The Participation of small and medium sized Industries in the Carbon Market – Opportunities and Barriers.The Case of Red Ceramic Manufacturing Industry in Brazil

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Abstract

The objective of this work is to outline opportunities for small and medium sized enterprises SMEs to develop CDM (Clean Development Mechanism) projects.
A case-study of industries in the sub-sector " Red Ceramics"[11] is presented, based upon results from a project implemented by SEBRAE/GTZ in 1995-2004, "Energy Conservation in Small and Medium sized Industries in the State of Rio de Janeiro".

1. Climate Change, Kyoto Protocol and CDM – Opportunities for Small and Medium Sized Companies.

Climate change[12] threatens the stability of the physical and biotic environment, and also affects the health and well being of humanity, and its economic activities. The increase of approximately 0.6 ºC of the average planet temperature, observed over the last 100 years, is attributed to the increased concentration, in the atmosphere, of GHG - greenhouse gases[13]. These gases are produced by anthropogenic activities, and the most important greenhouse gas is CO_2, responsible of more than half of global warming.

During UNCED – United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, the United Nations Framework Convention on Climate Change - UNFCCC – was adopted, with the ultimate objective of stabilizing GHG concentration at a level that will not harm sustainable development, food security and a natural adaptation of ecosystems to the new climate conditions.
Following the UNFCCC, in December 1997 the Kyoto Protocol was adopted, establishing targets to be achieved in the period from 2008 to 2012[14]. It was established that anthropogenic

[11] A sub-sector of the "Ceramics" sector of Manufacturing Industries , that produces fired clay artifacts such as bricks, both solid and perforated, roof tiles, and other products for the building industry, generally of a dark red color.
[12] A change that can be attributed, directly or indirectly, to human activities that modify the atmospheric composition, in addition to other changes resulting from normal climate variability as observed in comparable time periods.
[13] These are gaseous components of the atmosphere, of natural or anthropogenic origin, that absorb and reemit infrared radiation. According to the Kyoto Protocol, these gases are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), as well as two families of gases: hidrofluorocarbons (HFC_5) and perfluorocarbons (PFC_5). The gases emitted by human activities ("anthropogenic" activities) are mainly produced by the burning of fossil fuels (coal, oil and natural gas) in thermpower plants, industrial plants, vehicles and home heating and cooling systems, as well as by agricultural and livestock raising activities, garbage dumps and sanitary landfills.
[14]This period is called the First Implementation Period of the Kyoto Protocol.

emissions[15] be reduced by 5.2 percent, on average, using 1990 emission levels as a baseline. The above targets were assigned to the Parties[16] that are listed in the Annex I [17] of the Convention, called "Annex I Parties". The countries having no emission reductions targets are developing countries, and are called "non-Annex I Parties"[18].
The Kyoto Protocol established three flexibility mechanisms to help Annex I countries to meet the Convention commitments, namely:

a) Emission trade systems, allowing an Annex I country to buy emission reduction units from another Annex I country.
b) Joint Implementation (JI), allowing Annex I countries' partnerships to implement emission reduction projects.
c) CDM (Clean Development Mechanism – Article 12 of the Protocol), allowing Annex I countries to purchase CERs – certified emission reductions arising from projects implemented in non-Annex I countries.

CDM is the single flexibility mechanism that allows for the participation of developing countries, such as Brazil. CDM projects must meet the additionality criterion, that is, reduce GHG emissions compared to a baseline scenario that would occur in the absence of the project. They should also help non-Annex I Parties to achieve a more sustainable development. CDM may also help Annex I Parties in achieving their QELROs - quantified GHG emission limitation or reduction obligations.

Two types of projects are eligible for CDM:

a) Emission reductions, through the increase of energy efficiency or the replacement of fossil fuels by renewable energy sources, or lower carbon content fuels (for example, shifting from fuel oil to natural gas).
b) Emission removal by means of carbon sinks, such as forestation or reforestation.

During the UNFCCC Sixth Conference of Parties – COP 6, some types of small-scale CDM projects have been defined as eligible to a fast-track approval system by the CDM Executive Board. They are:

a) Renewable energy production projects with a maximum capacity of 15 MW.
b) Projects to improve supply-side or demand-side energy efficiency, reducing energy consumption up to a 15 GWh per year.
c) Project activities to reduce CO_2 emissions up to 15 kton/year

In order to produce CERs [19], the CDM project activities must pass through the following Project Cycle stages:

a) Elaboration of a Project Design Document (PDD).
b) Validation and approval of a CDM Project activity by a Designated Operational Entity – DOE.
c) Register – formal acceptance of the CDM project activity based on a validation report from the DOE

[15]Releasing of greenhouse effect gases and/or their precursors into the atmosphere, over a specific area and during a determined period.
[16]Countries or economic blocks, such as the European Union
[17] The Annex I of the Convention is composed of the Parties that subscribed the UNFCCC, belonging to OECD in 1990, and by the industrialized countries of the former Soviet Union and of Eastern Europe.
[18] They are all the Parties not listed in Annex I of the UNFCCC, among them Brazil, exempted from commitments to achieve quantified emission limitations defined for the First Commitment Period of the Protocol.
[19] These certify the emission reductions of GHG produced by project activities within the CDM that, passing through the CDM Project Cycle, obtain at the end "ex post" issue of CERs, expressed in metric tons of equivalent carbon dioxide (one CER = one metric ton of equivalent carbon dioxide).

d) Monitoring
e) Verification and certification
f) Issue and approval of CERs

Main CDM project opportunities in Brazil include:

a) Energy sector
   1) Increase of energy efficiency
   2) Utilization of renewable energy (alcohol, sugar cane bagasse, biodiesel, solar, wind, wood)
   3) Use of lower carbon content fuels (natural gas)
b) Industry
   1) Improved technology
c) Agriculture
   1) Cattle feeding
   2) Manure handling systems
d) Garbage disposal and sanitation
   1) Collecting and burning methane from sanitary landfills
   2) Collecting and burning methane from wastewater treatment

2. Overview of Small and Medium Sized Enterprises in Brazil

Small and middle-sized enterprises - SMEs [20]- are important in Brazil's economy. 2001 data [21] show that, even though these enterprises contribute with only 28% to the total economy output, they employ about 41.4% of total labor force.
Due to their specificities, SMEs face difficulties and problems that are often different from what are found in large enterprises. We can point out the high foreclosing rate, difficult access to new technologies, difficult access to credit, precarious systems for production, process, inventory and energy consumption control, the use of inefficient technologies, insufficient organizational structures, and the difficulty of their owners to establish connections between the effects of macroeconomic questions and their business.
In SMEs we find barriers that hinder the diffusion of new technologies and actions towards a more efficient use of energy, such as, for instance, a reduced access to information. In this connection, barriers may be of technological, economic, institutional and behavioral nature.
There are also difficulties in establishing standards for energy efficiency, due to technological differences, complexity and size of installations, and a lack of organized accounting of energy consumption, raw materials and other inputs, and also of the company's production.

As for the environmental performance, it must be tackled with the implementation of new production and consumption standards. Present standards of production and consumption jeopardize the sustainable management of environmental resources, since in general they still lead to waste, pollution and environmental degradation. In spite of worldwide environmental

[20] According to SEBRAE (Support Services for Micro and Small Size Enterprises) the classification by size of enterprises is:
Microenterprise – for industry, up to 19 employees, for commerce or service up to 09 employees
Small enterprise – for industry, 20 – 99 employees, for commerce or services 10 – 49 employees
Medium size enterprise – for industry, 100 – 499 employees, for commerce or service 50 – 99 employees.
Large enterprise – for industry, above 499 employees, for commerce or service above 99 employees.
[21] RAIS 2001 Yearly Report of Social Informations – MTE, Observatory of micro and small enterprises, SEBRAE News Agency, SEBRAE, Brasília, 05/10/2003

concerns, only few SMEs use tools such as Ecoefficiency[22] and Cleaner Production[23] that strive to improve the environmental management of enterprises. Ecoefficiency and Cleaner Production should be envisioned by SMEs as a strategy to increase their market share, which depends essentially on product quality and price. To increase competitiveness the following issues are relevant: the production process efficiency, a more efficient use of inputs, by a reduction of raw materials and energy waste, the production control, and the adoption of new technologies.

However, in view of their features, SMEs are more susceptible to economic fluctuations. In an attempt to overcome their problems and get stronger, SMEs have been trying to gather in associations, as for example the investment in Local Productive Arrangements, a type of "clusters", created by groups of enterprises , that cooperate with one another in order to overcome their individual weaknesses.

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2. 1. The Red Ceramic Subsector

The choice of the "Red Ceramics" subsector to identify CDM opportunities for SMEs is due to their characteristics, as follows:

:a) Energy consumption profile (fuel oil, firewood, gas and electric power)
b) Energy participation in the production process
c) Potential energy savings
d) Possible changes in the project
e) Impact on environment of the fuels used
f) Representativeness of the sector in the economy

In Table 1 the number of enterprises and the number of jobs in the red ceramic subsector are shown. From it we see the relevance of the subsector in Brazil's regions

Table 1 – Number of enterprises and of jobs in the Regions of Brazil

Regions	**Number of enterprises**	Direct Jobs	**Personnel rate Employees/Enterprise**
North	260	11 000	42
Northeast	1 360	50 000	37
Center West	460	20 000	43
Southeast	1 530	76 000	50
South	3 250	57 000	18
Total	6 860	214 000	31

Source: ABC, 2002

Concerning the environment question, one of the most important impacts on the environment is connected to atmospheric emissions caused by the burning of the fuels used. This shows the

[22]The World Business Council for Sustainable Development defines ecoefficiency as "The sustainable production of goods and services of use by society, adding value through the reduction of natural resources usage and the minimization of any kind of pollution."

[23] Cleaner Production is the continuous application of a preventive environmental strategy, which is integrated into the production processes, the products and the services, in order to reduce relevant risks for human beings and the natural environment..

importance of the manufacturing of red ceramic artifacts in the context of environment impacts reduction. (Table 2)

Table 2 – Average energy consumption per ton of product in the Red Ceramic industry

Product	**Energy consumption**	
	Fuel oil (kg)	**Electric power (kWh)**
Bricks	50 a 70	20 a 30
Roof Tiles	60 a 75	20 a 30

Source: Manual for the Red Ceramic Industry , SEBRAE/RJ, 2000.

All over the world many actions are being enacted in order to reduce emissions of gases that contribute to the earth warming, the so-called green house effect gases – GHG. In this context, energy efficiency and other tools that promote a better efficiency in the use of natural resources and reduce environment impacts[24] may also be relevant for SMEs, in view of the fact that, in addition to environment benefits, they also provide economic, managerial, technological and social opportunities, and improve company sustainability.

3. CDM Projects – The Case of Red Ceramic Industries

Even though SMEs may generate CERs by CO_2 reduction, it is also necessary that targeted industries develop "baselines"[25], an indispensable tool to enable the quantification of emission reductions and to assure that such reductions are additive. CERs will be calculated as the difference of the baseline emissions to the emissions occurring on account of the CDM project activities, including leakage.

The baseline is qualified and quantified by a "Business-as-usual Scenario"[26].
Small scale projects, as mentioned in item 1, yield only small volume CERs. This type of project is dedicated to enterprises, such as SMEs, with small production volumes, and will generate small emission reductions by the adoption of CDMs. As a consequence, reduced carbon credits can be claimed, and this may make the process for individual enterprises not viable, due to the high transactional costs[27]. In these cases, a possible solution for a company to minimize process costs, would be to join a so called "cluster", organized by sectors, or regions, e. a., making it possible, as an instance, the union of several enterprises in a specific sector to implement energy efficiency projects, or projects to replace fuels by a less polluting energy source, resulting in a significant emission reduction. Following the same direction, a *bundling* can be organized, to join CDM activities of several plants.
Considering the type of projects more suitable for small businesses, the following possibilities may be proposed for the Red Ceramic sector:

a) replacement of a fuel to reduce emissions
   # oil by gas
   # natural gas by biomass

[24] Any change in the environment physical, chemical and biological properties, caused by any form of material or energy resulting from human activities, that affect, directly or indirectly, the health, safety and well being of the population; social and economic activities; the biosphere; esthetic and sanitary environment conditions; the quality of environment resources (Conama Resolution 001 of 01/23/96)
[25] Within CDMs, the baseline of a project activity is the scenario representing anthropogenic GHG emissions from sources that would occur in the absence of the proposed project activity.
[26] A scenario that quantifies and qualifies GHG emissions, in the absence of a CDM project activity.
[27] In the specific case of CDMs, these are the costs covering the Project Cycle and commercialization of CERs..

others

b) energy efficiency improvement (in process and equipment), because the reduced consumption of electric power will reduce GHG emissions caused by power generation.

The Project for energy conservation in small and medium sized industries in the State of Rio de Janeiro (1996–2004) implemented actions aimed at reducing the specific energy consumption (energy/production) in three red ceramic industries functioning in the State of Rio de Janeiro. These actions were related to process optimization, resulting in a lower consumption of electric power and fuel oil per produced unit, and as a consequence in a reduction of CO_2 emissions caused by oil burning. Supposing that the technological profile of all other companies of the same sector in Rio de Janeiro state were similar to that observed in the participating industries of the Project above, the results originated by the Project will be used hereafter to support their extrapolation to a larger number of industries located in the Rio de Janeiro state.

The results presented in Tables 4, 5 and 6 show the CO_2 emission reductions obtained in the three a.m. industries as a consequence of the Project actions implemented. Diagrams 1B, 2B, and 3B show the potential of lower size companies in the red ceramic sector to adhere to CDMs .

a) Cerâmica Argibem Ltda

Table 4 – Results

Energy	Energy Consumption		Emission of CO_2 before Pr. actions[28] (m.ton/year)	Emission of CO_2 after Project actions (m.ton/year)	CO_2 emission savings (m. ton/year)	CO_2 emission increase (m. ton/year)
	Before Project actions	After Project actions				
Fuel Oil (m. ton/year)	2 202. 96	1 412. 64	6 774.10	4 343.86	2 430.23	-
Electric power MWh/year	903.08	1885.41	32.60	68.06	-	35.46

Source: Cerâmica Argibem Ltda, Commitment for dissemination of Results, Project for energy conservation in small and medium sized industries in the State of Rio de Janeiro, SEBRAE/RJ, Rio de Janeiro, 2000

b) Tijolar Indústrias Cerâmicas

Table 5- Results

Energy	Energy consumption		Emission of CO_2 before Project actions (m.ton/year)	Emission of CO_2 after Project actions (m.ton/year)	CO_2 emission savings (m.ton/year)	CO_2 emission increase (m.ton/year)
	Before Project actions	After Project actions				
Óleo Combustível ton/ano	2 530.8	2323.2	7 782.21	7 143.84	638.37	-
Energia Elétrica MWh/ano	1 669.53	1 685.39	60.27	60.84	-	0.57

Source: Tijolar Indústrias Cerâmicas, Commitment for Dissemination of Results, Project for energy conservation in small and medium sized industries in the State of Rio de Janeiro, SEBRAE/RJ, Rio de Janeiro, 2000

[28] According to GERBI Project, the following factors were used for emission calculations: Fuel oil emission factor = 3.075 ton CO_2/ton of fuel oil. Electric power emission factor S/SE/CO=0.0361 m. ton CO_2/MWh

c) Cerâmica Pessanha

Table 6- Results

Energy	Energy consumption		Emission of CO_2 before Pro. actions (m. ton/year)	Emission of CO_2 after Project actions (m. ton/year)	CO_2 Emission Savings (m. ton/year)	CO_2 emission Increase (m. ton/year)
	BeforeProject actions	After Project actions				
Fuel oil m. ton/year	829.21	827.19	2 549.82	2 543.61	6.21	-
Electric Power MWh/year	368.56	489.6	13.30	17.67		4.37

Source: Cerâmica Pessanha, Commitment for Dissemination of Results, Project for energy conservation in small and medium sized industries in the State of Rio de Janeiro, SEBRAE/RJ, Rio de Janeiro, 2000

In a consolidated form, Diagram 1A presents an estimate of accumulated savings in emissions by the three industries above for a period of 10 years and Diagram 1B presents these same figures in an annual basis.

Diagram 1A – Accumulated Emission Savings

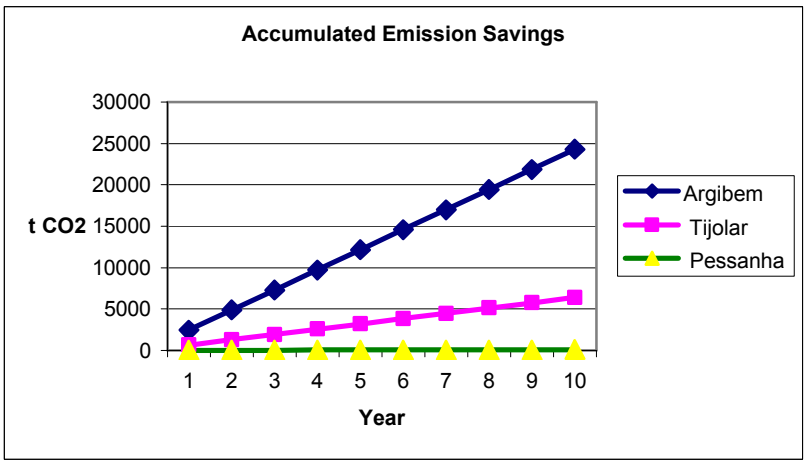
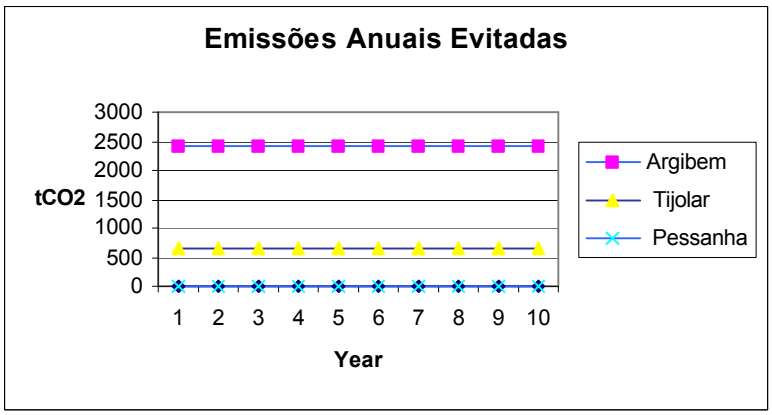


Diagram 1B - Annual Emission Savings



Considering that the projects implemented in the Tijolar Indústria Cerâmica company and Cerâmica Argibem company were directed, essentially, to an increase of process efficiency, in Diagrams 2A and 3A we extrapolate the results of estimated accumulated emission savings by these companies as applied to 20 other industries having a similar potential, over a period of ten years. In Diagrams 2B and 3B considered the same figures of Diagrams 2A and 3A presented in an annual basis.

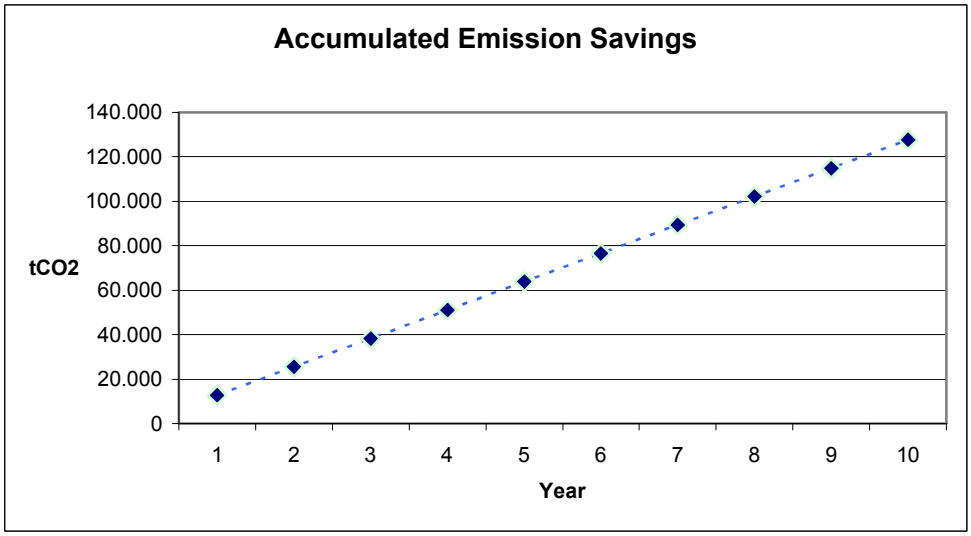


Diagram 2A - Accumulated Savings in 20 Industries

Diagram 2B – Annual Emission Savings in 20 Industries

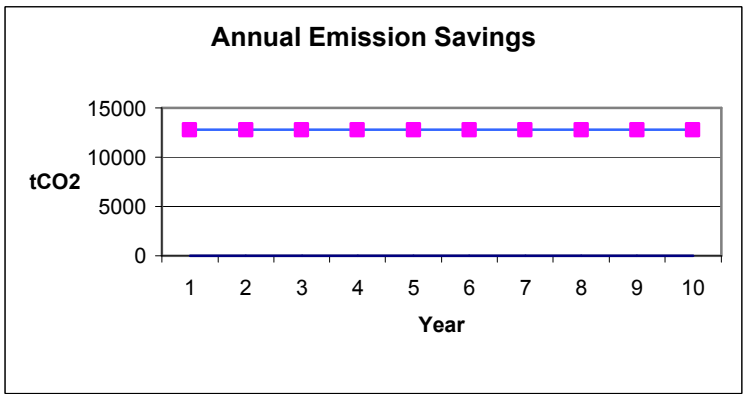


Diagram 3A – Accumulated Emission Savings in 20 industries.

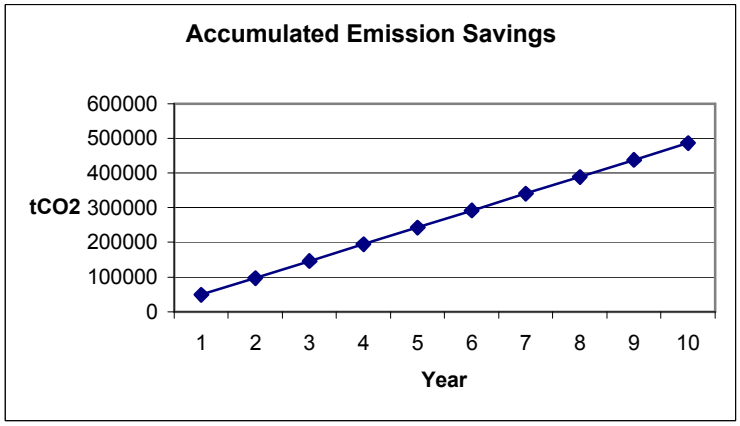
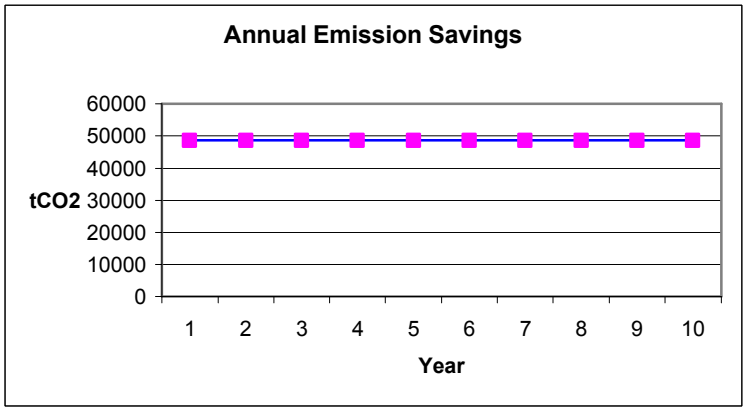


Diagram 3B - Annual Emission Savings in 20 industries



4. Conclusions

Even though the actions implemented in the three red ceramic industrial companies did not reduce the electric power consumption in these companies, because of their low technological profile, a substantial reduction of fuel oil consumption was obtained.

This demonstrates that implementing plans such as Ecoefficiency and Cleaner Production in SMEs, may be a strategy to identify projects that may qualify for CDM in small businesses. Within this perspective, industries that invest in improvements of their production processes, in the use of less polluting fuels and energy efficiency projects will also reduce CO_2 emissions, and may request carbon credits, that would help sustain the process continuity in this field.

However, even considering the preliminary favorable indications, the subject examined would demand an ampler study, particularly in connection with wider sampling, in view of the application of small scale projects for SMEs within the CDM. Moreover, a study of the economical viability of CDM projects for SMEs must be part of this analysis about the inclusion of small businesses in the carbon market.

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