Will the Clean Development Mechanism Hold Market Transformation Programs?

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ABSTRACT

This paper assesses the possible impacts of the Clean Development Mechanism (CDM), established under the Kyoto protocol, on cooperative procurement programs for market transformation. The mechanism, that is not yet in place, is meant to ease the implication of developing countries in the climate change struggle and at the same time provide the industrialized countries with a margin of flexibility in fulfilling their reduction commitments. The idea is that an industrialized country realizes a project reducing green house gas emissions in a developing country, and uses the resulting reductions to fulfil a part of its own quota.

Cooperative procurement programs for increased end-use energy efficiency are one of the project categories that will possibly be eligible since they meet the double objective of the mechanism: to benefit simultaneously the environment and the development of the host country. The paper presents a theoretical framework to study the impact of the CDM on procurement programs and seeks to answer the question under which circumstances the mechanism will incite industrialized countries to invest in such projects. The conclusions are based on a numeric sensitivity analysis studying the impact of changes in the design of the mechanism, the level of remuneration of emission reduction credits, and the national and international energy policies. Projects carried out in Brazil are used as an illustration.

Comparisons between the incentives for the implicated actors to invest in energy production and end-use efficiency projects are made. Lastly, an optimal design of the mechanism in order to make market transformation projects more attractive is proposed.

Introduction

The international climate change negotiations have more and more come to focus on the importance of involving also the developing countries in the effort to reduce greenhouse gas emissions. The difficulties to join the preoccupations of the industrialized countries with the priorities of the developing countries have become evident. The former seek to minimize their overall cost of meeting their emission reduction commitments while the latter, confronted with development needs that widely exceed their financial capacities, legitimately put the development of their countries in the first room. Despite strong pressures, the developing countries have not accepted to take on binding emission reduction targets. To rectify this situation a number of so called “flexibility mechanisms” have been discussed. One of those is the Clean Development Mechanism (CDM), that emerged during the Kyoto Conference in December 1997, and can be seen as a way to merge the divergences in views upon climate change policy between developing and industrialized countries.

The purpose of the mechanism is "to assist Parties not included in Annex I[1] in achieving sustainable development and in contributing to the ultimate objective of the Convention[2], and to assist Parties included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments" (Article 12 of the Kyoto protocol). The objective is thus double:(1) to ease a sustainable development of developing countries, and at the same time, (2) to open a margin of flexibility for the annex 1 countries having taken binding emission reduction targets. A fundamental condition for project eligibility is that they result in an ecological additionality[3] compared to a pre-determined baseline.

The use of the mechanism involves a number of practical problems like, for example, the difficulties related to the baseline setting, the coherence with national policies and priorities of the developing countries and the possible asymmetry when it comes to the kind of projects and countries selected for implementation. Another important question is how to attract private investors to invest in CDM projects when it is the governments which are responsible for the emission reductions. One of the possible merits of the mechanism is namely that it could help mobilize private capital for development aid, something that has been recognized as of utmost importance given the insufficiency of the ever so ambitious institutional aid programs and bilateral governmental aid currently in place.

The discussion that follows will not judge the way in which these practical questions will be treated. It will simply seek to find out under which circumstances market transformation projects for end-use energy efficiency would be an interesting, i.e. economically viable, project category to consider for an Annex 1 investor.

Institutional Setting and Expectations of the Different Actors

There are three main actors whose interests and objectives have to coincide for a project to be put in place. The different flows between these actors are described below.

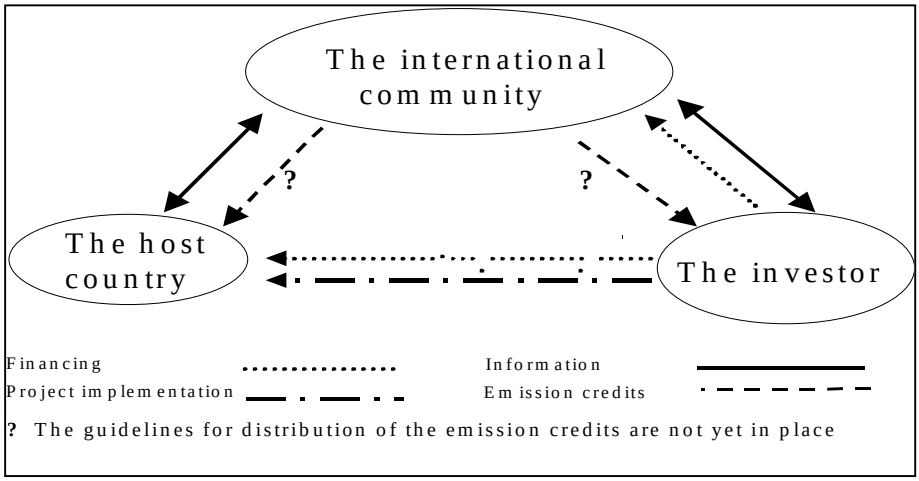

Figure 1. The Main CDM Actors and Their Interactions

[1] Annex 1 of the Kyoto protocol lists the countries having taken binding greenhouse gas emission reduction targets.

[2] Refers to the Objective of the United Nations Framework Convention on Climate Change i.e. to slow down climate change.

The host country. The main criteria for the host country when evaluating its interest in a certain project will be the likely effect on its own development. While the global environmental questions do not play a major role, projects having a positive impact on the local environment, like water and air pollution in the big cities, might be of high interest. Here the governments of developing countries see a possibility to attract foreign investments to increase national development resources.

Due to the high indebtedness of the developing countries, local companies often lack funding for investments or are faced with loans with high interest rates. They do accordingly operate with high discount rates. This is why many projects that would have been profitable in the long-term never are carried out due to lack of capital in the short-term. These companies are most likely interested in any form of cooperation with Annex 1 investors.

The Annex 1 investor. The Annex 1 investor can be a purely financial actor, an industrial company or an institution. From an Annex 1 country point of view the main interest in the CDM would be the margin of flexibility in meeting its Kyoto commitments. The governments wish to fulfil these commitments in a credible way and reduce the need for public funding in doing so.

Facing rigid regulations or taxes on their emissions, private companies and industries will seek to reduce their emissions. The CDM might provide an interesting possibility, particularly where the investors see a business potential beyond the emission reduction. They will be interested in emission reductions in the short or medium-term. This is provided that the emission reductions accrue to these private actors, for example, as emission permits that can be traded at an international market. One could also imagine that the accredited emission reductions are given a certain monetary value by the national government, which is responsible for the realization of the emission reductions in the Annex 1 country, through, for example, tax policies.

The international community. The international community is here represented by the Executive Board of the CDM under the authority of the UNFCCC – United Nations Framework Convention on Climate Change (art. 12-4 of the Kyoto protocol) and the operational entities (art. 12-5 of the Kyoto Protocol). The Executive Body will be a light structure composed of representatives from different regions, and will function as guarantor for the respect of the objectives of the convention. This actor will intervene by establishing and following-up the rules and guidelines for the CDM.

The operational entities will be responsible for the certification of the emission reductions according to the rules put in place by the Executive Board. They will also collect the charges foreseen to cover the administration of the mechanism and preventive measures in the countries most vulnerable to climate change. Private consulting firms or development banks could play this role after having passed a pre-qualification test.

This international community is probably the only actor to unambiguously be interested in a true ecological additionality and will therefore call for environmental efficiency.

[3] This means that the realisation of the CDM project shall result in lower GHG emissions than what would have been the case in absence of the same.

Envisaged Projects

Given that the interests of all these actors need to coincide for a project to be realized under the CDM we are looking for projects that at the same time: offer cost-effective emission reductions for the Annex 1 investor; contribute to a sustainable development in line with national priorities in the host country; and result in true emission reductions to serve the ultimate objective to slow down climate change.

A number of project types fulfilling these three conditions could be imagined, for example energy supply projects, electricity production, infrastructure development, CO_2 sequestration (through for example forest plantation) and projects in favor of energy efficiency. Energy supply projects are amongst the most discussed and are undoubtedly needed given the high demand expected to meet the development targets. One of the project categories that has been least discussed is end-use energy efficiency projects, although such projects would offer cost-effective complements to energy supply projects.

Under the CDM such projects could have an important role to play. This is especially true with respect to the second criteria, namely to contribute to a sustainable development in line with national priorities. The fulfillment of most developing countries' priorities requires increased access to energy and especially electricity. Rising living standards, increasing urbanization and industrialization result in a greater demand for energy services. By adopting efficient end-use technologies at early development stages developing countries could benefit from considerable economic savings in the short-term and environmental advantages in the medium and long-term.

Energy supply versus end-use energy efficiency projects. Comparing energy supply to end-use efficiency, one can first note that new energy production capacities demand large capital investments and that capital spent on energy production not can be spent on other development necessities like health and education. Energy efficiency is often less expensive than energy production even though investing in energy efficient end-use technology might require a higher first cost than less efficient equipment.

This kind of "negawatt" thinking is already present in many developing countries. One example is the Brazilian national electricity conservation program, PROCEL, established in 1985 and run by the government and the national supply utility. With its national scope and wide range of activities including information and demonstration projects, cooperative efforts with equipment manufacturers as well as direct installations of energy-efficient end-use technologies, PROCEL inherently contributes to market transformation in favor of energy efficiency.

Even when energy efficiency is apparently a less costly choice than energy production to satisfy the need for an energy service, the actual realization of the energy efficiency option may be difficult to finance. This is because energy producing companies and the often scattered energy users have different views upon energy, different investment priorities and different access to capital. Many investments in end-use efficiency that would pay for themselves in only a few years and yield a far greater return than investments in energy production do not appear financially beneficial to the final energy users who make the investment decision. This so called "pay-back gap" calls for policy measures targeted at stimulating investments in energy-efficiency improvements. (Swisher et al. 1997)

Market Transformation Programs – Where Do They Fit In?

Market transformation has been recognized as one important set of tools to work on the demand side of energy efficiency that could help to close the "pay-back gap". The term conveys a situation where the entire market, its products availability and customer choices, is altered as a result of intervention (*STEM, 1998*). From an energy-efficiency perspective, the goal is to change the market, in all its links and stages, into one that features more energy-efficient products. Such a transformation can be achieved by making products with poor performance leave the market, enlarging the market for the products with good qualities, and promoting technological development. Many different instruments are being tried in order to attain the desired changes; for example, labeling schemes, rebate programs, minimum efficiency standards, information, education and various types of procurement programs. All these instruments have their pros and their limitations and should thus be used in appropriate combinations. Most of them will, because of their legislative nature or vaste scope, not be suitable project alternatives in a CDM context. For example, labeling schemes and efficiency standards are measures carried out at national or even supranational level and are not suitable for implementation by an Annex 1 actor in a developing country in the search of emission reduction credits. A procurement program, however, is one of the market transformation tools that could possibly fit in.

Procurement Programs

Procurement programs aim at creating a bridge between supply and demand on a market. By focusing on the demand-side they initiate a demand-pull meant to inspire manufacturers to respond by developing new, improved products[4], or to make more obtainable those currently existing products having good qualities[5]. The idea is to bring a group of purchasers together under the management of an independent organization in order to identify good existing products or potential product improvements rectifying deficiencies on the current market and resulting in a new product-specification. Manufacturers are then asked to submit tenders, the tenders are compared and evaluated, and the selected winner is ensured certain awards, such as a sizeable initial order or publicity. If the purchasers are sufficiently large or influential, they will encourage the manufacturers to take up the challenge and enter the competition. Once the competition is finalized, activities for reinforcing and securing demand are to follow. (*Engleryd 1995*)

This process allows the often scattered and weak buyers to express their needs and demands, and by joining forces, exert power over the other market actors. At the same time the process decreases the commercial risk assumed by the manufacturers when developing new products for which the demand is either unknown or uncertain. Procurement programs give confidence to the manufacturer that a market exists for more efficient products and thereby reduce the constraints that prevent the introduction of technical innovations; instead they accelerate adoption of new, more-efficient technologies.

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[4] Technology procurement is the term often used for processes with the explicit aim of promoting technological development. Its use is intended for increasing the market availability of products or systems that better correspond to the needs of the buyers than those existing when the process is initiated. (Westling, IEA DSM annex III, 1996)

[5] The term co-operative procurement refers to a process that is designed to create significant markets for already existing technologies with good qualities. (STEM, 1998)

Procurement programs in a CDM context. In the context of CDM, procurement programs could constitute a good long-term complement to other measures having more immediate, short-term effects. The energy savings, and thus the reductions in greenhouse gas emissions, resulting from a procurement program will not be seen until several years after the finalization of the program when the dissemination of the procured product on the market can be determined. In return the effects are of a more long-term and strategic character that can lay the basis for a more structural sustainable development of the host countries by changing the demand for and supply of energy using equipment.

One of the aims of such programs is to introduce a trend of decreasing prices for good products on the market thus allowing more consumers in the developing countries to purchase these good quality products and thereby raise their living standard. This trend of decreasing prices is initially obtained by the negotiating power of the purchasing group and after the finalization of the program, by the continued activities to reinforce the demand. Of importance to the industrial development of a country is that a procurement program also may lead to a cost reduction on the supply side. A large volume of sales allows manufacturers to introduce modifications in the production process, to benefit from experience, to reduce some fixed costs (marketing for example), to benefit from economies of scale, and finally to decrease their production costs. A potential for cost reductions also lies in engineering and installation of complex systems or improvements in the supply chain (i.e. cost decreases in the retail sector as a result of faster product turn over) or decrease in marketing costs with increasing use of the product. Along with price decrease, innovation may also be expected as a result of the process. Technical innovation may take place, even in the case of co-operative procurement aimed at enlarging the market for existing products, regarding the production process, as may organizational innovation in the distribution chain.

Procurement programs may also result in the expression of a new demand, not only for new technical products but for new skills that do not currently exist on the market and that would spread the development of some products; for example, a procurement on energy efficient lighting could target the development of "system design capacities", thus encouraging the adoption of more efficient lighting systems. This could have an effect on job creation.

The effects of procurement programs may thus raise the quality of life for the inhabitants when they get access to better products at better prices, raise the competitive power of local manufacturers, and at the same time provide an important foundation for emission reductions in the long-term. Finding a way to reach these desired effects on the developing countries' markets for energy-consuming products would mean an important contribution towards more sustainable societies, all in line with the overall aims of the CDM.

Cooperative Procurement Projects in Brazil - a Case Study of a Key Country

Brazil, one of the key countries in the international climate negotiations, provides an example of how cooperative procurement programs could fit under the clean development mechanism. In a CDM context these programs would imply transferring existing good technological solutions for increased energy efficiency from an Annex 1 country to Brazil. The programs would aim at making these products produced by local manufacturers, more widely available, and a realistic choice of more end-users.

Brazil is, together with China and India, one of the most important developing countries that will need to be part of any successful global greenhouse gas abatement strategy.

These three countries presently account for about 40% of the world's population and about 18% of industrial CO_2 emissions (WRI, 1998). Orders of magnitude of CO_2 emissions will increase with the predicted growth of these countries. By 2010 their economies could be 50 – 100 % bigger than today and their combined population could have increased by more than 250 million people. If they were to follow conventional development paths this could, in a somewhat pessimistic scenario, mean an additional 900 million metric tons of CO_2 per year. (WRI, 1999).

Although a smaller emitter than China and India, Brazil is the largest emitter in Central and South America releasing about 80 million metric tons of carbon per year into the atmosphere (EIA, 1999). This is relatively low emissions for a country of its size and is due to the fact that a large fraction, about 95%, of the electricity is generated from hydropower. However, future energy use and electricity production will increasingly rely on fossil fuels, as the exploitable hydro potential is nearly exhausted. This will have immediate negative impacts on local environments and in the long-run also affect the global environment[6]. The situation will be further aggravated by the fact that the demand for electricity is increasing. An important development goal of the country is to provide electricity to the about 20 million Brazilians lacking this service today.

The end-use market transformation potential. Studying the potential for cooperative procurements for increased end-use efficiency in Brazil a number of suitable product areas can be identified. In the case study presented below two products with a high energy savings potential have been used: (1) domestic refrigeration, that accounts for about 32% of total domestic electricity use (Lionelli, 1998). The savings potential is important as the mean refrigerator/freezer today in use in Brazil is estimated to consume about 833,5 kWh/ year more than Europe's today most efficient unit of comparable type and size consuming 219 kWh/year. This unit was recently put on the market partly as the result of a European-wide cooperative procurement program called Energy +, (2) lighting, consuming about 25% of total domestic electricity (Lionelli, 1998) and an important part of the electricity used in offices. The replacement of a standard office meeting room installation for a fixture including a specular reflector, electronic ballast, two 32 W lamps and an occupancy sensor, is by PROCEL estimated to save about 405 kWh/year. (PROCEL 1997)

We easily see that the interests coincide for at least two of the main actors discussed earlier. Such programs would first of all satisfy the interest of the International Community and the climate convention by resulting in an ecological additionality when the demand for polluting electricity production decreases, and the electricity usage becomes more efficient. Increased end-use efficiency also goes well in line with the development priorities of Brazil. The national development plan recognizes the need to take additional actions to improve the utilization of energy to meet energy needs while seeking environmental effects. This aim is sometimes in conflict with economic objectives. Provision of energy and electricity is the most pressing issue. Procurement programs would mean that more people would be able to benefit from electricity services when every service consumes less energy. Such projects further raise the living standard by increasing the households' access to high quality products.

We now need to find out if such programs could also meet the interest of the third key actor, the Annex 1 investor. This is more complicated since it will to a high degree depend on

[6] Another important CO_2 emission source in Brazil, that also gives rise to other negative environmental externalities, is the persistent deforestation that lies outside the scope of this paper.

the final design of the mechanism and the remuneration of certified emission reductions which at the time of writing has not yet been fixed.

Theoretical Framework

Microeconomic Foundation for a Single Project

The CDM framework with its remuneration of avoided emissions may help to render profitable non "no-regret projects"[7] leading to reduced emissions which under normal economic circumstances would not be economically viable. To study the interest of an Annex 1 investor to invest in different CDM projects, we here consider one of the most common figures of merit used for economic evaluation of investment projects, the Internal Rate of Return(IRR)[8].

Adding the possibility that the country in question may have some national politics and measures in place, let's here consider a carbon tax, the situation can schematically be presented as in figure 2. The tax is here supposed to be applied to the carbon emitted and be proportional to the quantity of emissions. Concerning the emission credits we presume that these are attributed to the investor in the form of money when they are either sold on an international market or changed against a predetermined value from the national government responsible for the emission reductions under the Kyoto protocol.

We here look at the situation from the perspective of an Annex 1 investor facing the choice between two CDM projects: one energy supply project and one end-use energy efficiency project. The emission credit system under the CDM will raise the profitability of both projects in proportion to the emissions avoided compared to the baseline. The IRR curves in figure 2 are pushed in the direction of the arrows named 1. With an emissions tax, the supply project, if not based upon renewable sources, will see its profitability decrease in the direction of arrow 2, while the energy efficiency project is untouched by this measure.

The profitability of the two projects may with these two measures in place get closer to one another. Which one will be the most profitable for an investor depends on the level of the credits and the level of the tax.

[7] A no-regret project is a project that is economically viable in itself without CDM or other incentive measures.
[8] Rate where the revenues of the project cover the invested capital without deficit. The higher this rate the more profitable is the investment.

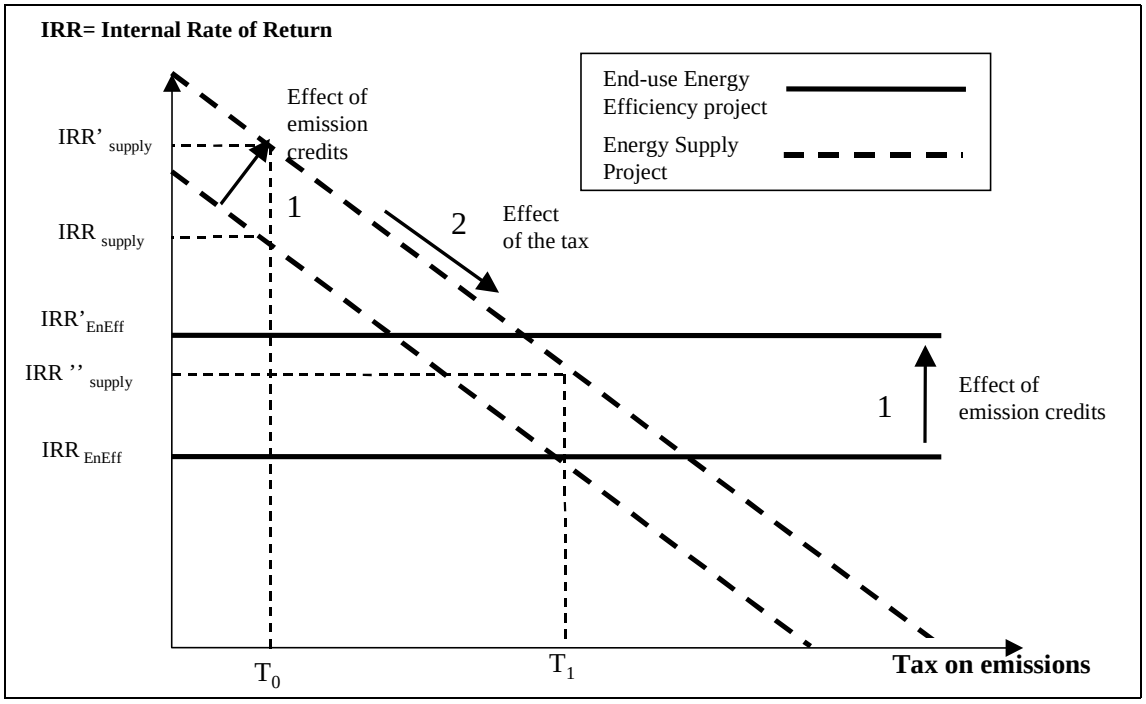

Figure 2. The Effect of Emission Credits and Emissions Taxes on Energy Supply and End-Use Energy Efficiency Projects under the CDM.

Under a system where the avoided emissions are remunerated and with a tax on emissions in place, the Net Present Value (NPV) can simply be expressed as:

$$NPV = -I + \Sigma_t^T \frac{R_t + (\Delta G \times V_c) - D_t - (G \times T)}{(1 + r + i)^t}$$

I investment
R_t income period t
D_t expenditures period t
T tax level per quantity of green house gases emitted
G quantity of emitted green house gases
ΔG quantity of green house gases emitted compared to the baseline
V_c value of credits per quantity of emissions avoided
i discount rate
r risk prime when investing in developing countries. The effective discount rate is thus (r+i)

We can now calculate the profitability of the two project types and seek to find out under which economic conditions the energy efficiency project becomes as interesting as, or more interesting than the energy supply project. The relative part of the investor's portfolio that will contain energy efficiency projects will vary with the profitability of the two options. A basic condition for either of the projects to be carried out is of course that they are more profitable than any non-CDM, i.e. non emission reducing, project the investor could imagine.

The simple payback. The simple payback, SP, is another commonly used indicator for the evaluation of investment projects, specially when facing a number of practical problems in an uncertain environment where governments and political programs change fast. In an unstable situation it is not practical to use complicated indicators demanding very detailed and precise information. Often used for small-scale projects, the SP simply tells the time necessary for the incomes of the project to be equal to the initial investment without discounting. We consider here that the incomes are equal every year.

$$SP = \frac{I}{(R + (\Delta G \times V_c) - (D + (G \times T))_{annual}}$$

When looking at the projects under the pilot phase of Joint Implementation and other investment projects undertaken by industrialized countries in developing countries, one can notice that the simple payback often is used as a main decision criteria[9]. Most of the projects realized under the pilot phase of Joint Implementation had simple payback times of about three years(Klaasens, 1998).

Circumstances Favoring Market Transformation (MT) Projects

Based upon a numeric sensitivity analysis of the Brazilian case, a number of factors favoring the choice of MT projects under the CDM can be distinguished. The interest to invest in two energy production projects: one wind energy project and one natural gas project, and two procurement projects: one for energy efficient lighting and one for energy efficient fridge/freezers (see earlier section), has been compared. The IRR and the SP have been calculated for the four projects considering that the best available technology in Europe is transferred to Brazil. Letting four factors vary: (1) the electricity price, (2) the amount of remuneration of certified emission reductions, (3) the level of an emission tax, and (4) an investment subsidy for energy-efficient equipment, some observations can be made. Lacking precise data and taking into consideration that the final design of the CDM is not yet known, the results are to be seen as tendencies only.

The price of electricity is an important factor for both kinds of projects that are favored by high prices. The electricity production projects are positively affected since a high electricity sales price increases their revenues. The procurement projects are positively affected since the consumers interest to participate in the project raises and the dissemination is facilitated. However, the impact of a high electricity price on the host country's development must be seen in a wider perspective.

Secondly, the amount of remuneration of certified emission reductions raises the interest of the least emitting projects most. Since this is the only source of real cash income in the procurement cases, this value is of decisive importance. 20-25USD/ton of carbon, as proposed under the pilot phase of Joint Application, is far too low to make the procurements viable for an Annex1 investor. Considering an IRR>10% a necessary condition, it can be noted that, without other policies and measures in place, the fridge/freezer project would need a remuneration in the vicinity of 320 USD/ton, and the lighting project a remuneration of about 280 USD/ton to be of interest. The wind energy project would need a remuneration of about 100 USD/t. With such remuneration rates the projects would have payback times of 6-7 years. The gas project has an IRR of over 15% even without remuneration and being

[9] This uncertainty is also reflected by the risk prime used to calculate the NPV.

remunerated with 25 USD/t the IRR reaches about 20%. This indicates that procurement projects must be carried out in cooperation with and with the financial participation of authorities or utilities in the developing country having a strategic interest in market transformation.

Thirdly, the emission tax is effectively lowering the economic interest in the gas project without improving the profitability of the other projects. With only a tax in place we risk loosing the gas project having positive effects on the developing country while emitting less than, for example, a cheaper coal alternative would do, without having another project realized in its place. Keeping a remuneration level of certified emission reductions at 25 USD/t an emissions tax may reach 50 USD/t for the gas project to keep an IRR over 10%

Lastly, the subsidy for investment in energy-efficient equipment has a large impact on the success of procurement programs. Even at low subsidy levels the market dissemination is remarkably affected in a positive direction. The effect on the project profitability of such a larger dissemination of the energy efficient products depends on they way in which the project will be accredited for the dissemination, and on the amount of remuneration discussed above. A precise method to take this into account would need to be formulated.

The baseline issue. The establishment of a baseline permitting to evaluate the emission reductions resulting from the project is of great importance to all kinds of CDM projects. In the case of Brazil the fact that most of the electricity produced today originates from low emitting hydropower, but that tomorrow's energy demands to a high extent will have to be satisfied with fossil sources must be carefully taken into consideration. For the sake of analysis the average emissions for electricity production based upon fossil fuels in Brazil, 873t CO_2/kWh (IEA 1999) has been used. This baseline assumption is to be seen as rather high thus rising the profitability of CDM projects.

In order to favor MT projects in particular, the baseline needs to have a long time horizon and be based upon an actualization of future estimated emission reductions for the investor to be credited within a reasonable time from the investment. This is due to the fact that the result of a MT project only can be seen several years after the finalization of the program, while the reduced emissions from a supply project can be estimated as production starts. A system for evaluation of future long-term effects on a project-to-project basis would thus be necessary. This might be difficult to develop and result in high transaction costs when putting a project in place.

Optimal design to take MT projects into consideration. The sensitivity analysis suggests that in order to increase the Annex 1 investors' interest to invest in procurement projects for market transformation, the CDM needs to be combined with national policies and measures. The mechanism should ideally be designed to also incite the host country to enhance the efficiency of economic policies in some key sectors, such as the energy sector, where policies might be put in place for other reasons than climate preoccupations but that will result in lower carbon emissions. One means could be to increase the share of certified emission reductions attributed to the host country when measures to increase the profitability of abatement projects are put in place. These measures should be targeted to increase the profitability of non-emitting projects rather than to punish emitting projects, and, by that risk to lose those projects with good development impacts and some, even if low, emissions (i.e. the gas project in our example). The principle of investment incentives in a developing country can be described as in figure 3.

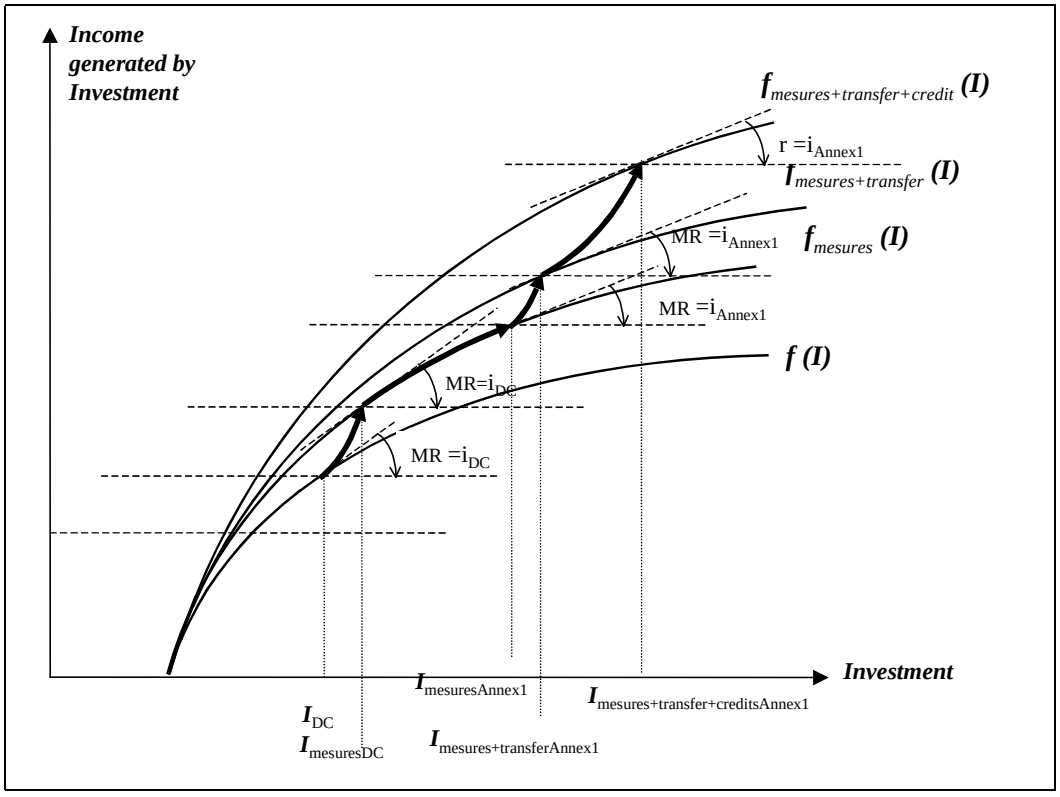

Figure 3. The Principle of Investment Incentives under the CDM. (Mathy et al 2000).

Let ***f(I)*** be the income resulting from investment ***I*** in a developing country ranked by decreasing profitability. The curve ***f(I)*** represents the income generated by the sum of all investments. Let the marginal revenue from the investment ***I*** be denoted ***MR(I)*** = ***f'(I)***. ***MR(I)*** is tangent to the curve ***f(I).***

The Base Case. The last project spontaneously realized by local investors in the Developing Country, DC, in the absence of financial constraints, has a rate of return equal to its discount rate i_{DC}. ***MR(I)*** = i_{DC}; thus the optimal investment level is I_{DC} in the absence of indebtedness constraints. Many companies in developing countries however are exposed to financial constraints growing with the debt burden. Their discount rate is thus higher than the rate used by a non-indebted company. The rate considered in this schematic macro economic description is a mean for the developing country under consideration, which is higher than the mean rate used by Annex 1 countries. The maximum level of investment obtainable in the DC is I_{DC}.

National measures. The curve ***f(I)*** does not represent the maximal production function, but the second best optimum that can be reached considering market failures, incomplete information, tariff distortions, etc. A government may like to adopt some measures to remove these barriers, even without environmental preoccupations. As a consequence of such measures, some projects having a positive impact on the global environment and which were not profitable before become profitable, others move to the left on the curve, stiffening its slope. We assume that these projects are of no-regret character and that the balance

therefore is positive. The curve $f(I)$ inflates and is replaced by $f_{measures}(I)$. With the same discount rate, i.e. only local DC investors, the level of investment increases to $I_{mesuresDC} > I_{DC}$. This represents the benefit of domestic policies and measures in the absence of external capital and technological inflow.

Technology transfer from Annex 1 countries. The idea of the CDM is to interest foreign investors. Their discount rate i_{Annex1} is lower than the one used in the DC even if a risk prime is taken into consideration, and hence, the volume of investment in the DC increases until the tangent gets down to $MR(I) = i_{Annex1}$; that means that we move from $I_{mesuresDC}$ to $I_{mesuresAnnex1} > I_{mesuresDC}$. The Annex 1 investors have at their disposal, cleaner and more efficient technologies than Developing Countries. This is why we speak about a technology transfer. Thus, for the same level of investment the resulting income is higher. Such a technology transfer once again inflates the curve $f_{measures}(I)$ to $f_{measures+transfer}(I)$. We now reach investment level $I_{mesures+transferAnnex1} > I_{mesuresAnnex1.}$

Until now, the improvement of the net situation is unrelated to the value of carbon and any environmental target. One may thus think that even without CDM, these "no regret" policies and measures would be implemented without climate change considerations. This is, however, not the case due to transaction costs associated with the removal of market barriers and institutional bias. That is why, if profitability of investments is increased, CDM may become a catalyst to eliminate the transaction cost barrier.

CDM and emission credits. Finally, if creating and sharing credits through the Clean Development Mechanism is settled, this will again inflate the profitability of investments. In this case the curve moves to $f_{measures+transfer+credits}(I)$ and the corresponding level of Investment thus becomes $I_{measures+transfer+creditsAnnex1} > I_{measures+transferAnnex1}$.

To summarize, the basis for an effect of the CDM on development lies in the contribution of three sets of benefits: (1) the gap between the value of carbon and the abatement cost of the project, (2) commercial benefits, and finally (3) social, commercial or local environment, positive externalities. Seen in such a global context, including CDM as well as national measures, end-use technology transfer through MT programs could find their place.

Conclusions

Although Market Transformation projects would well fulfill the environmental and development criteria demanded for a project to be eligible under the CDM, private investors could be tricky to attract. We are here in another logic than the one under which market transformation projects are normally realized. MT projects in Europe in favor of increased end-use energy efficiency are mostly carried out by national Energy Agencies to meet national policy objectives. To make MT projects enter the CDM might mean an important trade-off between environmental effectiveness and high transaction costs. To the more well known barriers to energy efficiency the CDM context adds another one concerning how to meet the economic exigencies of the private Annex1 investors.

However, the important demand-side of energy efficiency must not be forgotten in the debate. One possibility might be to impose MT actions as one category of measures to be

implemented by the host country in order to back up other climate change and development mechanisms as the CDM, and thus enable an inflation of the investment curve in figure 3. One could also imagine a CDM where the host country institutions together with the operational entities prepare a portfolio of projects with a total expected emission credit outcome that they propose to the Annex1 investors. Here the Executive Board could insist on a certain quota of the projects proposed to be MT projects.

My judgement is that MT projects can be integrated by different forms of contracts with endogenous monitoring elaborated to be environmental effective and have a positive impact on development while preserving the economic attractiveness for foreign investors. This will need to be treated in a separate paper, however.

References

Engleryd, A.1995. *Technology Procurement as a policy Instrument – a comparative study*, Department of energy efficiency, Swedish National Board for Industrial and Technical Development, NUTEK, Stockholm, Sweden.

Engleryd, A. 1999. *Le mécanisme de développement propre – impact sur le secteur électrique en Inde.* Institut Francais du Pétrole, Université de Bourgogne, Paris.

Enerdata, energy database, 1999 version, France.

Energy Information Administration, EIA, website.

International Energy Agency, 1999. *Options for project emission baselines*, Paris, France.

Klassens, E.L. 1998. *Opportunities for AIJ in India*, Faculty of Economic Sciences, University of Groningen, the Netherlands.

Lebot, B. 1998. *Account of Efficientia 98 - International Seminar to Combat the Waste of Electricity*, Rio de janeiro, Brazil.

Lionelli, P. 1998. *Procel Setor Residencial*, presentation at Efficientia 98, Rio de Janeiro, Brazil.

Mathy, S. Hourcade, J-C. De Gouvello, Christophe.2000 *The Clean Development Mechanism – From a flexibility mechanism to a leverage on development*, CIRED, Paris, France.

PROCEL, website.

Swisher, J. Jannuzzi, G. Redlinger R. 1999. *Tools and Methods for Integrated Resource Planning*
UNEP Collaborating Centre on Energy and Environment, Riso National Laboratory, Denmark.

Swedish National Energy Administration, 1998. *Procurement for Market Transformation for Energy-Efficient Products A study under the SAVE programme*, Stockholm, Sweden.

United Nations, *The Kyoto Protocol*, 1997.

Westling, H. 1996. Co-operative procurement – Market Acceptance for Innovative Energy-Efficient Technologies, AIE DSM implementing agreement, annex III, Stockholm, Sweden.

World Resources Institute, website.