DEVELOPMENT OF CLEAN DEVELOPMENT MECHANISM (CDM) PROJECT AT CST [(1)]

Guilherme Corrêa Abreu[2]
Tsutomu Morimoto[2]
Alexandre Rosado Barbosa[3]
Odair José Kimrse[4]
Carlos Henrique Sampaio[5]
Antônio Avancini Régio[5]
Roberto da Cruz Júnior[5]
Jarildo Francisco Pinho[6]
Marco Antônio Fujihara[7]
Carlos Henrique Delpupo[8]

Summary

According to CST's Environmental Policy and within the context of its Entrepreneurial Planning 2003/2007, which guides the sustainable development actions, the CDM Projects has been developed due to specific projects at the operational units.

This is an approach based mainly in the potential carbon credits generation due to new operational units and process, associated to the energy co-generation.

CST is an integrated steel plant, coke based, with an annual production of 5,0 Mt (slabs and coils). According to the nature of its process, it has the carbon as main reduction agent.

The carbon credits generation is intimately related to the metallurgic associated process knowledge, and also to the energy co-generation due to CST energy model, using the internal gas production.

This paper shows the evolution of the process at CST, since the first study done for the orientation of the hole project, until de Baseline Validation Step, that is the current status of the project. The potential of carbon credits evaluated in this paper, according to CST actual production stage, is estimated in 47.000 tons of CO_2 per year.

Keywords: environment, sustainable development, electricity generation

(1) Technical contribution to be presented at XXV Seminário de Balanços Energéticos Globais e Utilidades - ABM, to be held in August 24 – 26, 2004

(2) Environment Specialist, Companhia Siderúrgica Tubarão – CST, Brasil

(3) Power Plant Specialist, Companhia Siderúrgica Tubarão – CST, Brasil

(4) Steel Mill Specialist, Companhia Siderúrgica Tubarão – CST, Brasil

(5) Reduction Area Specialist, Companhia Siderúrgica Tubarão – CST, Brasil

(6) Engineering Specialist, Companhia Siderúrgica Tubarão – CST, Brasil

(7) Sustainability Director, PriceWaterhouse Coopers, Brasil

(8) Coordinator, PriceWaterhouse Coopers, Brasil

1. Introduction

1.1 Companhia Siderúrgica Tubarão – CST

CST, is today the biggest producer of steel slabs in the world (accounting for 20% of the volume marketed world-wide). Located in the municipality of Serra, in the state of Espírito Santo, in the southeast of Brazil, the company channels abut 91% of its production to the foreign market. Its capital stock is distributed amongst the Arcelor group, with 37,3% of its shares, CVRD with 22,9%, Mitsubishi with 8 % and the other minority stockholders with the rest of the shares.

Its steel production process is based on coal as a source of energy, and the main processes are: the Coke Plant, the Sinter Plant, two Blast Furnaces, Desulfurization of Pig-Iron, Lime Plant, Steelmaking Shop, RH and IRUT Units, and Continuous Casting, besides a recently implanted Hot Strip Mill – HSM.

With the HSM coming into operation in 2002, the company started to cater to the domestic market as well, and so reducing by 2,5 million tons the volume of slabs available for export. This is something that creates the possibility of investing in increasing the company's production, since the coils to be produced at the HSM aim at a different market from the one served by CST today.

The company aggregates other values to its production process, with the aim of optimizing costs and minimizing the impacts arising from its operation. It has an environmental management system that has as one of its objectives the on-going improvement of its environmental control systems. Another point, also emphasized in this system, is the quest for excellence in electricity efficiency, which it has been working on through greater operational efficiency and the re-use of the gases generated in the production process.

Today, the company has an installed generating power of 211MW through 3 Thermoelectric Plants that make use of the gases generated in the Blast furnaces (BFG) and Coke Plant (COG), from a top turbine, to take advantage of the kinetic energy of the Blast furnace gases, besides the generation of electricity making use of the hear originating from the dry extinguishing of coke.

CST's consumption of electricity is currently 165 MW, counterbalanced by an actual generation of 197 MW, making it possible for the company to make available 32 MW for the state of Espírito Santo, 32 MW and transforming CST into the only integrated steel mill in Brazil to enjoy a surplus in electricity. The system of co-generation of electricity has already even brought about for it the CNI ECOLOGY 1998 award, in the Conservation of Production Consumables category, due to its efficiency in energy. Besides this award, CST also won, in 1999, the National Award for the Conservation and Rational Use of Energy, in the category Industry – Alternative Energy, with the TRT- Blast Furnace Top Turbine.

1.2 The project description

Implantation of the Steelmaking Shop Gas Recovery system is the first initiative tobe analyzed in this report is the implementation of the LD gas recovery system, the objective of which is to direct this gas for generating electricity at the company's Thermoelectric Plants, with the advent of the implantation of the 4th Thermoelectric Plant.

Currently, the gas generated in CST's converters during the blast of oxygen is directed towards a gas scrubbing system and afterwards "burnt" in the stack, when the concentration of CO in the gas increases. The project consists of implanting a system for collecting a fraction of this gas rich in CO and directing it towards the Thermoelectric Plant #1, #2 and #3 (existent) and #4 (to be installed) and using it for generating electricity. The major part of the investments will be applied in a suitable LD gas cleaning system, so as to adapt the gas to the requirements of the CTE process, as well as in a gasholder to carry the gas.

With the implantation of this system, it is estimated that 47.355 Nm3/h de LD gas will be recovered, which corresponds to a generation of electricity in the order of 94,7 Gcal/h. It will come into operation in March 2004.

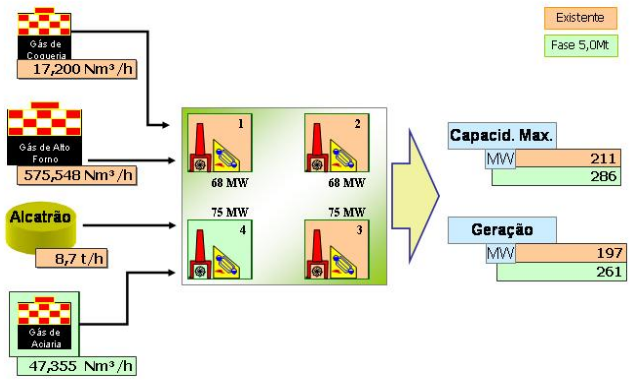


Figure 1: Flowchart of Electricity Generation and the Recovery of the LD gas

1.3 Optimization of the operational control of electrical equipment in the Steelmaking shop

The second initiative is the implantation of a series of electronic devices for actuating and controlling motors, in such a way as to operate them only when their use is necessary.

All the steelmaking shop's systems currently operate non-stop around the clock, regardless of the condition of the process. The project is going to add electronic starting systems (soft-starters) for the current motors and to adapt the mechanical equipment and accessories, in such a way as to keep them in operation only during the intervals of time necessary.

The systems taken into consideration in this initiative are: Gas Washing System, Lance and Converters Refrigeration System, Sub-Lance Refrigeration System, RH Hydraulic System, IDF System and RH Dedusting System. The estimated annual savings in electricity with the implantation of these projects is 43.466 MW. They will come into operation in March 2004.

1.4 Determining the Baselines for GHG Emissions

In the context of the Clean Development Mechanism (CDM), reductions in emissions are based on the difference in emissions of greenhouse gases (GHG) between usual or projected practices (known as the point of reference or baseline scenario) and the practices adopted as a result of the implementation of the project (known as the project scenario).

This difference in GHG emissions between the two scenarios is called “Additionality”, which is perhaps the most important criterion for the eligibility of GHG mitigating activities in the ambit of the Kyoto Protocol..Determining the baselines can be divided into two steps:

- Determining the future scenario in the absence of the activities of the project. In other words, what will probably happen in the absence of the activities of the project. Determining this is done on the basis of an analysis of the tendencies of the factors that can affect the project, such as the economic, financial, social and regulatory ones. Given the nature of this project, this analysis should focus on the Brazilian electricity sector.
- Determining the emissions of CO_2 equivalent that would occur in this future scenario. This is done by making use of all the hypotheses pertinent to the chosen future scenario. Given that the baselines, not least by definition, are hypothetical, it is not rare for measurements and data from other analogous companies or areas to be necessary.

After determining the baselines, the emissions that will occur as a result of the implementation of the project have to be quantified or estimated, with a view to determining the impact of the project’s reductions in emissions. This report is based on this methodology, and the results are presented in the following sections.

2. Determining the Future Scenario: The Brazilian Electricity Sector

Over the major part of its extent, the Brazilian electricity sector features an interconnected electricity system, which, at the end of 2000, corresponded to a generating capacity of 65.757,10 MW, distributed as detailed in Table 1, by the different technologies for generation.

Table 1: Installed capacity at the end of 2000 by technology for generation (Source: National Operator of the System – ONS)

Technology for Generation	Capacity in MW
Hydroelectric	53.327,60
Thermoelectric	4.163,50
Nuclear	1.966,00
Itaipu (50%)	6.300,00
Total	**65.757,10**

2.1 Justification for the choice of methodology and the reason for its applicability to the project

Although the matrix for the supply of electricity that exists in the country today is highly renewable, based in a majority way on hydroelectric power stations, there is some signposting that the percentage participation of thermal power stations is going to increase in the next few years, making the electricity supply system more intensive in the use of fossil fuels.

This expansion is based on a series of facts:

- ✓ The need for expanding the system for generation and transmission to meet demand is going to bring about the need for investments over the next 8 years of about US$ 34 billion (source CCPE), which means R$ 11 billion / year, just to provide for the forecast capacity of infrastructure.
- ✓ The rationing in 2001 caused political damage that no government will want to repeat in the next few years, although the availability of funds for investments in electricity cannot be regarded as a priority, when compared with the social agenda of other demands.
- ✓ The need for expansion in the short term is easier to be met by the inclusion of thermal power stations using natural gas, not least because:
- ✓ They are works that are quicker to build.
- ✓ They offer a lower environmental risk, when compared with the more considerable portion of the Brazilian hydroelectric potential yet to be exploited, located in the main in the northern region and with potential damage to the Amazonian forest.
- ✓ The thermal power stations use the technology with which the investors (the “players”) in the new competitive electricity market are more familiarized, on account of their previous experience in their countries of origin.
- ✓ Availability of gas, following investments made, in the main, by Petrobrás.
- ✓ The Brazilian government is beckoning with subsidies for transporting gas to make the Thermoelectric Priority Plan viable and with big increases in the price of electricity, the major part of which with the intent to make expansion financed by the private sector viable. In measure number 15 of the Plan for Revitalizing the Electricity Sector, published on 1st February 2002, the government announces the intention of subsidizing part of the expenses with transporting gas in the Brazil – Bolivia gas pipeline for power stations included in the PPT - Thermoelectric Priority Plan. The same Plan signposts a big increase in electricity prices in measure number 3, which preconizes new rules for the electricity that will be gradually released form the initial contracts.
- ✓ The plan for revitalizing the electricity sector is signposting the acquisition of emergency thermal based electricity to allow the recovery of the capacity for pluriannual regularization of Brazilian reservoirs.

It is also important to highlight the information from the Electricity Crisis Management Chamber (CGE), in the document titled: “Strategic Program for Increasing the Supply of Electricity”, published in May 2002.

In this document, it is possible to find a more detailed plan as a point of reference for the expansion program for the period. Besides the expansion in generation, the CGE has been giving priority to and facilitating investments in transmission and transformation, in accordance with the following:

Table 2: Strategic Program for Increasing Supply 2001 – 2004 (Source: energiabrasil.gov.br)

TIPO DO EMPREENDIMENTO (Unidade)	AMPLIAÇÃO DA OFERTA (2001-2004)				
	2001 Realizado	2002	2003	2004	Total
HIDRELÉTRICAS (24)	1.397	3.045	2.463	3.122	10.027
(*)TERMELÉTRICAS (40)	1.354	2.829	4.342	916	9.441
TERMELÉTRICAS EMERGENCIAIS (58)	_	2.163	_	_	2.163
IMPORTAÇÃO (5)	98	1.188	400	800	2.486
PCHs (29)	66	170	145	_	381
COGERAÇÃO (17)	125	162	500	_	787
EÓLICA (42)	2	261	394	393	1.050
TOTAL (MW)	3.042,0	9.808	8.244	5.231	26.325
LINHAS (26) DE TRANSMISSÃO - Km	505	1.037	4.383	3.348	9.273
SUBESTAÇÕES (MVA)		3.347	4.450	1.050	8.847

* Considerada uma redução de 30% de não realização do programa previsto.

It should be added that, besides the scheduled expansion, an important portion of thermal electricity is being aggregated to the system as an emergency measure. This is electricity acquired by Comercializadora Brasileira de Energia Emergencial (CBEE), which will mean the addition of 2.153MW in the period 2002/2004, of an emergency nature.

To sum up, from the expansion in generating capacity in Brazil over the period from 2001 to 2004, taking into consideration only the projects that are more consolidated, one arrives at a total of 26.325MW (Strategic Program + Emergency Purchase), of which 11.594MW coming from thermal sources.

That is to say, it is reasonable to adopt as a point of reference for the immediately forthcoming periods (up to 2004) that 44% of the whole expansion of generation will come about via thermal generation.

If, however, we consider that not all the installed capacity will be actioned in the short term, it is also legitimate to build scenarios for the release of electricity by these power stations, allowing parts of the installed capacity as actually being released. To explain this better, part of the power stations will depend on the market forecasts being put into effect and, at the same time, on the hydrological factors, for the electricity actually to be released from the thermal power stations.

No greater detailing of the justification shown was considered, although should the designated operational entity that will proceed with validation find it necessary to do so, this will be included in an appendix specific to the theme.

2.2 The Future Scenario

In this issue resides the central point of the matters discussed in this section, that is to say, what actually is the point of comparison of measures that foster the use of electricity in a more efficient way that is most appropriate for controlling and curbing the expansion of greenhouse gases.

In the light of all that has been set out in this section of the report, there is today clearly a tendency for a dirtier matrix of Brazil's generation of electricity.

Accordingly, we believe that the baseline for the Brazilian electricity sector, to be drawn up for the opportunities listed and analyzed in previous sections for an increase in CST's efficiency in electricity, should be done in the light of a future scenario that takes into consideration the prospects for an expansion in thermoelectric capacity in Brazil's electricity matrix.

3. Quantifying the Emissions of CO_2 equivalent in the Future (Baseline) Scenario and Estimating the Reductions in GHG Emissions

3.1 Methodology

As described in the previous section, the construction of the baseline is based on the assumption that the actions performed, taken from the roster of opportunities previously listed, contribute towards the shifting away of new additions of thermoelectric power stations in Brazil.

The accounting of the benefic effects will be done taking the units in kWh of electricity generated or saved. The quantification of the GHG avoided will be done from the equivalent emission by a natural gas-fuelled thermoelectric power station with the best technology, capable of generating the same quantity of kWh brought about by the initiatives under analysis.

With the objective of maintaining a conservative approach, it is important that the emissions accounted for should be proportionalized by the quantity of thermoelectric power stations identified in the expansion of the electricity system, in relation to hydroelectric power stations. This proportionalization will therefore set the upper limit for accounting for the GHG emissions arising from the hypothetical best technology thermoelectric power stations described above.

This figure will be further reduced by the introduction of dispatch factors form Brazil's thermoelectric power stations, compared with hydroelectric power stations, on the horizon of the project. Accordingly, the result, that is, the reductions in GHG emissions will be given in the following way (equation 1):

$$RE = EGC \times ET \times P \times F \qquad (1)$$

Where: RE=Reductions in Emissions; EGC=Electricity Generated or Conserved; ET= Emissions from Thermoelectric Power Stations; P=Proportionalization of Thermoelectric Power Stations; F=Dispatch Factor of the Thermoelectric Power Stations.

3.2 Hypotheses Used

We show below the IPCC's table of the factors for carbon emission, by type of existing technology.

Table 3: Source: IPCC 1995

Types of Commercially Existing Thermoelectric Conversion Technologies. Efficiency in Electricity and Carbon Emissions (in gC/kWh)				
System	**Technology**	**Efficiency (%)**	**Portion of Electricity**	**Emissions(gC/kWh)**
	Primary source: Coal			
Steam turbine Steam turbine Pressurized combustion on fluidized bed Steam turbine – co-generation Steam turbine – co-generation Co-generation	Conventional average The best available Conventional average The best available	34 39 42 78 83 86	 0.50 0.60 0.65	325 280 260 175 145 135
	Primary source: Oil			
Steam turbine	Conventional average	38		230
Combined cycle gas turbine	The best available	48		180
Steam turbine – Co-generation	The best available	81	0,60	130
	Primary source: Natural Gas			
Combined cycle gas turbine	Average	36		175
Combined cycle gas turbine	The best available	45		140
Steam injection gas turbine – Co-generation		75	0,80	90
Combined cycle gas turbine – Co-generation	The best available	77	1,00	85

For the purposes of accounting, based o, the value adopted is 0,14 ton C/MWh for emissions from a natural gas-fuelled thermoelectric power station of the best technology.

As analyzed in the previous section, it is reasonable to adopt as a point of reference up to 2005 that 44% of all the expansion in generation will come from thermal sources. Accordingly, for the accounting purposes, the proportionalization factor adopted will be this percentage.

On the immediate horizon, we can imagine a few simplified scenarios until the new criteria of load dispatch are defined, as preconized, though not yet detailed, by the Committee for Revitalizing the Electricity Sector.

Hence 3 scenarios are proposed, according to whether the adversity of the water situation is more or less severe in the next few years:

Pessimistic scenario	Dispatch from Thermoelectric Power Stations in 90% of the time
Average scenario	Dispatch from Thermoelectric Power Stations in 60% of the time
Optimistic scenario	Dispatch from Thermoelectric Power Stations in 30% of the time

Under these conditions, and until new coefficients based on dispatch operations are defined by the National System Operator are defined, the reductive coefficients of thermal power equivalent would be 0,396; 0,264 and 0,132 respectively.

For the calculation of the reductions in emissions, based on the future (baselines) scenario and the project scenario, the object of this document, we shall be taking into consideration the average scenario, that is, a factor of 0,264.

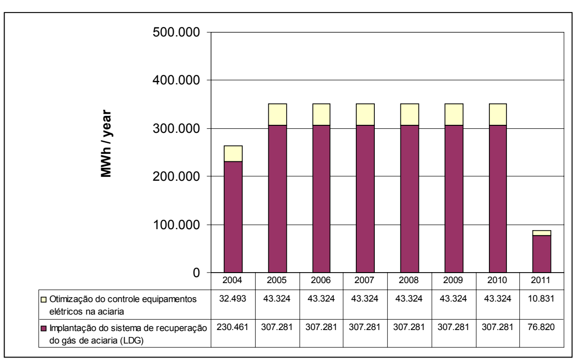
3.3 Estimate of the Reductions in GHG Emissions

In accordance with the description of the methodology that has been given, the calculation of the estimated reductions in emissions will be done according to equation 1, shown above, which has the benefit of calculating the reduction in GHG emissions directly, which facilitates the monitoring process.

However, the same result can be obtained by the difference between the emissions in the future (baselines) scenario and the project scenario, as provided for in the regulations for projects in the ambit of the Clean Development Mechanism.

Figures 4 and 5 show the estimates of the gains in the generation of electricity (first initiative), as well as the conservation of electricity (second initiative), and the resulting reductions in emissions of GHG.

With the implementation of these initiatives, the estimate is that CST will attain, in the seven year period, a total reduction in the demand for electricity of 2.454,24 GWh, equivalent to 332.599 tons of CO_2 equivalent.



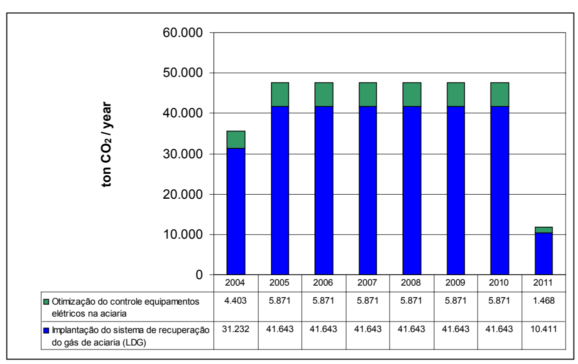


Figure 4: Estimative of the total energy gain

Figure 5: Estimative of the total CO_2 displaced emission

4. Conclusions

As presented in this report, the project has the capacity for generating a total reduction in the emission of greenhouse gases of 332.599 tons of CO_2 with the implantation of the initiatives during the 7-year life cycle. Of this total, 291.499 tons refers to the implantation of the steelmaking shop gas recovery system, and 41.099 tons to the optimization of the operational control of the electrical equipment in the steelmaking shop.

In addition to the GHG benefits, the project brings social, environmental and economic benefits relating to CST's initiatives, and as a consequence it meets the criteria for eligibility of the FCCC and of the Kyoto Protocol as well. Furthermore, it is in accordance with the Brazilian government's expectation with regard to the objectives related to the CDM and sustainable development.

References

[2] Installed capacity at the end of 2000 by technology for generation, National Operator of the System – ONS, http://www.ons.org.br/ons/sin/abertura2.htm

[3] Detalhamento da rede básica, National Operator of the System – ONS http://www.ons.org.br/ons/sin/abertura2.htm

[3] Participação da Eletricidade na Matriz Energética Nacional, http://www.mme.gov.br / sem / ccpe / seminário / sem05_junho.htm

[4] Perspectivas de Evolução da Economia Brasileira até 2010,http:// www.ccpe.gov.br/index.asp

[5] Expansão do Mercado, http://www.mme.gov.br/sen/ccpe/seminario/sem05_junho.htm

[6] Potencial Hidroelétrico a Explorar por Região, http://www.eletrobras.gov.br / atuação / sipot / tabela.asp?a=região

[7] Expansão baseada em projetos institucionais, http://www.mme.gov.br / sem / ccpe / seminário / sem05_junho.htm

[8] Programa Estratégico de Aumento da Oferta 2001 – 2004, http://www . energiabrasil . gov.br setframe.asp?Marcado=oferta&Pagina=oferta_resumo.asp

[9] Emissões, http://www.mme.gov.br/sen/ccpe/seminario/sem05_junho.htm

[10] Oferta e Demanda Energética, http://www.aderes.com.br/es_energia.asp

DESENVOLVIMENTO DE PROJETOS DE MECANISMOS DE DESENVOLVIMENTO LIMPO (MDL) NA CST[1]

Guilherme Corrêa Abreu[2]
Tsutomu Morimoto[2]
Alexandre Rosado Barbosa[3]
Odair José Kimrse[4]
Carlos Henrique Sampaio[5]
Roberto da Cruz Júnior[5]
Jarildo Francisco Pinho[6]
Marco Antônio Fujihara[7]
Carlos Henrique Delpupo[8]

Resumo:

De acordo com a Política Ambiental da CST, e dentro do contexto de seu Planejamento Empresarial que norteia ações de desenvolvimento sustentável, os projetos de Mecanismos de Desenvolvimento Limpo – MDL, conforme estabelecido no Protocolo de Kyoto, vem sendo desenvolvidos.

Este trabalho descreve as ações realizadas para a determinação da baseline dos potenciais de reduções de emissões de CO_2 equivalente da CST. São apresentadas a descrição do processo produtivo da CST e uma análise do cenário futuro do setor elétrico brasileiro. É feita uma projeção das reduções de emissões de gases de efeito estufa durante o ciclo de vida do projeto. O total de redução de emissões é calculado para toda a área do projeto.

O projeto está dividido na implantação do sistema de recuperação de gás da aciaria e na otimização do controle operacional de equipamentos elétricos da aciaria. Está associado à implantação da 4ª Central Termo Elétrica, e prevê além da redução de emissão de gases de efeito estufa, a manutenção da auto-suficiência em termos de energia elétrica, sem demandas adicionais da matriz. Tem capacidade de gerar uma redução total de emissões de gases de efeito estufa de 331.159 toneladas.

Palavras-chave: meio ambiente, créditos de carbono, gases efeito estufa

(1) Contribuição técnica a ser apresentada no XXV Seminário de Balanços Energéticos Globais e Utilidades da ABM, a ser realizado nos dias 24 a 26 de agosto de 2004.
(2) Especialista de Meio Ambiente, Companhia Siderúrgica Tubarão – CST, Brasil
(3) Especialista em Energia e Utilidades, Companhia Siderúrgica Tubarão – CST, Brasil
(4) Especialista em Aciaria, Companhia Siderúrgica Tubarão – CST, Brasil
(5) Especialista da Área de Redução, Companhia Siderúrgica Tubarão – CST, Brasil
(6) Especialista da Área de Engenharia, Companhia Siderúrgica Tubarão – CST, Brasil
(7) Diretor de Sustentabilidade da PriceWaterhouse Coopers, Brasil
(8) Coordenador da PriceWaterhouse Coopers, Brasil