Presented at the Congress of the International Agency for Energy Economics, Orlando, USA, Aug 1999

The Climate Change Debate and the Screening of CDM Projects: a developing country's perspective.

by

Oswaldo Lucon[1]
Researcher, University of São Paulo

Edmilson Moutinho of Santos[2]
Senior Lecturer at the IEE - University of São Paulo

Greenhouse Gases and the Kyoto Protocol

One hundred and sixty three countries ratified the United Nations Framework Convention on Climate Change - UNFCCC, as a result of the Rio Earth Summit 1992. The objective of this Convention is to stabilize the concentrations of greenhouse gases to levels that prevent dangerous antropogenic interferences to the earth's climate system. A main form to achieve these objectives is to limit greenhouse gases emissions provenient from burning of fossil fuels.

The Annex A of the Kyoto Protocol defines six greenhouse gases (GHGs): carbon dioxide, methane, nitrous oxide, hydrofluorcarbons, perfluorcarbons and sulfur hexafluoride. Defines also cathegories and sectors of origin for these gases: Energy (fossil fuel burning, power generation, manufacturing industries, construction, transport sector amongst others); fugitive emissions from combustibles (solid, oil, natural gas and others); industrial processes (mineral products, chemicals, metallurgy, production and use of halocarbons and sulfur hexafluoride, other); use of solvents and other products; agriculture (enteric fermentation, livestock management, rice cropping, agricultural soils, savannah burning, agriculture residues burning etc.) and; wastes (solid waste landfilling, liquid effluents; incineration).

Since the majority of the emissions has been historically produced by industrialized countries, these are in principle liable for a major part in the responsibility in limiting their future emissions. Meanwhile, populational expansion and the legitimated needs of economic growth of developing countries indicate that, in a not distant future, most of the GHGs will be produced in such countries, which will need to be involved in the search for a solution to the problem. One of the key

[1]Researcher at the Institute of Energy and Electricity – IEE - University of São Paulo, Brazil
Av. Prof. Almeida Prado, 925 – Cidade Universitária
05508-900 – São Paulo – SP – Brasil
Phone: 55 – 11 – 3030 - 6560
Fax: 55 – 11 – 3030 – 6480
Email: oswaldol@cetesb.br

[2]Senior Lecturer at the IEE - University of São Paulo, Brazil
Phone: 55 – 11 – 818 – 5064
Fax: 55 – 11 – 818 – 5031
Email: edsantos@iee.usp.br

principles of the FCCC is to recognize that climate change is a global problem and industrialized and developing countries must have "common, but differentiated" responsibilities and respective capacities.

The Clean Development Mechanism

Articles 6 and 12 of the Kyoto Protocol establish respectively the Joint Implementation (JI) and the Clean Development Mechanism (CDM). Through the Clean Development Mechanism (CDM) projects, Annex I, developed countries, signatories of the Kyoto Protocol, aim to attain their commitments for the reduction or limiting of greenhouse gases (GHG) emissions. This type of projects is designed to be conducted between a private investor from an Annex I country and a non-Annex I, developing nation. The reduction in GHG emissions achieved by the project in the host country is then supposed to be accounted to the amount committed by the investor's nation.

CDM Projects , according to the Article 12, must result in emission reductions "additional" and "certified" above a business-as-usual baseline in the host non-Annex I country. The CDM framework establishes thus an emergency phase of a North-South market for "certified" compensations or emission reduction credits of greenhouse gases.

In these market-driven projects, investors will be interested in maximizing their objectives at a cost as minimum as possible. For example, amongst the most commonly announced possible alternatives, such as production of renewable energy, abatement by gains in energy efficiency and carbon sequestration by sinks (like forests), the latter usually presents the least cost by unit of mitigated carbon (US$/tC).

With respect to the Article 12, this indicates that the CDM only authorizes certified emission reductions, without mention to carbon sinking enhancement projects, such as reforesting. Discussing the intentionality of this exclusion, some argument that carbon sequestration projects are valid as a CDM activity. Others insist that this restriction was intentional, in order to guarantee that CDM promote the sustainable development through transfer and use of cleaner technologies; otherwise, CDM would give preference to a transfer of trees that limit development options, confining host countries into long term commitments of land use. Based on this assertive, previous experience with Activities Implemented Jointly (AIJ, the pilot phase of Joint Implementation/CDM) has shown that the costs of forestry carbon sink projects - of about US$ 18 per tonne of mitigated carbon - were significatively less than those for emission reductions in the energy sector (about US$ 136/tC) in an equivalent basis for carbon compensation i.e. per tonne of mitigated carbon.

Article 12 of the Kyoto Protocol leaves most of the CDM operational details to be negotiated thereafter, during the Conferences of Parties, including financial, administrative and institutional arrangements , their modes of operation and detailed guidelines to compensation certification criteria and project eligibility. There is thus a tremendous chance to complete the structural design of the CDMs in order to create conditions to mobilize private non-subsidized funds to these new opportunities of investment.

The Role of the Local CDM Screening

CDM projects are supposed to be interesting to host countries. Not at all times the most attractive projects to the foreign investor will be the so attractive to the host country. For example, reforesting (at costs of $10-40/tC mitigated) would likely be economically preferable to generation of energy

from biomass and to improvements in the energy efficiency of industrial processes, but also deprives the host country of the opportunity of investments in infrastructure and competitiveness.

The objective of the CDM is not only to avoid antropogenic climate change, but also to promote the "clean development", compatible in the time scale with social, economic and environmental systems. The willingness of developing countries in participating in hosting CDM partnerships will not be materialized unless concernings about the sustainability of the project are satisfactorily addressed. In particular, they need to ensure that CDM offer tangible benefits in order to maintain the sustainable development. Since long term - 25 to 50 years - sustainability projects are not strongly amongst national priorities in countries with short term economic objectives, some kind of selection criteria should be established. CDM projects should, therefore, be subjected to the following successive screenings: commercial-economic, environmental (saved and generated impacts), social and national (in the host country). Negative environmental screening may dequalify potential CDM projects that add impacts to already deteriorated environmental resources. Most of the types of technology in the energy sector may negatively impact the local environment in some way. When an Environmental Impact Assessment indicated that such impacts may critically stress the local environment, or be contrary to targets proposed by multilateral environmental agreements, a project could be dequalified as CDM. Social screening for energy projects have to consider aspects such as availability of service, low access costs to the user, minimization of local health problems and fostering to commercial and industrial activities.

As stated on Article 3 of the Climate Convention, to achieve compatibility between different objectives, the potential agents are encouraged to follow basic guidelines, based on practical measures and equity principles. Many specialists have the opinion that it is important, at this stage of the conception of the CDM, to have at least some projects implemented. The discussion about the local screening for these projects is therefore of extreme importance.

The Case of Brazil - a Developing Country's Perspective

As previously mentioned, there is a broad range of opportunities for CDM projects: more efficient lamps, processes and motors; less carbon-intensive fuels; combined heat and power schemes; renewable energy technologies, methane recovery and use and foresting/reforesting.

In the case of Brazil, hydroelectricity contributes to nearly 95% of power generation. Although this may be a first option for CDM projects, there are serious local impacts, especially from large dams in areas of native forests. The consumer's market is located in the Southwest and South regions, mostly in the State of Sao Paulo, responsible in 1998 for 37% of the GNP and 32% of the electricity consumption. These areas have already explored a significant part of the hydroelectric potential by constructing large dams with significant social and environmental impacts. The exploitation of the higher hydric potential has many environmental problems and high capital investment and transmission costs.

Lower capital costs associated, de-regulating and international forces of free energy market have been taking to Brazil a higher proportional use of carbon dioxide emitting fossil fuels. This inevitable reality leads to a discussion of the best uses and other demand-side management issues.

Natural gas could show up as an important candidate for CDM projects in the Brazilian perspective, without putting aside energy alternatives from biomass as well as projects on energy conservation, immediately appearing as preferable alternative CDM options.

Most studies usually adopted a project-based perspective trying to figure out the reduction of emissions provided by a particular project. Integrated systemic approaches have been set nearly out of the discussion. The reduction in the carbon release by the adoption of a different energy matrix, considering more efficiently designed fuels or taking into account the life cycle analysis, are being very little discussed.

Supply: - the natural gas expansion in the energy matrix

The Brazilian national energy policy has the following strategic guidelines: rational and efficient energy use; reduction of internal and external vulnerability; realistic price policy; system efficiency and competitiveness; technological innovation; harmonization with the National Environmental Policy; private sector participation under market conditions; taking advantage of the opportunities of energetic integration with other Latin American countries. The national natural gas program has been trying to comply with these objectives as much as possible.

With the prospective operation of the 3-4 billion U.S. dollars project Brazil-Bolívia 3.400 km gas pipeline, natural gas is expected to increase its share in the Brazilian energy matrix from the current 2.8% to12% by the year 2010. The Bolivian proven reserves of 18 billion cubic meters (48 billion cubic meters of probable reserves) are considered sufficient to match the supply, expected to reach the peak of 16 million cubic meter per day after 8 years in operation. Additionally, the Brazilian internal supply in 1998 of natural gas was 22 million cubic meters per day (from 154 billion cubic meters of proven reserves).

Demand: determining the Local Best Use for Natural Gas

Without including thermal electricity generation, the Brazilian potential demand for natural gas, in million cubic meters per day is expected to raise from 17 (1975) to 35 (year 2000), then to 64 (2010). In São Paulo State only, the demand forecast for the year 2000 is of 12,7 million cubic meters per day, plus approximately 8-9 millions cu.m/day for power generation.

The residential sector is responsible for 27% of the electricity consumed (or 74 TWh, from 296 TWh in 1997), of which water heating corresponds to 26%. The largest part of these 7% of the total demand of electricity is consumed during the peak load (around 7 p.m.). This peak load could be significantly lowered down if electric boilers and showers could be replaced by other types of heating, like solar, LPG or natural gas fuelled.

In the industrial sector, it is important to notice that energy intensity in products is also growing in the time scale (energetic intensive products' participation in total energy usage growing from 45% in 1970 to 62% in 1992), as well as exports of energy-intensive products in relation to economic added value. This means basically some kind of imports of liabilities for additional greenhouse gases emissions.

Many companies in the industrial sector are switching or planning to in a short-term switch fuels, mainly from crude oil to natural gas. This fact has been occurring due to the penetration of the latter in the energy matrix, mainly by the development of the Bolivia-Brazil gas pipeline.

In 1998, the per capita natural gas consumption in Brazil is of 33 cubic meters, against 380 cubic meters per capita as a world average.

Barriers to Natural Gas Market Penetration

The entrance of the natural gas in the energy matrix has to overcome some short term but vital problems: economic, local environmental and cultural.

Problems Concerning Contract Modality and Foreign Currency Fluctuations

The contract for the supply of Bolivian natural gas is based on take or pay terms, paid in U.S. dollars. Since the gas is being paid with or without use, the supplying companies need also to develop the demand as fast as possible, in order to reduce their opportunity costs.

Negotiations between contractors foresee that 80% to 90% must be taken, in an annual basis. Concessionaires, still in a very preliminary operational phase, assume to be a very high risk to accept take or pay over 80%.

Seasonality is another issue to be addressed. From December to April gas takings are much below contractual volumes. On weekends also the system difficults takings of more than 65% of the contracted volume, reducing the possibility of supplying buffer consumers. Operation of thermal plants only on peak loads are problematic as well, since there is a coincidence in the consuming cycles of electricity and gas, both in hour and seasonal levels.

Studies have shown an extreme sensitiveness to the price question. In 1996, prices for natural gas at the city gates were of about US$2.70/MMBTU, whereas fuel oil prices range from US$2.83MMBTU to US$3.09/MMBTU. The distribution margins are, thus, very narrowed.

The payment modality of international contract subjects the market forces to fluctuations in foreign currency exchange rate, increasing the risk factor.

Resistance of Public Opinion to Natural Gas Projects

The economic pressure over suppliers caused by the take or pay contracts sometimes may push the use of natural gas to less environmentally friendly options, such as power generation by thermoelectric units located very close to or even within large city limits. Amongst problems to be mentioned are the nitrogen oxides (NOx) emissions and the consumptive uses of large amounts of cooling water.

Hence, these new projects of gas-fired thermal power plants are facing tough resistance from the public opinion in Brazil. A great deal of this pressure is fairly reasonable, once these large cities have already noticed problems with water shortages and NOx air pollution from vehicles and industrial processes. However, it is necessary to bear in mind that an expansion in the power generation capacity is needed.

Thermal plants are also necessary to act as consumer anchors, contributing to lower transportation tariffs.

Lack of Awareness and Low Capacity of Investment in Fuel Switching by Industry and Water Heating Systems

The switch to natural gas has also to overcome the barriers of lack of awareness and low capacity of investment in new systems, in both residential and industrial sectors.

In homes, changing an electric shower by a natural gas boiler implies in additional civil works and investment in equipments: hot water pipes, insulation, safety ventilation etc. Some cities in the São Paulo State have already included in the Municipality Codes the compulsory installation of gas heating system for condominial new homes. Fears of explosions and intoxication are other factors against switching from a simple (and cheaper in terms of capital costs) electric shower to a gas system. Local study conducted by the State Secretariat for the energy has shown, nevertheless, economic advantage of 35% in energy bills favorable to gas.

In industries, problems with low capacity for investing also occur. Conversion of industrial equipments demand investments of about US$ 100 thousand for each 10 thousand cubic meters consumed per day. High prices at the city gates do not allow operation with larger buffer consumers, such as cement and petrochemical industries

Allied to this factor, the expectancy of raises in prices due to foreign currency exchange rate fluctuations drive companies to a standby position.

The Importance of Natural Gas in the Brazilian Context

Natural gas is an important factor for a country's development. In the decade of 1960, the exploration of natural gas in the North Sea has boosted the British economy and reduced pollution problems by substituting coal in the industry and electricity generation.

Brazil, a developing country, has historically depended on foreign governmental investments (like those from the World Bank) for constructing large dams. After this cycle, in the decade of 1980, the country has plunged into external debts, soared by the raise in the international interest rates. The shortage of resources for new investments has taken the power generation capacity very close to collapsing.

Before the entrance of natural gas, the few new power generation projects were based on dams located far from demand, with high environmental, capital and transmission costs. Some oil-fuelled thermal plants contributed to air pollution (sulfur dioxides and particulate matter) in populated areas. Combustion of oil in industries is also a relevant source of air pollution and an inefficient process.

In relation to transportation, the vast majority of load is carried by roads. Underground and train transportation shares are very timid. Although a minor (but increasing due to low renewable fuel prices) part of the car fleet is fuelled by sugar cane ethanol, nearly all trucks and buses are moved by diesel oil, contributing even more to pollution problems in urban areas.

CDM as an Economic Bonus to Natural Gas Projects

The rational use of natural gas could bring several economic and environmental benefits to all the aforementioned sectors. In special, when substituting oil, improves the air quality and provides gains in terms of energy efficiency.

In the transportation sector, there are some local initiatives in terms of fostering the use of natural gas fuelled buses. The city of São Paulo has 189 vehicles (1998), expected to reach 2000 by the end of the century, renewing 35% of the fleet.

Only in the State of São Paulo, the forecast in the demand for natural gas in the industry sector is of 10.9 million cubic meters per day. Substitution of oil is expected, mainly to the sectors of steel, metallurgy, glass, chemical, pulp and paper, food and ceramics. Gains in efficiency, translated to emission reductions and thus being prospective CDM projects.

Not only those alternatives seem the best use of natural gas in an economic, social and environmental perspective, but also substitution of oil in the industry and diesel in transport are private projects, potentially entitled to be granted by CDM bonuses. These bonuses could act as an additional economic incentive; a "buffer" to the recent devaluation of the Brazilian currency which is negatively interfering with the competitive advance of gas in the Brazilian energy market.

Although CDM projects were not initially conceived for boosting a particular fuel or energy alternative, if a systemic approach is adopted, it can be perceived that countries will have either to plant trees or to change their energy consumption patterns in order to stop the increases in carbon concentration in the atmosphere.

To guarantee a realistic social and economic sustainable development, local priorities must then be taken into account.

References

1. ACQUATELLA, J **Private finance and investment issues in GHG Offset Projects - Implications for the design of the CDM mechanism. (Draft)** International Academy for the Environment, Geneva, 1998.
2. Brazilian Ministry of Mines and Energy. **Balanço Energético Nacional 1998.** (National Energy Balance 1998). Download available at <www.mme.gov.br> in June 1999.
3. COMGÁS **COMGÁS Natural.** Secretaria de Energia, São Paulo, 1997
4. FIESP **Gasoduto Brasil-Bolívia: Desenvolvimento do Gás Natural** DEINFRA, São Paulo, 1996
5. HAITES, E. **International emissions trading and compliance with greenhouse gas emissions limitation commitments.** International Academy for the Environment, Geneva, 1998.
6. HAMWEY, R.; SZEKELY, F. **Practical approaches to CDM projects in the energy sector.** International Academy for the Environment, Geneva, 1998.
7. **Kyoto Protocol - Conference of the Parties, Third Session, Kyoto 1-10 December 1997.**
8. HINIKER, M **Creating Environmental Partnerships: JI/AIJ Project Proposal Guide**. International Academy of the Environment, Geneva, 1997
9. LaROVERE, E.L.; LEGEY, L.F.L.; MIGUEZ, J.D.G. **Alternative energy strategies for abatement of carbon emissions in Brazil: a cost-benefit analysis.** Energy Policy 1994 **22**(11) 914-924
10. **Mercedes Entrega mais 25 ônibus a gás (Mercedes delivers more 25 gas fuelled buses).** O Estado de São Paulo, 13 Nov 1998 p.L2
11. MOREIRA,J.R.; GOLDEMBERG. J. **O Programa do Álcool no Brasil.** Ministério da Ciência e Tecnologia, Brasília, 1997

12. MULONGOY, K.J.; SMITH, J.; ALIROL, P.; WITTHOEFT-MUEHLMANN, A. **Are Joint Implementation and the Clean Development Mechanism Opportunities for Forest Sustainable Management through Carbon sequestration Projects?** International Academy for the Environment, Geneva, 1998
13. OGUNLESI, A.O. **Viabilidade do Projeto (Project Feasibility).** *In* Gasoduto Bolívia-Brasil - Desenvolvimento do Gás Natural (Bolivia-Brasil Gas Pipeline - Natural Gas Development). FIESP/CIESP, São Paulo, 1996
14. PROCEL - The Brazilian National Program for Energy Conservation. Site <www.eletrobras.gov.br/procel/cons.htm> accessed in June 1999.
15. ROSA, L.P.; TOMALSQUIM, M.T. **An analytical model to compare energy-efficiency indices and CO2 emissions in developed and developing countries.** *In* Carbon dioxide and methane emissions: a developing country perspective. COPPE/UFRJ, Rio de Janeiro, 1996
16. ROSA, L.P.; RIBEIRO, S.K. **Activities Implemented Jointly and Equity in CO2 Abatement Negotiations.** COPPE - Federal University of Rio de Janeiro, Rio de Janeiro, 1996
17. SAHAGOFF, D. **Potencial do mercado paulista (São Paulo market potential).** *In* Gasoduto Bolívia-Brasil - Desenvolvimento do Gás Natural (Bolivia-Brasil Gas Pipeline - Natural Gas Development). FIESP/CIESP, São Paulo, 1996
18. SCHELEDER, E.M.M.; **O gás na matriz energética. (The gas in the energy matrix).** *In* Gasoduto Bolívia-Brasil - Desenvolvimento do Gás Natural (Bolivia-Brasil Gas Pipeline - Natural Gas Development). FIESP/CIESP, São Paulo, 1996
19. SECRETARIA DE ENERGIA (SÃO PAULO STATE SECRETARIAT FOR THE ENERGY). **Opção por gás reduz carga no sistema (Option for gas reduces system load).** Information Bulletin n.45, Nov/Dec 1997
20. TOLMASQUIM. M.T. **CO2 emissions from energy systems: comparing trends in Brazil with trends in some OECD countries.** *In* Carbon dioxide and methane emissions: a developing country perspective. COPPE/UFRJ, Rio de Janeiro, 1996
21. UNDP **Issues and Options- The Clean Development Mechanism** United Nations Publications, New York, 1998 ISBN 9211261066