterprises (SMEs). A five-year program is proposed to develop, demonstrate, market and disseminate 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 proposed approach seems appropriate to reduce or remove some of the barriers found in this industry for energy-efficiency improvement.

However, specific elements of the proposal and program need additional attention to demonstrate the likelihood of success and improve the long-term sustainability of the approach. Below we discuss these aspects in detail. The most important elements that need improvement are:

- - More information on the economic and technical characteristics (including distribution) of SRRM-sector is needed to devise an effective and efficient communication strategy.

  The economic and technical characteristics of the SRRM sector have been investigated and analyzed prior to the project's design, and detailed reports have been prepared as part of the PDFB phase. A comprehensive evaluation of the mills was conducted on all key aspects --- technical, financial, infrastructural, social and concerns for pollution. Further, the distribution of mills by size, product, region, volume, etc. is now provided in Section 1.2 of the Brief..

- Development of a more plausible forecast of the long-term development within the sector, and the impact on program design.

  The share of the SRRM has been continuously growing. Currently, the SRRM meets 70% of the total long products requirement in the country. Section 1.2 has been strengthened to reflect the significance of the sector. Section – 1.3 of the Project Brief highlights the growth rate of this sector.

- Improved assessment of the direct and indirect impacts of the proposed program on energy use, GHG emission reduction, local air pollution and air quality, as well as economic performance of the industry.

  An assessment of the direct and indirect impacts of the Programme was carried out, as described in. Section 8.4 and Table 10 of the Brief.

- Training of SRRM operators and managers needs to be clearly included as an integrated activity to achieve additional savings, and improve effectiveness of the program.

  Section 5.1.4, dealing with capacity building of different stakeholders, specifically includes training of SRRM operators and managers as part of the development of in-house industry capacity.

- Embedding of the program and organization into existing international standards (ISO), protocols (for evaluation) and existing experience in working with innovative SMEs.

  The project will strive to achieve international standards and protocol as part of the long-term strategy for technology upgrades in the SRRM sector, and the project will specifically introduce the concepts of existing international standards to the sector. Based on the experience of implementation of technical packages in the select mills, the standards will be implemented in a phased manner. Please refer to Section 1.2 and Section 1.4 of the final project brief.

- Embedding of the program in existing organizational structures of the SRRM-industry on a regional or local basis (if existent).

  The project recognizes the importance of an effective model for accelerated adoption of technical packages by the industry. Section 4.1 of the final project brief reflects a five-step integrated model for embedding the programme in the existing industrial clusters has been proposed, and will be included at the Project Document stage:

  Step 1: To redefine five geographical clusters with model units as centers of excellence. Each zone has been studied with regard to the number of units in various categories, technologies employed, aggregate energy use and pattern, scope of energy conservation, institutional settings, and awareness and competence levels. The data is used to develop investment portfolios by clustering of the units in each zone.

  Step 2: To strengthen legal, policy, and administrative support to energy efficiency initiatives and secure commitment at local, state and central levels.

  Step 3: To develop zone level leadership and energy and technology management skills as a two-pronged strategy; first within the zone and secondly through proposed TIRFAC under the project. A competent group of entrepreneurs (core group) would be developed which aims at cooperative procurement of services for hedging the transaction costs, post-installation assistance and after-sales-services. TIRFAC provides an organizational base to the private sector units and acts as a focal point for dissemination of information, documentation of activities in the zone, monitoring of energy consumption profile/patterns, assimilation and absorption of technologies and measuring development through progress indicators. In addition, it acts as a technology resource center. The center develops energy managers who provide leadership in development of energy efficiency projects and programs in the zones.

  Step 4: To develop a culture of willingness among local FIs/banks to finance, through demonstrating cost recovery of EE projects and facilitating mainstream financial support, including from those having links to foreign and multilateral development banks.

  Step 5: To develop strategic energy plans and targets for the zones linked to the national strategy for energy efficiency improvement and mitigation of local, regional, national and global environmental impacts.

- Design of an effective and efficient communication and dissemination approach tailored to the specific needs of the SRRM-sector.

  Dissemination of best practices, lessons learned from implementation of technical packages and facilitating replication is integral to the proposed communication strategy. In particular, the differences among the clusters and within the clusters are recognized. The revised document *includes an activity to focus on effective designing of the communication strategy to meet specific needs of the SRRM sector. Please refer to Section 5.1.3.*

- Development of ways and means to ensure the sustainability of the market transformation effort through cost-reduction (after 5 years of establishing the program), partnering, market development and direction of the program efforts (e.g. market segment of the SRRM-industry).

The Government of India has already given highest priority to the energy efficiency improvements of all sectors including the small and medium scale and steel sectors. The programme has been conceived and developed taking into account the significance of the sector in the long term and had proposed integrated measures instead of the piecemeal approaches of the past.

Based on my understanding it will be possible for the proposers to adapt and improve the proposal taking into account my suggestions in the review report. This would strengthen the proposal considerably.

Scientific and Technical Soundness
The large number of SRRMs is a unique characteristic of the steel industry in India. Many of these plants have an extremely small capacity, especially when compared to the international iron and steel industry. Given this unique character, it is advisable that the proposal, or appendices, contain more detail on the sector and its future. The current proposal provides average data, based on an extensive survey in the five clusters of SRRMs. The survey is extremely valuable. However, the proposal does not contain any data on economic, environmental and product quality issues of the SRRM-sector. This is not only important to evaluate the co-benefits of the proposed technology packages, but also to evaluate the most successful direction and implementation of the proposed program (see also below under sustainability and stakeholder involvement).

Section 1.2provides additional details as suggested.

Given that 75% of the 1200 plants are small-scale plants, there may be serious limitations to the product quality and the consistency of product quality of products of these small-scale plants. The scale of the plants is extremely small. For comparison electric furnaces in the SRRM sector have a heat size of a few tons, while modern electric arc furnaces have heat sizes of over 100 tons. Many of the rolling mills (not composite plants) have an even smaller production capacity. It would be good to provide a distribution of the sizes of the plants to get a better understanding of the industry and be able to better pinpoint the target group of the proposed program within the wider SRRM-industry (see also below under sustainability).

The SRRM sector comprises 1200 working mills, however this sector produces steel products that meet national BIS standards. Product quality is largely driven by the market rather than by the scale of operations. The SRRM's long products are more than 70 % of the automobile component market (both OEM and replacement), whereas SRRM construction steel also supplies nearly 85% of the rural and sem-urban market where there is a demand for "cheap" steel rather than quality. On quality front, the SRRM sector is continuously diversifying into higher end producs such as import substitution steels, production of special and engineering steels for export, steels required for metro and other infrastructure projects, TMT steels, and coated rebars for construction. Since quality has a premium in the market, therefore, product innovation is more visible in the sector than the energy innovation. The present induction based composite mills are now using 70 to 90% of sponge iron in their charge mix to produce international quality of steel. The project is further reinforcing the concept of quality and productivity improvement through implementation of the technology packages. A separate Section 1.2 has been included in the final project brief.

The program proposes the development of efficiency standard and benchmarks. While the standards can help to 'weed out' the inefficient and polluting smallest plants, the use and legal basis for the standards is unclear in the proposal (see also below under sustainability). Also, the use of benchmarks for the technical packages is unclear. This part of the proposal needs to be further developed and the expected use of standards and benchmarks needs to be clarified, and whether these are used with respect to *processes* or *technical packages.*

> *Technical packages have been designed after carrying out energy and process audits and therefore include processes as well. However, the process of standardization aims to strengthen the industrial base rather than weeding out inefficient mills. The standard for these packages will evolve in partnership with BEE, regulatory agencies such as pollution boards, and other stakeholders.*

The program aims at the introduction of *technical packages*, but does not address process and energy management issues. Given the lack of specialized personnel within SMEs, training in 'best practice' management strategies and practices would be an important item to add to the program. Training should not be provided as a single event, but should be provided in the form of continuous learning. Providing a program of continuous training will also help to build an active network of plant operators and managers, contributing to the success of the overall program. It is advised that the proposed center (TIRFAC) would develop and provide the training material, and 'train the trainers'. The trainers need to be based and active within each of the clusters, making communication routes shorter and more effective.

> *The technical packages have evolved as integrated packages that combine process and energy management issues. The Programme would therefore not only demonstrate the best practices but also activities to sustain these practices through continuous training at all levels. TIRFAC would play an important role by effective partnering with other key and potential stakeholders.*

The assumed growth scenario (until 2022) seems unlikely, given an increasing demand for higher quality products, and increasing economies of scale to compete on a national and global steel market.[5] Also, the current capacity utilization of the SRRMs seems very low (60% on average), underlining that future growth can for a large part be met by available capacity. It is unclear from the proposal how much new construction of SRRMs is expected, and how the project will influence the energy-efficiency of the new plants. The current proposal aims at existing SRRMs. However, SRRMs to be constructed (if the scenario in the proposal were correct) provide a low-cost opportunity and new capacity will actually be constructed. The assumed growth scenario is also important for estimating the expected savings (directly and indirectly) due to the program.

> *The growth rate projected has factored in the cyclic nature of the steel industry's demand patterns. While some mills are operating at lower capacities, new mills are also being set up and the existing mills have diversified their product towards higher value steel. Section 8.3 has been revised to give a clear basis for the expected growth in the sector ensuring replicability of the proposed packages.*

To sustain the results of the project it is advisable to focus on the segment of SRRMs that will survive long-term (see also below). This can be strengthened by emphasizing the use of international standards in

[5] For example, many small inefficient and polluting plants that produced low-quality iron and steel also characterized the Chinese steel industry. In the past decade many, if not all, have been closed, and iron and steel plants have production capacities comparable to international facilities (even though the capacity of individual process (e.g. blast furnace, electric arc furnace, BOF converter) are still relatively small).

the selection of mills for the demonstration projects. For example, companies that have an ISO 9000 certification, or will receive one, would be eligible for participation in the program. Furthermore, the project can work with participating SRRMs to foster the use of ISO 14000 and energy management systems.

The proposal has been designed around the mills that would survive in the long–run and are already adapting to changing conditions of the market. Table 8 gives the reorientation / restructuring of capacity of the SRRM sector over a period of 20 years.

Although the quantitative basis for the assumptions in the proposal look reasonable, the proposers do often not clearly define the terms used in the proposal, which makes it hard to interpret the technical basis of the proposal:

- Generally, secondary steel production means the production of steel from secondary resources (= scrap). However, the authors seem to use the term to reflect both secondary steel production and SRRMs. However, only part of the SRRMs do melt steel in furnaces, while others may use ingots or billets. These ingots and billets may come from primary and secondary mills. Hence, SRRMs (without the composite mills) are a third segment of the market, and not necessarily part of the secondary steel market.

  A glossary of important technical terms used in the context of steel rerolling mills has been included as part of the final brief.

- The proposers claim that 75% of the 1200 units are 'small scale' the definition of small scale is never given. Is this less then 10,000 tonnes/year or more?

  This information is provided in Section 1.2.

- The proposers use the terms ecotech and alltech, without proper definition of the terms. The International Iron and Steel Institute introduced the terms in the 1998 report "Energy Use in the Steel Industry".[6] In the IISI report ecotech represents a process that makes use of all proven energy saving technologies that are commercially attractive. The alltech process represents a process in which all proven energy saving technologies have been included. However, the proposers use it to define a set of energy-efficiency measures. From correspondence with the proposers it is clear that they used different economic criteria to select "ecotech" energy-efficiency improvement technologies (e.g. selecting all cost-effective measures using a 30% discount rate).[7]

  Definitions have been provided in the Project Brief and in the Glossary.

- The proposers give average fuel use for the different clusters/regions by fuel in kg of coal and liters of oil, without specifying the energy contents of the fuels used. Using common international energy contents for coal (29.3 MJ/kg) would give an extremely high energy consumption of 7.5 GJ/tonne or rolled steel (compared to 5.06 GJ/tonne in Table 2). Given, the variation in coal quality in India it is recommended to provide energy consumption figures in accepted SI energy units.

[6] International Iron and Steel Institute, Committee on Technology. *Energy Use in the Steel Industry*. IISI, Brussels. Belgium, September 1998.

[7] From the technical appendix it can be deducted that the selected combustion measures all have a CCE (or payback period) far below the criteria set for selection. Only the packages developed for coal-fired furnaces come close to the criteria. This suggests that there may be more cost-effective opportunities available in the furnace.

The actual conversions are provided below:
1 kg of oil = 41 MJ
1 normal cu.m.= 34.5 MJ
1 kg Coal = 27.8 MJ
1 kWh = 12 MJ

Table 2 in the Project Brief gives the total energy use (which includes power, and fuel) in the SRRM based on 6.92 GJ/tonne and 5.06 GJ/tonne only refers to the fuel use. A note to the table has been added.

- Does the electricity use provided in Table 1 include induction and electric arc furnaces? I assume not, and that solely the electricity in the rolling operations is included.

Table 1 does not take into account induction and electric arc furnaces.

Hence, the proposers need to develop a clear set of definitions to provide a clearer basis for the assessments included in the proposal.

Definitions have been provided within the Project Brief and in the Appendices.

In this context it is unclear what the purpose is of the comparisons in Table 2. The Ecotech and Alltech (Europe) cases in Table 2 are assessments of best practices around the world (based on the 1998 report of IISI, see above), and not actual average energy consumption in section mills in Europe. The energy consumption figures for Japan seem to be for a hot strip mill, and not for section, bar or wire mills. Furthermore, the plants in Europe and Japan are typically large-scale facilities, and incomparable in size to the SRRMs.

Table 2 intends to show a comparison given that this industry must compete on products and not on processes. The reference made is not to a hot strip mill but rather a KYOEI plant.

A central element of the proposal is the establishment of a research and information center specifically for the secondary steel industry (TIRFAC) in India. International data collection: this is a sector specific for India, as steelplants in the rest of the world are typically of much larger scale, and even stand alone rolling mills are of much higher capacity. Only a few developing countries would face similar issues. Hence, technology available elsewhere in the world would need to be ‘downscaled’ for use in the small-scale SRRMs. How will TIRFAC collect international data, select and evaluate technologies specific enough for the SRRM situation? This justifies the research and testing facility to be housed in the center. Also, the institute should be housed in an appropriate organization and location, so that it can easily be integrated in existing networks of SRRMs throughout the five regional clusters.

The project proposes to set up the facilities along the lines suggested and details will be provided at the Project Document stage.

Global Environmental Benefits (and Drawbacks)

The proposal does not provide an understandable estimate of the overall direct energy savings from the proposed program and estimates of the indirect savings due to dissemination and replication throughout the SRRM sector. In the current proposal a footnote estimates savings at 21 PJ over 20 years. This seems low, as the total potential (30% savings, 100% penetration at current production volume) would be equal to 17.6 PJ *annually*. Furthermore, the basis for a project cycle of 20 years is unclear. Burners and motors last shorter than 20 years, as will many other parts of the furnace (lining) and rollers of the section mill. The estimate given in a footnote is impossible to understand without further information, e.g. expected degree of implementation by furnace-type and package (directly and indirectly). The same holds true for reductions in CO_2 emissions, which are currently not estimated in the proposal.

Revised Annex A provides the required information on incremental cost.

Other Environmental Benefits

The proposal does not estimate other environmental benefits of the improvements in energy-efficiency. This is unfortunate, as these savings will be very important for local air pollution (e.g. SOx, NOx, PM) reduction. Although the GEF Operational Strategy focuses on climate change, these improvements in local and regional air quality are very important for local support of the program. Furthermore, improvements in working conditions and employee health are important co-benefits.

Section 8.4 of the revised project brief and Annex A on incremental cost covers the stated benefits.

GEF Priorities

The project fits with the GEF priorities as defined in the Operational Strategy for Climate Change and the Operational Program for removal of barriers to energy efficiency and energy conservation. The proposed program will remove and reduce barriers to energy-efficiency improvement in an industry that traditionally is hard to reach with energy policy (SMEs). The proposed technical packages do meet economic criteria, and would lead to "win-win" solutions.

Evaluation

There is a clear need for improved methods of quantitative evaluation of the program results. While it is hard to quantitatively evaluate program elements such as dissemination and stakeholder participation, it is important to measure those elements that can be quantified, e.g. achieved energy savings at the 30 plants, sales of the technical packages and technologies, etc. For this purposes the proposers should develop a clear protocol, possibly following the International Monitoring and Verification Protocol (IPMVP). Furthermore, it is advised to have the evaluation done by an independent organization to ensure unbiased results.

The Monitoring Plan will be developed for the Project Document, and will include a methodology for evaluation of the project's results. In addition, all UNDP projects are subjected to mid term evaluation and evaluation by independent team of experts.

While it is essential to have a representative Project Steering (PSC) and Project Advisory Committee (PAC), these should not be too large to reduce overhead, to reduce delays and complex decision making structures. Furthermore, it seems strange to have large steel plants participate in the PAC for a project aimed at technology improvement in the SRRMs (a competitor). Participation of individuals from the steel industry with expertise essential for the project should be welcomed.

The reviewer's suggestion will be taken into account when finalizing the project's management and oversight structures.

Replicability

The program initially will work with 30 of 1200 SRRMs in India, but a dissemination approach is developed to reach out to the other mills (see also below). The size of the industry would provide ample potential within the sector. Further replication outside of India will be limited, as SRRMs are a development typical for India. However, some of the concepts developed, and especially the combination of a number of approaches for barrier removal may be replicable in other sectors dominated by SMEs in India and other developing countries.

Sustainability

The sustainability of the proposed program will depend on the establishment of networks and an organizational structure that can survive without additional international funding after 5 years. The likelihood will depend on the effectiveness and efficiency of the program in reaching out to the SRRMs, achieving cost reductions for SRRMs, while demonstrating the overall gains for the Indian economy and (global) environment.

The Appendix to this Annex provides an analysis of the sustainability of the Programme.

There are three elements in the proposal that need attention in evaluating the long-term sustainability of the program. First of all, the sustainability of the SRRM-sector is an important factor. As discussed above, it seems unlikely to me that the 900 small SRRMs can survive the next decades. I think that the Indian steel industry will follow similar development patterns as elsewhere in the developing world, and ultimately will focus on large integrated mills, and medium-scale flexible plants using scrap, DRI (direct reduced iron)[8] and smelt-reduction as inputs. The larger SRRMs may survive and develop into flexible secondary steel mills. Hence, for the sustainability of the program it is advisable to focus on the plants that are likely to survive in the developing Indian steel market.

Secondly, the sustainability of the ESCO market for industry in India is an uncertainty factor. Outside of India ESCO-activity in industry has been limited, and experience relatively recent. It is unclear from the proposal what the ESCO-experience is in Indian industry, especially with SMEs. This may need more research at the beginning of the project, to identify the most effective and successful ways to improve collaboration between ESCOs and SRRMs. As a backup strategy, the proposal includes working with banks. It may be attractive to actively identify ways to develop appropriate ways of financing energy-efficiency projects in the SRRM-industry by commercial banks.

The ESCO related activities are considered to be an innovative component of the project. To date, ESCOs have been operating in larger sectors. Several ESCOs have already shown interest in participating in this Programme.

Thirdly, the overall effectiveness and efficiency of the program has to improve to sustain the program. Because of high transaction costs, any energy-efficiency program with SMEs is likely to have higher costs than other industrial energy-efficiency programs. The specific costs of the program (based on estimated energy savings and submitted financing request), are $1.3/GJ-saved (excluding cost-share industry), which are high. Part of the high costs is due to the actual cost of energy-efficiency demonstration projects (cost-shared with industry), and the start-up costs of an information and research center. Still, the program should search for effective ways to reduce the overall costs for future sustainability and replication.

The Appendix to this Annex provides additional information.

Finally, it is important provide a sustained regulatory and policy framework for the program. The program may help to develop approaches that can successfully be adapted to policies, such as the

[8] India is already one of the larger producers of DRI in the world, using mainly coal-based processes. DRI is used as a high quality iron-input in the electric arc furnace to produce high-quality steel. However, total DRI-production is limited to about 4% of total pig iron production.

development of minimum efficiency standards for SRRMs and specific product categories. Also, the approach in the project may help to develop similar approaches for other industrial sectors dominated by SMEs. However, for this to happen the government needs to actively support the program with policy initiatives. The embedding of the program in a policymaking framework needs to be clarified and further developed.

The Ministry of Steel and Bureau of Energy Efficiency would be actively involved in influencing the appropriate policies.

Stakeholder Involvement

From the program proposal it is not possible to get a clear picture of the current level of organization within the industry on the regional and local level. To design the most effective and efficient communication and dissemination strategy it is important to use existing channels, as well as appropriate new networks. There are 4-5 clusters of SRRMs in different regions in India, and within each cluster mills seem to have comparable characteristics. What kinds of networks exist within the clusters? Are their networks of SRRMs and are there links to financing, consultants, or other technology and service suppliers? Similarly, how is the Ministry of Steel connected to the SRRMs, and what are the best ways to ensure collaboration between them (which historically has been very limited due to an emphasis on the large integrated producers)? In short, what is the best way to communicate with the SRRMs, as this is unclear in the proposal; it just mentions generic communication methods and provides no evaluation of the relative effectiveness and efficiency. The proposal states that a stakeholder participation of 75 at an earlier workshop was “overwhelming”, although it is unclear how many of the participants were from 1200 SRRMs. Hence, I believe it is key for the success of the program to develop the most efficient and effective communication tools that fit the characteristics of the sector (SME, regional clustering, limited organization), and not to develop a separate or competing structure or organization. This needs a strong emphasis in the project and proposal.

The project aims to network with existing institutions and especially industry associations.

Other important elements of stakeholder involvement are the involvement of ESCOs (and to communicate the program and successes throughout this industry) and of other (international) programs in India focusing on SMEs. For example, the UN Cleaner Production Program aims specifically at the introduction of innovative practices and technologies for cleaner production in SMEs. In India, the National Center for Cleaner Production is based in New Delhi, and collaborates with four other institutes throughout the country. Tapping into their experiences is essential to provide increased changes for success for working with SRRMs.

Capacity Building

The proposal is strong on the element of capacity building. The proposed program contributes to capacity building in the SRRM-industry, but very importantly, also in sectors of potential providers of services and technology to the SRRM-industry (ESCOs, banks, and technology suppliers). The establishment of the research and information center for secondary steelmakers can be an efficient way to establish indigenous technology assessment and development capacity. However, to be successful in transforming the SRRM-sector it needs to be clearly embedded in the industry and in a communication and dissemination strategy. There is no need for an additional research institute that has no connection to or impact on the industry. Hence, it should be carried by the industry. The proposal foresees future sustainability of the center through contribution of the SRRMs. It is very difficult to evaluate the likelihood of such a financing option without further information on the organizational structure of the sector. The potential for SRRMs to contribute to the center is also unclear, given the lack on financial information on the SRRM-industry in the proposal. Hence, this needs clear attention in the program and proposal.

Innovativeness

The project does not contain any new or innovative technical or policy approaches. However, the combination of the approaches in a single sector dominated by SMEs can be qualified as innovative. Some of the elements seem riskier (e.g. the use of ESCOs for SMEs in India) than others, and a comprehensive approach as proposed may reduce these risks.

The project's innovation primarily lies in the introduction of technologies and best practices that are being applied for the first time in the SRRM sector in India with close partnership with the Government of India and utilizing innovative institutional mechanisms. Some of the innovation features of the project have been listed below:

- *Nation-wide large-scale participation of private sector SMEs in the GEF project.*
- *Participation of national and international equipment manufacturers, technology providers, experts, etc. in the cause of EE improvement of SMEs.*
- *Focus on "Kaizen" measures to achieve baseline EE norms through multiple audit approaches namely energy, process, design and technical audits following international standards, for the first time in the country.*
- *The most innovative portion is "leap-froging" measures such as the design of the 5 low cost, cutting-edge, integrated technology packages tailored to provide "balance-of-system" at user-centered interface with a high degree of acceptance at all levels.*
- *Extensive application of "pinch" analysis/design in developing most cost effective energy efficient combustion designs of furnaces and recuperators, again for first time in the country.*
- *Many EE technologies will be introduced in the SRRM sector for the first time in the country (including large mills) such as regen burners, radiant burners and "hot riders".*
- *Many EE technologies will be introduced for the first time in the SRRM sector such as hot charging, walking beam furnace designs, over 70 % efficiency recuperators, VSDs, process control and automation, etc.*
- *Proactive R&D measures such as development of EE scale-free reheating measures have been started in anticipation of the project with SDF support (not included in the project budget) in realization of the needs of the industry.*
- *TIRFAC with prototype, hardware and software facilities providing energy services at local costs, including optimum EE solution designs, engineering, and implementation support.*
- *An innovative ESCROW third party financing mechanism for SME and value security mechanism in place of collateral security/bank guarantee.*
- *Although comprehensive steel policy is on the anvil but for the significance of this project, MoS has directed the PMC to follow 'Action to Policy' approach for the first time and assured full governmental support.*

Appendix: Economic Analysis on Sustainability of the Program

The Project aims at expanded investments in energy efficiency improvement in the SRRM sector. In order to assess the viability of investments to the nation and its long-term sustainability, the economic internal rate of return (EIRR) to the economy from the investment in the sample units was estimated. The EIRR for implementing the technology packages in 30 sample units was estimated at 116%. In case of successive replication of the packages was estimated at 35%. This, however, does not take into account the domestic environmental benefits that would accrue to the nation on account of reduction in TSP, PM-10, NO_x, N_2O and SO_2. If taken, this would further increase the EIRR to around 42%. Cost effectiveness of in terms of $ carbon avoided is 0.66. The various assump tions for EIRR are as follows:

Assumptions for Economic Internal Rate of Return

(i) The Opportunity cost of funds is assumed at 8%. This is based on the assumption that the economy is resource constrained and, hence, will have to borrow from outside the country. The borrowing rate is sum of LIBOR + Country Risk Premium + relative depreciation of rupee to dollar (based on forward premium rate).

(ii) The market rate of dollar was assumed to reflect the resource cost of dollar as dollar is freely tradable on the current account and also capital account, though to a limited extent.

(iii) The incidence of tax on capitals goods was estimated at 22%. This was based on the breakup of investments costs provided by SAILCON. The total project investment was deflated by this factor to arrive at resource cost of capital.

(iv) The cost of production of electricity as reported by annual performance review of State Electricity Boards (SEBs) was taken as resource cost for electricity.

(v) Fuel oil prices in India are market determined and also it is freely importable, hence, the cost to economy could be either landed cost of fuel plus a transportation cost. Given the market forces the prices from indigenous production too can be used by deflating them for tax incidence. This route was used to calculate the economic cost of fuel oil. Similar procedure was used for coal prices as well as material prices.

(vi) On the cost side increased labor costs were included as labour represents a resource which has an opportunity cost. Operational and maintenance cost were included as they are treated as resource allocations to maintain the productivity of the system.

(vii) The accrual of gains on account of reduction of various pollutants like SO_2, NO_x, SPM have not been accounted for in estimating ERR.

Table C1 below gives the Economic Internal Rate of Return of the Project, Table C2 shows the Fuels and Resource conserved and Table C3 depicts the Avoidance of CO_2 and other Emissions.

Table C1: Project Economic Internal Rate of Return (EIRR)
(in US $ '000)

Year	Capacity of SRRM Sector covered under Technology Packages		Production covered under Technology Packages		Incremental Investment				
	Sample Units	Replicated	Sample Units	Replicated	Sample Units plus TA component	Replicated	Total	Incremental Operating	Net Increment
1	206.2	0	0	0	3326	0	3326		3326
2	475.8	1364.5	123.7	0	4001	10433	14434	-465	13969
3	994.2	2210.0	306.1	819	8001	6382	14383	-4970	9413
4	1418.8	2952.0	664.7	1462	7469	5528	12997	-9129	3868
5	1762.2	4453.0	998.3	2129	5834	11035	16869	-13344	3525
6		6217.0	1298.6	3188		12796	12796	-19152	-6356
7		7881.0	1375.4	4471		11907	11907	-25268	-13360
8		9575.0	1409.8	5796		11956	11956	-31428	-19472
9		11281.0	1409.8	7155		11873	11873	-37637	-25763
10		14698.0	1409.8	8514		23446	23446	-43846	-20400
11		17827.0	1409.8	10904		21164	21164	-54764	-33601
12		20720.0	1409.8	13294		19284	19284	-65680	-46397
13		23699.0	1409.8	15685		19565	19565	-76599	-57034
14		29054.0	1409.8	18074		34645	34645	-87515	-52870
15		29760.0		21874		4498	4498	-99920	-95421
16		30960.0		23131		7528	7528	-105661	-98133
17		33000.0		24457		12598	12598	-111719	-99121
18		34935.0		25872		11760	11760	-118181	-106421
19		36893.0		27357		11708	11708	-124964	-113256
20		39016.0		28929		12486	12486	-132146	-119660
TOTAL			***14635***	**243112**	**28,631**	**260592**	**289223**	**-1162387**	**-873164**
NPV					**19,911**	**81,837**	**101,748**	**-271,263**	**-140,451**
EIRR									**34.38%**

Table C2: Fuel and Resource Conserved

Year	Total Energy Saved (TJ)	Coal (TJ)	Fuel Oil (TJ)	N Gas (TJ)	Iron (TJ)	Power (TJ)	Material Saved ('000 tonnes)
1	113.8	0.0	83.9	0.0	10.8	19.0	3.0
2	1525.9	541.6	951.9	-256.8	85.7	203.4	35.1
3	2941.7	1136.2	1662.8	-397.7	157.9	382.5	64.7
4	4460.8	1889.5	2431.9	-641.3	229.4	551.3	94.3
5	6494.6	2834.5	3401.4	-862.7	330.3	791.0	136.9
6	8558.5	3758.7	4451.3	-1127.2	432.6	1043.0	182.4
7	10616.8	4663.3	5503.4	-1383.5	535.4	1298.0	228.5
8	12678.6	5562.6	6568.8	-1646.4	638.5	1555.2	275.1
9	14740.7	6462.0	7634.2	-1909.4	741.5	1812.4	321.6
10	18366.4	8043.3	9507.6	-2371.7	922.6	2264.6	403.5
11	21991.4	9624.3	11380.6	-2834.0	1103.7	2716.7	485.4
12	25617.4	11205.8	13254.2	-3296.4	1284.9	3168.9	567.3
13	29242.2	12786.7	15127.1	-3758.6	1466.0	3621.0	649.1
14	33181.4	14471.9	17144.7	-4231.4	1657.8	4138.4	749.4
15	35088.1	15303.5	18129.9	-4474.5	1753.0	4376.2	792.4
16	37099.7	16180.9	19169.3	-4731.1	1853.5	4627.1	837.9
17	39245.5	17116.8	20278.0	-5004.7	1960.7	4894.7	886.3
18	41498.1	18099.2	21441.9	-5292.0	2073.3	5175.7	937.2
19	43883.2	19139.5	22674.3	-5596.1	2192.4	5473.1	991.1
TOTAL	387345.0	168820.0	200797.0	-49815.0	19430.0	48112.0	8641.0

Table C3: CO_2 and Other Emissions Avoided

Year	CO_2 (Th. Tonnes)	N_2O (Tonnes)	TSP (Tonnes)	SO_2 (Tonnes)	NOx (Tonnes)	PM 10 (Tonnes)
1	13	0.2	8.5	169.6	77.7	2.7
2	150	3.1	197.1	1859.4	1058.7	59.6
3	289	5.8	385.8	3373.6	1972.1	116.7
4	438	8.7	604.3	4950.9	2971.8	182.8
5	634	12.6	888.6	7036.1	4277.6	268.5
6	830	16.5	1177.4	9233.8	5632.0	355.3
7	1025	20.5	1463.9	11438.7	6983.7	441.3
8	1219	24.5	1750.8	13661.8	8342.4	527.4
9	1413	28.5	2037.7	15885.2	9701.3	613.4
10	1755	35.5	2542.2	19794.6	12090.7	764.8
11	2097	42.5	3046.5	23703.1	14479.6	916.1
12	2439	49.5	3551.0	27612.8	16869.1	1067.4
13	2780	56.5	4055.3	31521.2	19257.9	1218.7
14	3127	64.2	4616.6	35777.3	21866.7	1385.0
15	3307	67.9	4881.9	37833.2	23123.2	1464.6
16	3496	71.8	5161.8	40002.2	24448.9	1548.5
17	3699	75.9	5460.3	42315.9	25863.0	1638.1
18	3911	80.3	5773.7	44744.7	27347.4	1732.1
19	4136	84.9	6105.6	47316.3	28919.2	1831.7
TOTAL	36759	749	53709	418231	255283	16135