Ministry of Environment Commissioned Project for 2004

FY2004

Survey on the CDM Project as for

Countermeasures Against Global Warming

Study on the Destruction Project of HFC23 gas Emissioned
by Mexican Refrigerant Manufacturer

Summary Report

March 2005

UNICO International Corporation

CDM/JI Project Survey and Survey on the Project of the Clean Development Mechanism for Countermeasures Against Global Warming -Summary Form-

(1) Basic Factors of Project Implementation

■Outline of the Proposed Project and Background of its Planning

This project has developed from an encounter with the Mexican company, Quimobasicos, in the course of research on flon manufacturers. We found that although they discontinued production of chlorofluoromethane as early as 2000 under the Mexican government's policy of observance of the Montreal Protocol (protocol concerning ozone-layer destroying substances: regulation of five types of flon and three types of halon, with subsequent addition of trichloroethane and carbon tetrachloride) and were in the process of taking corresponding measures, including relocation of their production base, they continue to produce a product with the commercial name of Genetron "G-22" (HCFC22, hydrochlorofluoromethane) and are emitting into the atmosphere the byproduct HFC23 (hydrofluoromethane), a gas with 11,700 times the greenhouse effect of CO_2. That prompted us to start talks with them on the possibility of undertaking a CDM project concerning that. In March 2004 agreement was reached on carrying out a joint feasibility study, and concrete talks with regard to the study started in April 2004.

Mexico ranks the ninth among Annex I and non-Annex I countries taken together in level of emissions (CO_2e) of greenhouse gases, and although the absolute values are small in comparison with those of the three top ranking countries, Mexico's level is still approximately 55% of that of Japan, and therefore it needs to make considerable efforts in the way of reduction. That being the case, Mexico started two international cooperation projects concerning that as early as 1995 and 1998 (ILMEX, with the Norwegian government and GEF, and the Renewable Energy Mini-Grid Project, with the US) as AIJ (Activities Implemented Jointly), a precursor of CDM.

At the same time Mexico promoted three energy saving projects of its own, the efforts centering on the Ministry of Energy: (1) energy saving in buildings, (2) replacement of old type, poor-efficiency flon industrial refrigerators and (3) use of solar heaters. In promotion of those projects the CONAE (National Commission for Energy Savings), a body in the Ministry of Energy, played the central role, and in the project on the second them mentioned above had the goal for the time being of replacing approximately 200,000 large industrial refrigerators, which required production of the refrigerant HCFC22. At the same time more efficient refrigerant gas compressors made in Japan were studied. So we see that continuation of production of the refrigerant gas HCFC22 occurred in the context of a national energy-saving program.

There are only limited ways of making that flon, and since in the production process the reaction for synthesis of HCFC22 does not proceed unless the byproduct HFC23 is separated and removed, the method of separating it by distillation using difference in boiling point (about 40°C) or that of separation at low temperature is chosen. The problem is what to do with the HFC23 after it is separated. Generally it is released into the atmosphere because it has little ozone layer destruction capacity and also in view of its small yield as a byproduct of only 3% ± α. However, despite such small destructiveness of the ozone layer, it is a greenhouse gas (GHG) with an extremely high effect if it is reduced considering that its greenhouse effect is 11,700 times that of CO_2 gas, and hence the plans for a destruction treatment project for it.

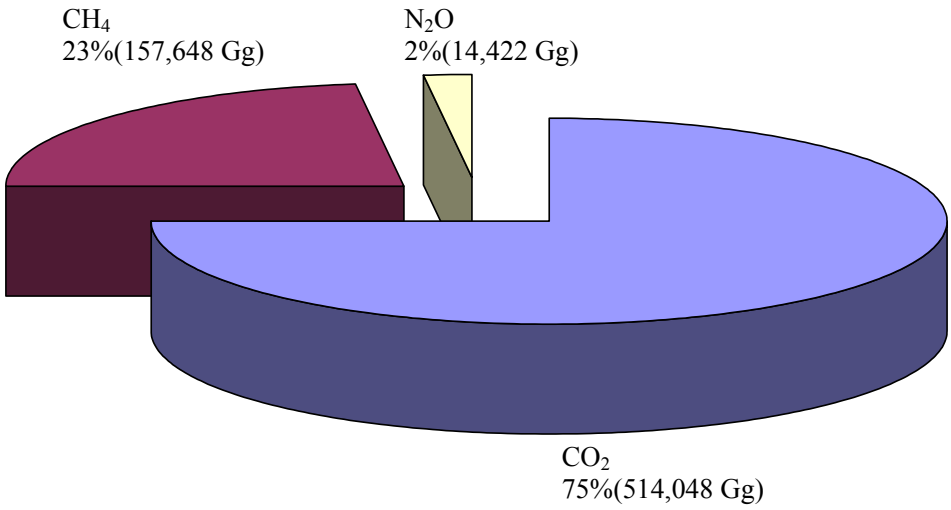
The project aims at breaking it down completely at low cost using the "plasma decomposition method", one of the seven technologies certified by the UNEF for destruction of such substances (temperature of 10,000°C for occurrence of plasma).

■Summary of the Host Country's Situation

According to the document "National Communications" (September 2001), submitted to the UNFCCC by the United States of Mexico, the country's CO_2 equivalent quantity of GHG is 675 MM tons a year, which is just about on a par with the U.K.'s 680 MM tons a year. The figure below shows the breakdown of the country's emissions of global warming gases by sector, that breakdown being a good reflection of its life style. The Mexican diet heavily relies on tortillas and meat (beef, pork and chicken), and that explains the very large percentage accounted for by agriculture and livestock raising.

Agriculture and Livestock Raising 32%	Electric Power Generation 28%	Transportation 18%	Oil Production and Manufacturing Industry 13%	Garbage Landfills 9%

Let us now look at the breakdown of those greenhouse gases:

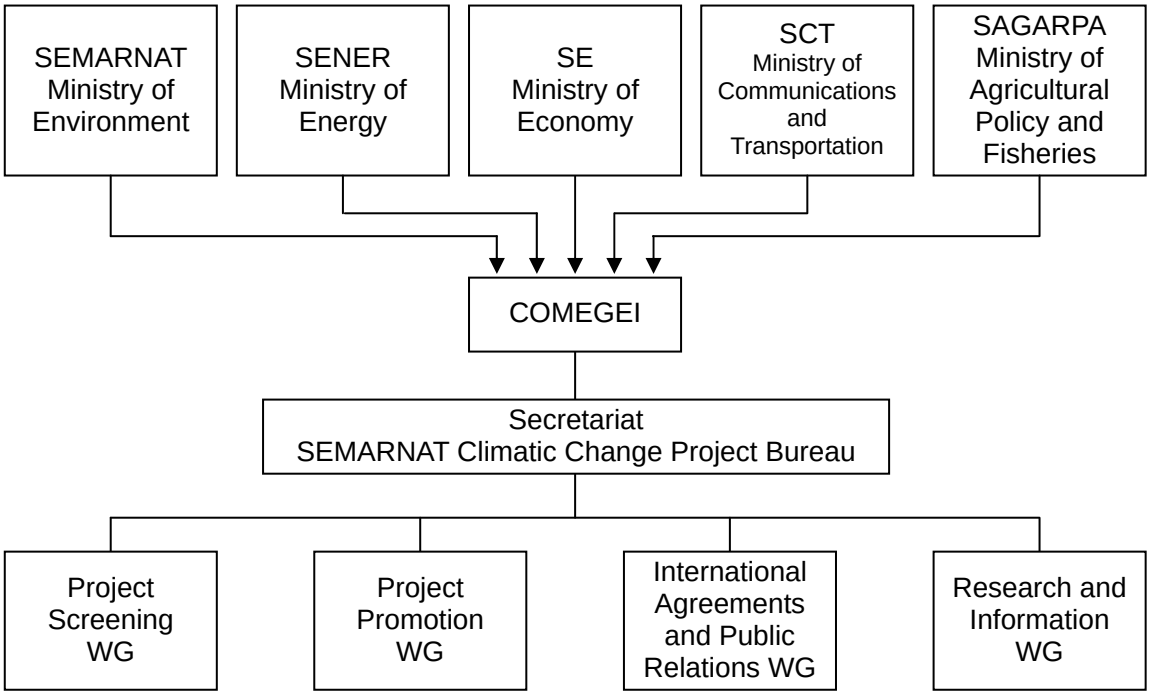


The large quantity of CH_4, which can be considered of nonenergy origin, in comparison with CO_2, a global warming gas that originates chiefly in energy, speaks for the fact of the large quantities generated by the agriculture and livestock raising sector as seen above.

Mexico has a population density only about one sixth of that of Japan, with a population of some 132 million people on a national territory 5.2 times Japan's. Nearly 40% of that land is affected by desertification, and the country's forest acreage is small, consisting practically only of the tropical rain forests of the Yucatan Peninsula.

■The Host Country's Policies and Situation Regarding CDM/JI, Including Its CDM/JI Acceptance Criteria and Situation Regarding DNA Establishment

(1) Situation Regarding DNA Establishment (the organization indicated below started January 23, 2004)



(2) Process for Approval of CDM Projects

CDM project operators

↓ Application (submittal of PIN or PDD and other necessary documents)

COMEGEI Secretariat (director: Mr. Cervantes)

Within 3 days ↓ Request for study of application documents

5 ministries and agencies concerned

Within 10 days ↓ Return with comments

DNA Working Group

Within 20 days ↓ Analysis based on the comments from the 5 ministries and agencies concerned

COMEGEI (Committee)

Committee decides whether or not to approve the project.

No-Objection Letter or Approval Letter issued or notification of rejection sent within 10 days after the decision.

(3) Criteria for CDM Project Approval

* Has to be a sustainable development project
* The attitude or intention concerning the project has to be voluntary.
  In other words, the project cannot be forced on them by others.
* It has to be a project that has undergone environmental assessment on the basis

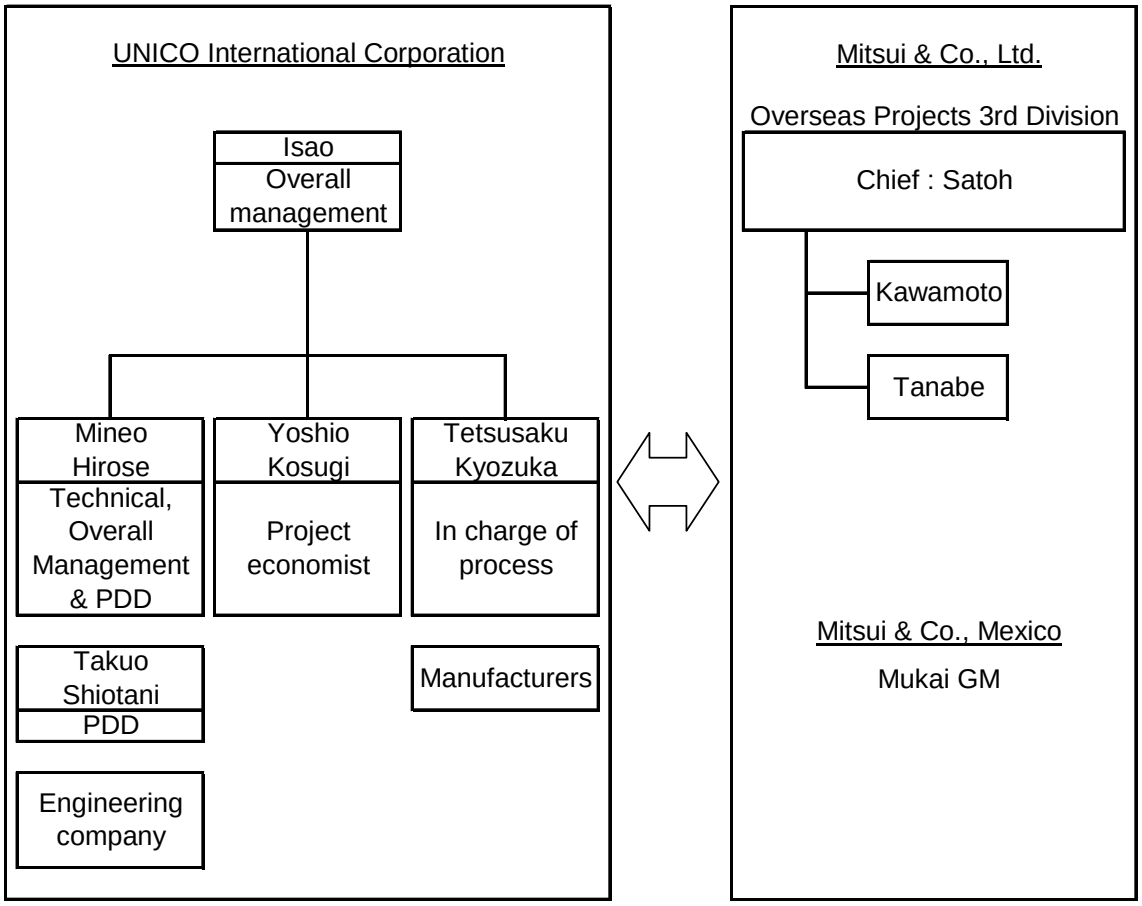
of an EIA report. (But not always, only in the case of legal obligatoriness.)

"We wanted the criteria for CDM projects in Mexico to be simple. Basically, our attitude is that if all Mexican laws are fulfilled, the project is OK. But we do ask developers to submit a letter on the sustainability of the project at national and local level, on social, technological and environmental grounds."

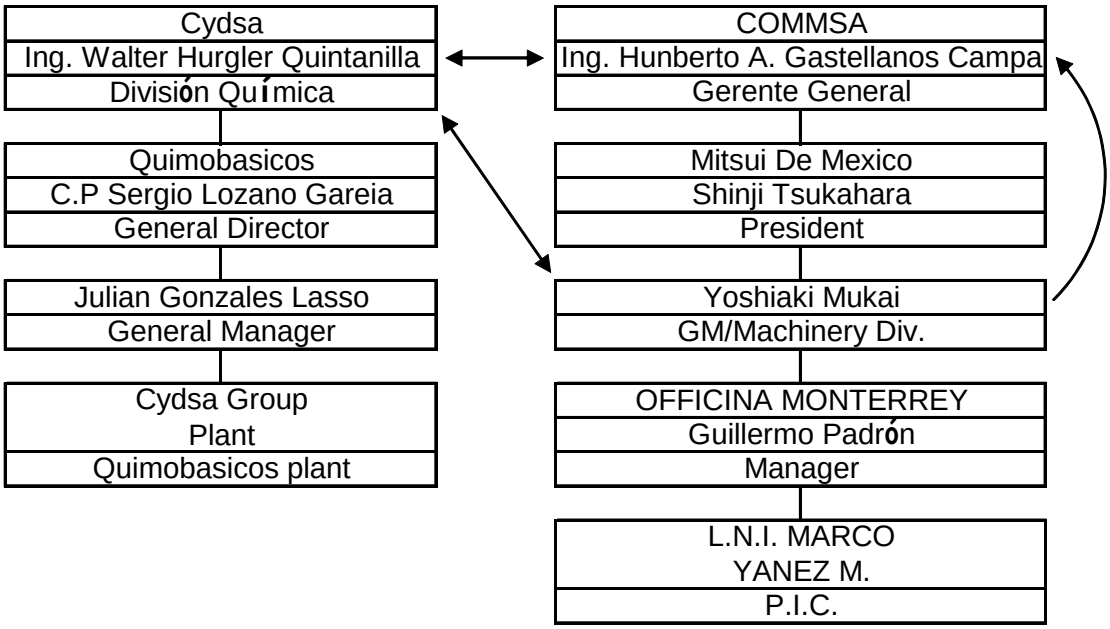
- From the article of M.A. Cervantes, 2004.4.21 Point Carbon -

■Study Implementation System (in Japan, in the host country and elsewhere)

(1) Organizational Study Setup in Japan



(2) Organizational Structure for Supporting the Survey in the Host Country



(3) Persons Cooperating in Providing Information in the Host Country

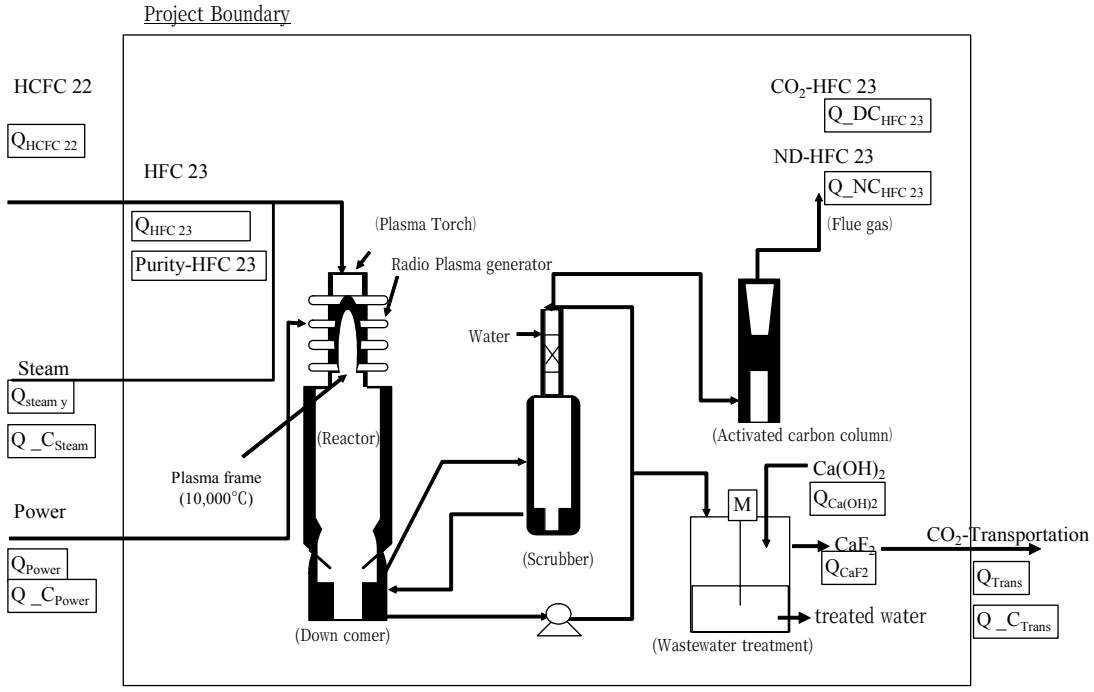
(2) Project Planning

■Specific Project Content

The purpose of the project is to contribute to prevention of global warming through decomposition treatment of the trifluoromethane (CHF3: generally known as HFC23) discharged into the atmosphere by Quimobasicos' facilities in Monterrey, Mexico, for production of chlorodifluoromethane (CHClF2: generally known as HCFC22), a refrigerant used for refrigeration and air conditioning. Specifically, there is to be improvement of the HCFC22 production equipment through installation of equipment for high-frequency decomposition that has already proved its effectiveness in decomposition treatment of flon in Japan. The HFC23 will be broken down by exposing it to a theoretical maximum temperature of 10,000°C in the presence of steam to rid it of its greenhouse effect before releasing it into the atmosphere. Since the greenhouse effect of HFC23 has been determined to be 11,700 times that of carbon dioxide (CO_2), the project's effect in terms of reduction of quantity of discharge of greenhouse gases will be considerable even with a small absolute quantity of discharge into the atmosphere. In the case of Quimobasicos, the quantity of reduction of greenhouse gases in terms of CO_2 is expected to be 2.5 million tons a year (a little over 1.4 million tons a year after this study), which is considered to qualify the project as a "Kyoto mechanism" under the Kyoto Protocol. The project is to be carried out as a CDM project between Japan and Mexico, and the quantity of reduction of emissions of greenhouse gases achieved after revamping of the equipment will be duly acquired by Japan as emission rights.

■Project Boundaries, Setting of Base Line and Demonstration of Additional Nature

(1) Project Boundaries



Referred : Information of New Destruction technology of Flon in Japan, Annual Research Report in 1999 NEDO-GET-9903-1 and NEDO-GET-9903-2

(2) Setting of Baseline

The standard quantity subject to decomposition set for the project, the so-called base line (QBHFC23), is the legal control value of the host country. If all of the HFC23 generated has to be decomposed according to the host country's legal controls, the entire quantity is set as the baseline.

$$QB_{HFC23} = Q_{HFC23} \times R$$

In the above formula, R is the percentage of the generated HFC23 (Q_{HFC23}) that has to be decomposed as required by the controls for the year in question. In Mexico, the host country of this project, there is no control value (percentage) concerning HFC23 emissions at present, and therefore, except for self-imposed measures by some companies, HFC23 is for the most part released into the atmosphere. In such a situation the state of 0 quantity of decomposition of HFC23 is the base line of CO_2e emissions.

HFC23 is an unavoidable byproduct generated in the process of production of HCFC22, one type of substitute for flon. At Quimobasicos, the partner in this project, their present production of HCFC22 is 35 tons/day, and the figure for all of 2003 was 6,000 tons. They say that the HFC23 byproduct rate [O_{HFC23}/Q_{HCFC22}] is 2% (see Note 2-1). Thus, the quantity calculated by the formula below on the basis of that actual production figure for 2003 is set as the base line for HFC23 emissions in this project.

QB-HFC23/ year = Annual production of HCFC22 x HCF23 byproduct rate
= 6,000[ton - HCFC22/year] x 2[%]
= 120[ton - HFC23/year]

(3) Additional Quantities

In Mexico, the host country of this project, no legal controls have yet been set concerning decomposition of HFC23, and therefore, except for the voluntary efforts of some companies involving new equipment investment and also input of operating and maintenance cost for decomposition of HFC23 in spite of lack of direct economic profit from doing so, discharge of HFC23 into the atmosphere is tolerated. Thus, if the quantity of HFC23 to be decomposed exceeds the baseline quantity, the quantity in excess has to be taken into account as an additional quantity.

(Note 2-1) The figure of a maximum of 4% has been published as the IPCC control value for the HFC23 byproduct rate with respect to HCFC22, but the figure of 2% has been adopted in this project as the average actual figure obtained reported by the plant in question.

■Quantity of GHG Reduction (CO_2 absorption quantity) Due to Implementation of the Project and Leakage

(1) Quantity of Reduction

The quantity of reduction of GHB resulting from the implementation of the project is calculated by the formula below:

$$ER = BE - (PE^{(in)} + PE^{(out)})$$
$$= (Q\text{-}_{HFC23} - QB\text{-}_{HFC23}) \times GWP\text{-}_{HFC23}$$
$$- (Q\text{-}ND\text{-}_{HFC23} \times GWP\text{-}_{HFC23} + Q\text{-}DC_{HFC23} + Q\text{-}C_{Power} + Q\text{-}C_{Steam} + Q\text{-}C_{Trans})$$

ER	:	Quantity of reduction of GHG emissions (equivalent quantity of carbon dioxide, ton-CO_2eq/y)
BE	:	GHG baseline emission quantity (equivalent quantity of CO_2, ton-CO_2eq/y)
$PE^{(in)}$	:	GHG emission quantity within project boundaries (equivalent quantity of CO_2, ton-CO_2eq/y)
$PE^{(out)}$	:	GHG emission quantity outside project boundaries (equivalent quantity of CO_2, ton-CO_2eq/y)
Q_{HFC23}	:	Quantity of emission of HFC23 (ton/y)
QB_{HFC23}	:	Baseline HFC23 emissions (ton/y)
GWP_{HFC23}	:	Global warming coefficient (11,700ton-CO_2eq /ton, IPCC SAR base)
Q_ND_{HFC23}	:	Quantity of HFC23 not decomposed (ton/y), less than 0.01% with the high-frequency plasma decomposition method to be used in this project.
Q_DC_{HFC23}	:	Carbon dioxide emissions generated by decomposition of HFC23 (ton-CO_2/y)
Q_C_{Power}	:	Carbon dioxide emissions due to generation of electricity used in decomposition of the HFC23 (ton-CO_2/kwh)
Q_C_{Steam-}	:	Carbon dioxide emissions due to production of steam for use in decomposition of the HFC23 (ton-CO_2/ton-Steam)
Q_C_{Trans}	:	Carbon dioxide emissions due to consumption of fuel by vehicles transporting solid waste (sludge) from the decomposition process (ton-CO_2/y)

ER ＝BE - ($PE^{(in)}$+$PE^{(out)}$), (quantity of reduction of CO_2 emissions)
＝1,404,000 – 510＝1,403,490　1,403,000[ton-CO_2eq/y]

(2) Leakage

The GHG emissions occurring outside the boundaries of the project in connection with implementation of this project are represented by PE (out) above.

- GHG emissions due to generation of the energy (electric power) and production of steam used in the decomposition process, brought in from outside the project
- GHG emissions due to consumption of fuel by the vehicles transporting the solid waste (sludge) produced in the project

The sum quantity of such GHG emissions is 281.7 ＋ 12.4 +0.4 ＝ 294.5ton-CO_2eq/y.

■Monitoring Plan

The monitoring to be applied in this project will be, as far as possible, direct measurement of the substances indicated in the above project boundaries (1) conceptual diagram, i.e. the HFC23 decomposed and the quantities of CO_2 generated in consumption of energy inside and outside the project boundaries in connection with such decomposition treatment.

The monitoring plan for implementation of this project (monitoring items and their measurement frequencies, etc.) will be prepared elsewhere.

It is reported that the substances generated in decomposition of the HFC and the HFC22 mixed in with it by the high-frequency plasma decomposition process in a very short time at the super-high temperature of 10,000°C in the presence of steam will be limited to HF, CO_2 and HCl, but the possibility of generation of the substances listed below as well, although in extremely small quantities, cannot be denied, and therefore it goes without saying that they, too, will have to be included among the items monitored.

Other possible emissions	Indicated as	Reason for occurrence
Carbon monoxide	Q_{CO2}	Part not captured in the washing process and in the activated carbon adsorption process
Chlorine gas	Q_{Cl2}	Same as above
Nitrogen oxides	Q_{NOx}	Same as above
Dioxins	$Q_{Dioxins}$	Same as above
Aromatics	$Q_{Aromaticus}$	Same as above

(see the attached file "GEC Summary Edition Annexed Materials")

■Environmental Impact/Other Indirect Influences

(1) Impact of Emitted Gases

The gases emitted from, or that might be emitted from, the accessory equipment downstream of the high-frequency plasma decomposition equipment within the boundaries of this project are as follows:

- The gases that are produced or that it is considered might be produced in thermal decomposition of HFC23 and the HCFC22 mixed in with it as an impurity are CO_2, HF, HCl and trace amounts of Cl_2, CO, noxious, dioxin, aromatics, etc.

- After removal of those substances through washing and absorption treatment of the discharged gases in the washing tower downstream of the above-mentioned decomposition equipment, the gases are then passed through an activated carbon adsorption tank for even more perfect removal of those substances, and they are discharged into the atmosphere from the discharge outlet at the top of that tank. It can therefore be considered that those emissions are negligible because of their extremely small environmental impact.
- The water from the washing tower containing washed out and absorbed CO_2, HF and HCl, etc. then goes to the sedimentation tank, where CaF_2 produced in reaction with $Ca(OH)_2$ is separated as a solid, after which it undergoes adjustment of pH before being discharged with $CaCl_2$, also produced in the sedimentation tank, dissolved in it.

The emissions outside the boundaries of the project in the case of this project include the CO_2 emissions due to consumption of fuel by trucks transporting the CaF sludge produced in the sedimentation tank, one of the above-mentioned accessory facilities, as well as soot and dust, noise, etc., but since such fuel (kerosene) consumption amounts to only 150 liters a year, it can be considered that the impact of the emissions from it is extremely small and therefore negligible. As for the environmental impact of the electric power (468,000 kWh/year) and steam (60 tons/year) consumed in this project, it is considered possible to exclude it from the scope of study of this project considering the premise that measures to cope with it will be devised in terms of discharged gas and discharged water treatment facilities installed on the equipment in which they are produced.

(2) Wastewater

The wastewater relating to implementation of this project is, inside the boundaries of the project, the treated wastewater from the above-mentioned sedimentation tank and, outside the boundaries of the project, the wastewater from above-mentioned facilities for production of the electric power and steam production to be consumed in this project. Of those two sources of wastewater, the wastewater from the first is discharged after appropriate treatment in the sedimentation tank as already mentioned. $CaCl_2$ produced in neutralization of the HCl absorbed in the washing tower with $Ca(OH)_2$ is dissolved in that wastewater, but the environmental impact thereof can be considered to be extremely slight. As for the second source, outside the boundaries of the project, it is considered that that wastewater can be

excluded from the scope of studied of this project in view of the fact that it is discharged only after appropriate treatment in the equipment in which it is produced.

(3) Noise, Vibration and Foul Odors

The noise from the high-frequency plasma decomposition equipment to be used in this project is very slight, and its accessory equipment (waste gas and wastewater treatment equipment) does not include any rotating machines, etc., of a size that could pose any problems regarding vibrations or noise. Furthermore, as already mentioned, the waste gas from the decomposition equipment will be discharged only after first being treated in the washing tower and then having foul odor components removed by treatment in the activated carbon adsorption tank. That being the case, such impacts can be considered to be negligible.

(4) Environmental Impact of the Construction Work

- High-frequency plasma decomposition equipment:	The equipment imported from Japan will be modular and compact and designed for a minimum of transport and installation work at the site.
- Water gas and wastewater treatment equipment:	That equipment, to be procured locally, will be small in size and can be considered to have only negligible environmental impact in terms of transport and installation work.

■Comments by Those With an Interest in the Project

1. Mitsui and Co., Ltd., which it is hoped will be a participant in the project on the Japanese side, has indicated that it would very much like to see it implemented in view of its attractiveness in terms of considerable emission rights.
2. The expressed position of Quimobasicos for its own part is that as an enterprise it finds income from credits attractive and that it would also very much like to be able to contribute to the country through reduction (elimination) of its GHG emissions and thereby be able to fulfill its social responsibility.
3. Of those in the Mexican government concerned with the project, particular interest has been shown by the COMEGEI Secretariat. SENER (Ministry of Energy) showed no interest, saying that the project does not fall under its purview in view of the fact that it is not a project for reduction of GHG originating in energy.
4. The presidents of companies that are important members of the Monterrey

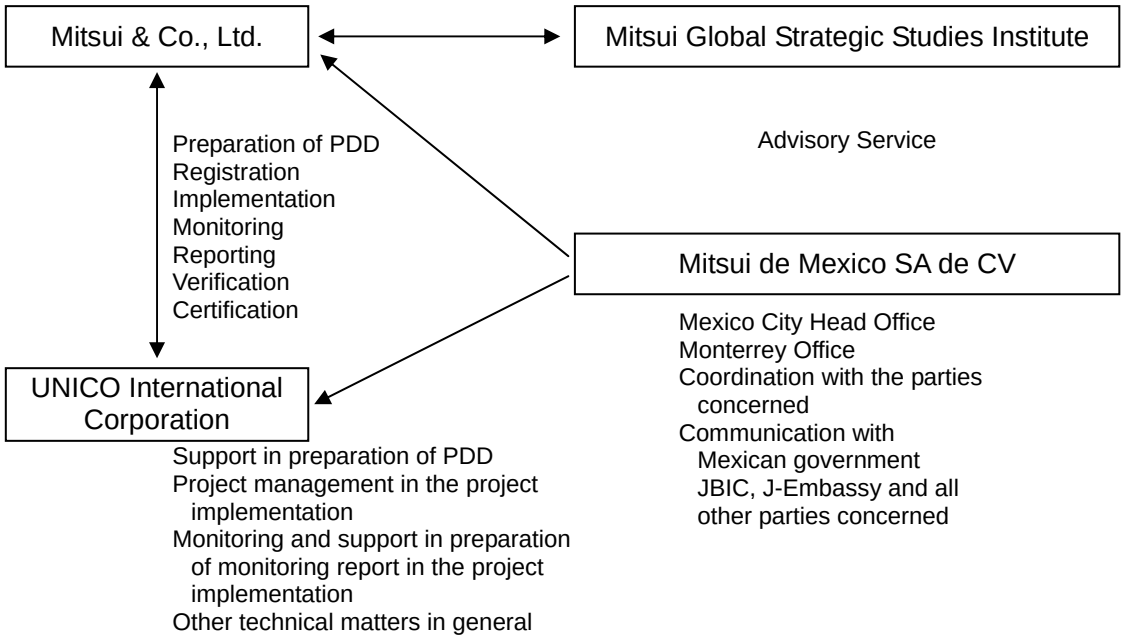
Chamber of Commerce and Industry showed a great deal of interest and have been very cooperative.

(3) Efforts Toward Realization of the Project

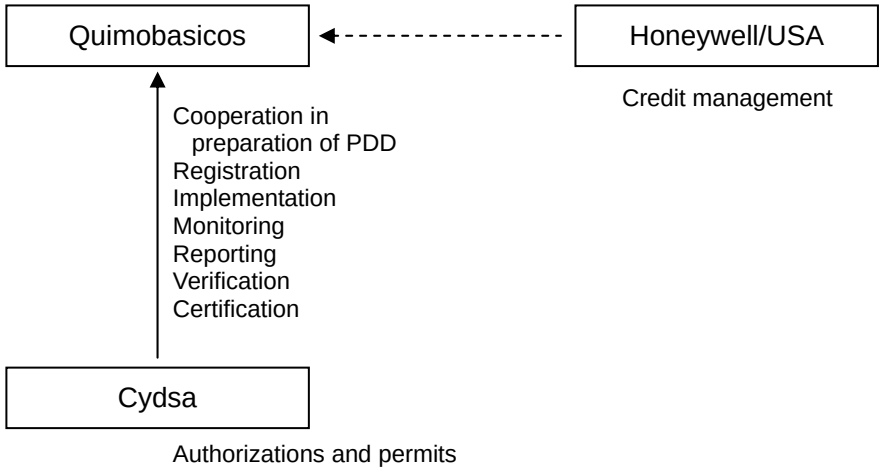
■Organizational Basis for Implementation of the Project (in Japan, in the host country and elsewhere)

Quimobasicos/Mitsui
Project Design
↓ DOE
Validation
↓ DNA & CDM-EB
Registration
↓ Quimobasicos/Mitsui
Implementation
↓ Quimobasicos/Mitsui
Monitoring
↓ Quimobasicos/Mitsui
Reporting
↓ DOE
Verification
↓ DOE & CDM-EB
Certification

(1) In Japan



(2) In the Host Country



■Planning of Funds for Project Implementation

1. In case of realizing the project on the 100%-equity basis and using institutional financing for procurement of equity funds.

   In the case of acquisition of emission rights by S.P.C. as a J/V, proportional distribution according to percentage of capital contribution makes for a method of calculation that is comparatively easy to understand and easy to accept as one of the methods for maximizing the credits that can be claimed by Japan.

   Assuming that that method can be arranged, the following two relationships can constitute the financing plans:

	Host country partner	Japanese company
Percentage of capital contribution	x%	100-x%
Distribution of credits	$\frac{x}{100}$	$\frac{100-x}{100}$

   If the project cost is covered 100% by equity, with practically zero borrowing, negotiations should aim to make "x" as small as possible for the sake of maximizing acquisition of emission rights by Japan.

   In the way of fund sources, besides government subsidies use of JBIC export and investment financing and NEXI investment insurance should be possible.

2. In case of implementing as an Investment Financing Project

In the case of switching from the above-mentioned investment-type project to a project of the investment financing type, the following funding scheme can also be considered on the basis of 25% equity procurement and a financial arrangement using Japanese funds for the remaining 75% as a perfectly normal scheme.

■Cost-Effect Analysis

The findings of analysis of the economic feasibility of the project are given in the table below.

Financial Internal Rate of Return of Investment (FIRROI)

		Price of CO_2 credits US$/ton-$CO_2$		
		1.50	2.00	5.00
Equity 100%	Construction cost rise of ± 0%	17.2%	26.8%	76.9%
	Construction cost rise of + 20%	12.8%	21.3%	64.1%
Equity 25% (loan interest rate of 4%)	Construction cost rise of ±0%	15.5%	25.2%	75.2%

■Possibility and Issues for Actual Realization of the Project

For concrete realization of the project it is necessary to grasp the financial management situation of Quimobasicos and to get a hint as to the situation regarding its ties to the U.S. company Honeywell as soon as possible and to accelerate the pace of project realization on the basis of this F/S. Considering the time limitations, it is necessary to get a clear picture concerning project realization in the first half of this year.

(4) Validation/Determination (in case of carrying out of this process)

■Summary of validation (determination) or desk review

■Course of interaction with OE