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Energy savings and carbon credits: Opportunities and challenges for Indian foundry industry

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ABSTRACT

Foundry is one of the most energy-intensive manufacturing processes. A large amount of energy is consumed in the melting operation. Adoption of energy efficient melting technologies by foundries is a win-win option. Improvements in energy efficiency not only reduce energy costs, but also have the potential of generating additional revenues through sale of carbon credits. Seeking carbon credits by developing appropriate Clean Development Mechanism (CDM) projects based on energy efficiency improvements promises to be a win-win option for Indian foundries. While the primary benefit of the CDM project would be the savings in energy, additional revenues through sale of Certified Emission Reductions (CERs) could help in improving the project returns.

This paper discusses a few options to improve energy efficiency of the melting operation. It also describes the process for acquiring carbon credits by registering a CDM project. High transactions costs involved in developing CDM projects are usually a barrier, especially among small and medium scale industries. 'Bundling', or bringing together, of small projects in different companies to form a single CDM project is permissible if the projects belong to the same type. The industry associations are probably the best suited to play this the role of a bundler. Proactive efforts of industry associations would help in initiating CDM projects especially among the small and medium scale foundry units.

The exercise is being done at Belgaum Foundry Cluster wherein the execution of concept is encouraging.

Keywords : Energy-efficiency, energy saving, carbon credits, CDM, Divided Blast Cupola

1.0 BACKGROUND

India is one of the leading producers of ferrous and non-ferrous castings. The recent surge in the internal castings market has contributed to a steady growth of the foundry sector in India. However, in order to maintain the brisk pace of growth the industry needs to improve their competitiveness. Hence, cost reduction and quality improvement are two key priorities for Indian foundry units today.

Melting is one of the most important foundry operation. However, it is usually one of the most neglected areas. Improvements in the energy efficiency of the melting firnce not only save the cost of energy, but also lead to improvements in castings quality. This is because a efficient melting furnace would result in more consistent molten metal quality and uniform molten metal temperature, which leads to lesser defectives. However, in recent times, apart from the lowering its cost of production cost through energy efficiency improvements, foundries may even seek additional revenues by selling the consequent reduction in carbon emissions in the carbon markets. Thus energy efficiency improvements can translate to be a win-win option for Indian foundries if they prepare a Clean Development Mechanism (CDM) project and sell its Certified Emission Reductions (CERs).

This paper highlights some of the major options to reduce energy consumption in melting furnaces. It also provides an overview of what carbon credits are and how the foundry unit may seek additional income by selling the carbon saved by reducing their energy consumption. Finally, the paper discusses an actual CDM project for foundry units located in Belagum in the state of Karnataka and a few barriers to implementing similar projects among foundry cluster elsewhere.

2.0 ENERGY EFFICIENCY IMPROVEMENTS IN MELTING FURNACES

Two types of melting furnaces are predominantly used by foundry units – cupolas and induction furnaces. A few examples of energy savings in these melting furnaces are discussed briefly below.

2.1 Coke saving in cupola melting

It is possible to save a substantial quantity of coke in a foundry unit using cupola furnace by converting it to divided blast operation. A divided blast cupola (DBC), as the name suggests, has two rows of tuyeres connected to two separate wind belts. One of the tuyeres supplies air just above the reduction zone, whereas the other supplies air in the oxidation zone. The possibility of CO formation in the reduction zone, due to inadequacy of air is taken care of by supply of secondary air through a second row of tuyeres in a DBC. It is possible to achieve a coke savings between 20 to 40% by conversion of a conventional cupola to DBC. Additional benefits of a DBC, include higher metal tapping temperature and an increase in melting rate. The investment in a new DBC is typically recovered within a year or two, based on savings in coke alone. Since carbon dioxide, a greenhouse gas (GHG) is emitted when coke is burnt; it is possible to seek carbon credits when an energy-inefficient cupola is converted to a more efficient one like DBC.

2.2 Reducing electrical energy in induction furnace

Typically, the amount of electrical energy required in induction melting should be in the vicinity of 500 to 550 kWh/ tones, for an optimally designed and operated furnace. However, most of the foundries record much higher specific energy consumption figures. Although there may be several ways to save electrical energy while melting using induction furnace, two important ones are discussed below.

2.2.1Online monitoring of melt temperature: It has been observed during energy audits in quite a few cases, that the power tap setting is manoeuvred based on visual assessment of melt temperature. Whereas the general engineering practice is to use optical pyrometer for monitoring surface temperature of the melt which in turn should influence the power tap setting. Burdened with the problem of lack of instrumentation, the operators generally tend to overheat the melt in order to maintain safety margin. Online monitoring of melt temperature could significantly reduce the specific energy consumption.

2.2.2Duplexing of cupola and induction furnace: The largest amount of energy is consumed in melting the iron while a much small amount is needed for superheating of the metal. Hence it is feasible to save a substantial amount of electrical energy by 'duplexing' of a cupola and induction furnace. In duplexing, while the cupola is used as the primary melter. The molten metal is then transferred to an induction furnace where it is superheated and further treatment, if required is carried out.

The amount of electrical energy saved in an induction furnace can be converted to carbon savings by the foundry unit. The following sections describe the phenomenon of climate change and international agreement which lead to the development of an international market for carbon in recent years.

3.0 CLIMATE CHANGE AND INTERNATIONAL RESPONSE

The climate system is complex, and scientists still need to improve their understanding of the physical processes that govern the earth-atmosphere system. While the earth's climate has always varied naturally, scientists now believe that rising concentrations of 'greenhouse gases' or GHGs in the earth's atmosphere, resulting directly or indirectly from human activity, is leading to irreversible climate change. The four Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) have confirmed that an alarming rise in global mean temperatures is leading to a rise in sea levels and changes in rainfall patterns. Further warming of the earth's atmosphere would have several dramatic negative impacts of climate change on human health, food security, economic activity, water resources and physical infrastructure. Farming could be seriously disrupted, leading to falling crop yields in many regions. Tropical diseases like malaria could increase at an alarming rate. Sea level rise and changing weather patterns could trigger large-scale migration. While no one will be able to escape from climate change, it is the poorer people and countries who are most vulnerable to its negative impacts.

Increasing scientific evidence of human interference with the climate change began to push climate change onto the political agenda in the min-1980s. The IPCC was established in 1988 by the World Meteorological Organization (WMO) and the UN Environment Programme (UNEP). The IPCC prepares assessments, reports and guidelines on the science of climate change and its potential impacts. Subsequently, an international treaty, called the UN Framework Convention on Climate Change (UNFCCC) was signed by governments of more than 150 countries at the 1992 Earth Summit in Rio de Janeiro, Brazil. All the countries which have signed the UNFCCC are termed as 'Parties' to the Convention. The Convention has divided the countries into two groups: 'Annex I' and 'non-Annex I Parties'. The Annex I Parties include the industrialized countries including economies in transition, who have historically contributed the most to climate change. These countries have a special obligation to provide 'new and additional financial resources' to developing countries to help tackle climate change, as well as to facilitate the transfer of climate friendly technologies to developing countries. The non-Annex I Parties are the developing countries which do not have obligation to reduce their GHG emissions.

4.0 THE KYOTO PROTOCOL AND CLEAN DEVELOPMENT MECHANISM

International negotiations under the UNFCCC gave birth to the Kyoto Protocol. This international agreement, which came into force in February 2005, defines greenhouse gas (GHG) emission reduction targets for Annex I Parties. Six GHGs are recognized under the Kyoto Protocol viz. carbon dioxide, methane, nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluorides (SF_6). These six GHG may be emitted for various sources of which the more common ones are given in table 1.

The developed countries or Annex I Parties have to reduce their GHG emissions to about 5 per cent below their 1990 emissions levels between the commitment period 2008-12. The Protocol has established three market mechanisms so that Annex I parties can reduce their costs of meeting their commitments by trading emission certificates or undertaking corrective actions abroad rather than domestically. These are: Joint Implementation (JI), Clean Development Mechanism (CDM) and International Emissions Trading (IET).

CDM is the only Kyoto Mechanism, which is directly of relevance to non-Annex I Parties like India. Under CDM, Annex I Parties, which have ceiling for GHG emissions, assist non-Annex I Parties to implement project activities to reduce GHG emissions and the credits are issued based on emission reductions achieved by the project activities. The credit from CDM is called the certified emission reduction (CER).

There is a well laid out procedure for converting the GHG reductions into CERs. The procedure is diagrammatically depicted in figure 1. The initial step to start a CDM project activity is preparation of a Project Design Document or PDD. The PDD can be prepared either by the company's own technical staff or by an external consultant. The PDD, once ready needs validation by a third-party designated as Designated Operational Entity or 'DOE'. Several organizations such as TuVs, DNV, SGS and BVQi are authorized to validate a PDD and the company may engage any one of them. Once the project has been validated, it is ready for registration with the UNFCCC.

While sending any project for registration, host country approval is also required. In India, host country approval is granted by the Ministry of Environment and Forests (MoEF).

After registration with EB, the company can start the project implementation, as per the plan they have provided in the PDD. Keep record of relevant data necessary for calculating GHG emission reductions is key during the implementation of the project. This record should be strictly in accordance with the monitoring plan given in the PDD. The GHG emissions reductions in the project will need independent verification by the DOE before issuance of CERs by the UNFCCC.

5.0 THE CARBON MARKET

The CER issued for a project activity may be traded, in a similar way as company shares, in the market. The international carbon market is large and there is a big demand from CERs. During 2006, the carbon market worldwide was worth $ 22.5 billion (Rs 88,000 crore)[1] and transactions of about 1.6 billion tones of CO_2 equivalent (CO_2 e) took place. The carbon market is expected to grow significantly in 2007, possibly up to 50 per cent.

India is a key player in the carbon market. Out of over 2000 CDM projects under development all over the world, the highest number of projects (about 650) is located in India. However, in terms of the actual volume of carbon credits or Certified Emission Reductions (CERs) traded, India ranks second with a current potential of 323 000 CERs by 2012, far behind China (1 015 000 CER). This is because China has a few very large projects.

A firm may prepare and register a CDM project in a number of areas. Some of the common categories where CDM projects have been developed are given in Table 2.

Also, UNFCCC has recognized the need to simplify the procedures to promote small-scale CDM projects. Energy efficiency improvements projects that reduce energy consumption upto the equivalent of 15 GWh or renewable energy projects with a capacity of upto 15 MW or any other projects that both reduce emissions and directly emit less than 15 kilotons of CO_2 annually qualify to be in the small-scale project category.

Bundling of several project activities to form a single CDM project activity can is possible, provided the project activities in the sub-bundle belong to the same type. A PDD for a bundled CDM small-scale project activity was prepared for foundries in Belagum in cooperation with the Belagum Foundry Cluster. A brief overview of this CDM project proposal is given on the next section.

Table 1

Greenhouse gases, Global warming potential and their emission sources

Greenhouse gases (GHG)	Global Warming Potential (GWP)	Common emission source
Carbon dioxide	1	Combustion of fossil fuels
Methane	21	Animal, agriculture & municipal wastes; rice cultivation
N_2O	310	Combustion processes, chemical industry
HFCs	140-11700	Refrigerants
PFCs	6500-9200	Semiconductor industry
SF6	23900	Electrical insulation

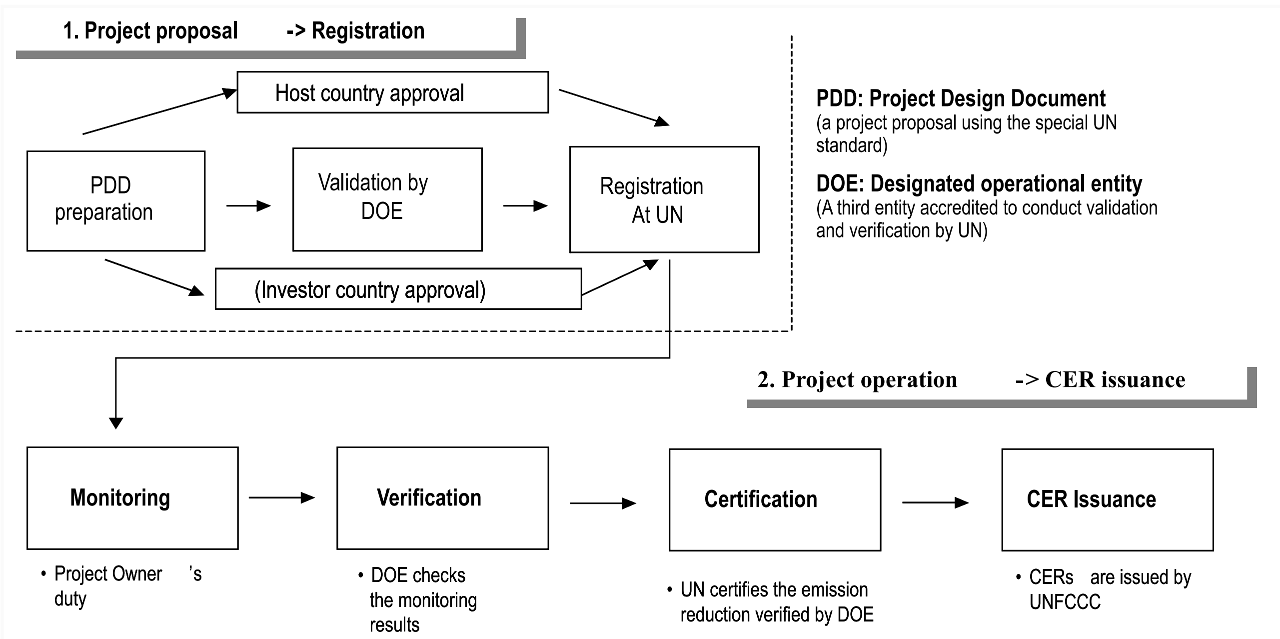

Fig. 1 : CDM Project Cycle

Table 2
Categories of possible CDM project

Common project types
• Renwable energy (hydro, wind, solar, biomass, etc.)
• Energy efficiency
• Demand-side management
• Recovery of methane (landfill, coalmine, wastewater, etc)
• Destruction of HFC (HFC-23) and N_2O
• SF_6 (electricity transmission/distribution lines)
• Fuel switching
• Transportation
• Afforestation and reforestation(Footnotes)

6.0 A CASE STUDY OF A CDM PROJECT AMONG BELAGUM FOUNDRIES

Energy saving, by adoption of DBC, was demonstrated by TERI, with the support of the Swiss Agency for Development and Cooperation (SDC), among Indian foundries in 1998. A demonstration plant was installed at a foundry unit located in Howrah in the state of West Bengal in East India. The energy savings achieved in the demonstration DBC was about 40% compared to conventional technology. Encouraged by the results of the demonstration at Howrah, several foundry units from different parts of India have now replicated the technology. However in Belgaum, no foundry unit has adopted the technology till now. In order to introduce the DBC technology among foundry units at Belgaum, the local industry association, Belgaum Foundry Cluster (BFC), organised an awareness workshop for foundry units at the Belgaum cluster, in October 2006. The event was attended by representatives of most of the leading foundry units at Belgaum. The benefits of DBC were well appreciated by all the foundry owners present at the workshop, who also expressed their willingness to adopt the DBC technology if a CDM project is formulated. The BFC agreed to act as the bundling agency, on behalf of all the local foundry units, who agree to participate in a CDM project aimed at conversion of conventional cupolas to DBCs.

A CDM project proposal or PDD aimed at achieving energy savings with consequent reduction of carbon-dioxide emissions by adoption of cleaner and energy efficient (EE) iron-melting furnaces was developed by TERI for BFC. The National Centre for Technical Services (NCTS), of IIF at Pune, who are providing technical support to BFC, was closely involved in the project meetings in Belagum and the PDD preparation process. The project proposes to change 28 conventionally designed melting furnaces (cupolas) of foundry units at Belagum to EE designs of divided blast cupola (DBC).

The baseline data used is collected through a survey of the foundry units there conducted by Belagum Foundry Cluster. The survey identified 22 foundry units which consume about 7,300 tonnes of coke and emit about 20,200 tonne of carbon dioxide (CO_2) per annum. Installation of energy-efficient DBC furnaces in these units will result in coke savings of atleast 20 per cent and reduction in CO_2 emissions by about 4,000 tonne per year.

7.0 CHALLENGES AHEAD

Seeking carbon credit by improving energy efficiency is a win-win option for Indian foundry units. While the real benefit of an energy efficiency project usually is the saving in energy cost, additional revenues generated by sale of CERs could help to improve the project's rate of return.

High upfront transactions costs involved in registering CDM projects are a barrier, especially among smaller foundries. Therefore bundling, or bringing together, of small projects in different companies to form a single CDM project would be a more viable option. However, this entails involvement of a need for responsible bundling agency who would take the responsibility for day-to-day coordination and project management. The industry associations are the best suited to play the role of a bundler. Hence, proactive efforts of the industry associations will help in development of more CDM projects, especially among the smaller foundry units in India.

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