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22824

cc: Chris Puff
Ann Hynes

**ASSESSING THE UPTAKE OF ENVIRONMENTALLY
SOUND TECHNOLOGIES IN SELECTED DEVELOPING COUNTRIES
CASE OF MEXICO: IRON AND STEEL MAKING SECTOR**

Presented by:

Centro Mexicano para la producción Más Limpia

FINAL REPORT

December 17, 2002

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1.1.5 Environmental Policies

Environmental policies in Mexico favour end of pipe in most instances for all industrial sectors, including steelmaking for the three means: air, water and soil. Governmental policies are of federal competence for the steelmaking sector.

Environmental Impact of Sector.

The steel making sector has been seen in Mexico mainly regarding with an air pollution impact (CO₂, SO₂ and NO_x production), followed by its impact on water consumption and pollution (approximately 25 cubic meters of water per ton of steel produced); lastly by the solid and hazardous residues production. It is important to note that the energy consumption as part of Environmental impact has not been taken onto account as seriously as it should. The sector consumes 10 percent of the country's energy as well as over 21 percent of the natural gas produced in the country

Environmental regulations Applicable to the sector

Regulation federal and state level applicable to the sector are presented in the following table. This is an informative compendium on the compliance of the Mexican Steel Industry, at least regarding environmental protection, which for the most part has closely followed applicable regulations governing industrial safety and hygiene, thus the inclusion of this document.

In the case of environmental protection is the job of the Ministry of the Environment and natural Resources (SEMARNAT) to design regulatory aspects. Heading the list is the general law on Ecological equilibrium and Environmental Protection (LGEEPA) which will be mentioned several times by its initials in the following tables. The second part, pertaining to industrial safety and hygiene, is regulated by the Ministry of Labor (STPS). This regulation however, is headed by the Federal Labor law (LFT) and with even further details on the matter is the Federal regulation on Labor Safety and Hygiene and Environment which cover the general concepts of the LFT and serves as the starting point for implementing all regulations.

The first of the two tables is regarding the federal laws and regulations, but the regulation on Environmental Audit has yet to be included because it means to regulate a voluntary activity and is performed at the request of the companies themselves, as is the case of the environmental protection Agency (PROFEPA) .

The second table is exclusively about Mexican Official Standards (NOM) and which highlights future publication dates in the Federal Daily Bulletin.

Worthy of mention is the enormous effort undertaken by the federal government regarding simplification of the official regulatory framework on industrial safety and hygiene , thus the cancellation of many standards and the including of others within the revision projects , many of which were approved by the National Standardization Advisory Committee.

Table 1 .- FEDERAL LAWS AND REGULATIONS FOR STEELMAKING INDUSTRY.

	LGEEPA (132/12/96)	Law on National Waters	Federal Duties law	Forestry law	Federal Labor law	LGEEPA regulation on hazardous wastes	LGEEPA Regulation on environmental impact	Regulation on atmospheric emissions	LGEEPA Regulation regarding water	LGEEPA Regulation regarding noise	Regulations for the low on National Waters, Reforms	Federal regulation on security hygiene and environmental work.
Pelletizing plant	X	X	X		X	X	X	X	X	X	X	X
Coking plant	X	X	X		X	X	X	X	X	X	X	X
Sintering plant	X	X	X		X	X	X	X	X	X	X	X
Lime plant	X	X	X	X	X	X	X	X		X		X
Concentration plant	X	X	X	X	X	X	X	X	X	X	X	X
Blast furnace	X	X	X		X	X	X	X	X	X	X	X
Electric arc furnace	X	X			X	X	X	X	X	X		X
Oxygen converter	X	X			X	X	X	X	X	X	X	X
Roll casting	X	X			X		X	X	X	X	X	X
Decoking mill	X	X			X	X	X	X	X	X	X	X
Primary rolling mill	X				X		X		X	X	X	X
Pre-heat furnace	X	X			X	X	X		X	X		X
Plate mill	X	X			X	X	X	X	X	X		X
Roller mill	X	X			X	X	X	X	X	X		X
Light profile mill	X	X			X	X	X	X	X	X	X	X
Bar mill	X	X			X	X	X	X	X	X	X	X
Rob mill	X	X			X	X	X	X	X	X	X	X
Heavy profile mill	X	X			X	X	X	X	X	X	X	X
Medium profile roller	X	X			X	X	X	X	X	X	X	X
Tube rolling	X	X			X	X	X	X	X	X	X	X
Sheet decaling	X	X			X	X	X	X	X	X	X	X
Sheet quenching	X	X			X	X	X	X	X	X	X	X
Sheet tinning	X	X			X	X	X	X	X	X	X	X
Sheet chroming	X	X			X	X	X	X	X	X	X	X
Sheet galvanization	X	X			X	X	X	X	X	X	X	X
Oxygen plant	X	X	X	X	X	X	X		X	X	X	X
Water system	X	X			X	X	X		X	X	X	X
Energy plant	X	X			X	X	X	X	X	X	X	X
Natural gas plant	X				X		X			X		X
acetylene plant	X	X			X	X	X	X	X	X		X
carbon injection	X	X			X	X	X	X	X	X		X
De-sulphurization	X	X			X	X	X	X		X		X
Skin pass roller	X	X			X	X	X	X	X	X	X	X
Tension leveling roller	X	X			X	X	X	X	X	X	X	X
Non- hazardous waste deposits	X				X	X	X	X	X			X

Skin pass roller	X	X			x	X	X	X	X	X	X	X	X				X	X	X	X
Tension leveling roller	X	X			x	X	X	X	X	X	X	X	X				X	X	X	X
Non- hazardous waste deposits													X				X	X		

X	Standards applicable to water
X	Standards applicable to air
X	Standards applicable to wastes
X	Standards for noise and vibration
X	Standards for heat and light energy
X	Standards regarding hazards

II. DESCRIPTION OF IRON AND STEEL MAKING SECTOR IN MEXICO.

The steel and iron industry, constitutes one of the most important activities of the manufacture industry of the country. In every economy, the steelmaking production is one of the main indicators economic of a country and reflects in great measurement the level of industrialization

The Mexican steelmaking industry initiated in 1900, when the first foundry company is created in Monterrey, Nuevo Leon, with a productive capacity of 100 thousand tons per year. At he beginning the decade of 1940, the first state - business is created in the state of Coahuila, with a capacity installed of 60 thousand tons by year. At the end the Second World War, the growing demand of steel prompted the rise of diverse Steelmaking businesses in Mexico and in 1970, with the creation of the state owned Siderúrgica Lázaro Cárdenas Las Truchas, in Michoacán, is consolidated the National Steelmaking industry. In the decade of 1980, the creation of agencies to help with functions of coordination, advising and research gave impulse to this sector, with the participation of the National Chamber of the Industry of the Iron and the Steel (CANACERO)

During the decade 1988 - 1997, the fulfillment of the Mexican Steelmaking industry presents two important moments to emphasize, before and after the privatization.

In this way, before the privatization the steel production registrations only reached a maximum of 8.7 million tons in 1990, that placed this industry at the 20TH place in the world; after ten years privatization was carried out, the production is 14.3 million tons, Mexican steelmaking is placed at present at the 15TH world place.

The total Mexican reserves of iron ore are estimated as 650 million tons, sufficient to guarantee the production during 40 years. The most important deposits are located in the states of Colima and Coahuila, with reserves estimated of 180 and 125 million tons respectively, to what they add the deposits of the mines of Jalisco, Chihuahua and Michoacán. Besides to use iron mineral, Scrap is also consumed, which equaled 3.5 million tons in 1990, provided mainly by the domestic market, although their importing has enlarged in an important way in the last years.

The steelmaking industry mobilizes a great volume of resources capital, , physical and human for complying with the functions of transformation and manufacture.

In it there is involvement of abundant investments in the construction of plants and equipment, exploitation of deposits, creation of infrastructure and services.

It mobilizes, also, considerable volumes of raw material for its transformation, (mineral of iron, coal and Scrap) and a high number of labor specialized (working, technical, engineers). The route of

steel production and ferroalloys cheaper, via blast furnace, requires four million annual tons of iron ore as minimum; new technologies promise to reduce the necessary scales and the specific investment, but its costs are still high.

This is a big industry of large economies of scale, for which the relation capital-product requires the biggest efficiency as for the utilization of the capacity installed.

By the long period of ripening of the investments and the constant change of technology, that complicate the technological reconversion in the medium time, indispensable objective to diminish their environmental impacts and to improve their productivity.

2.1 Main Sectoral Developments.

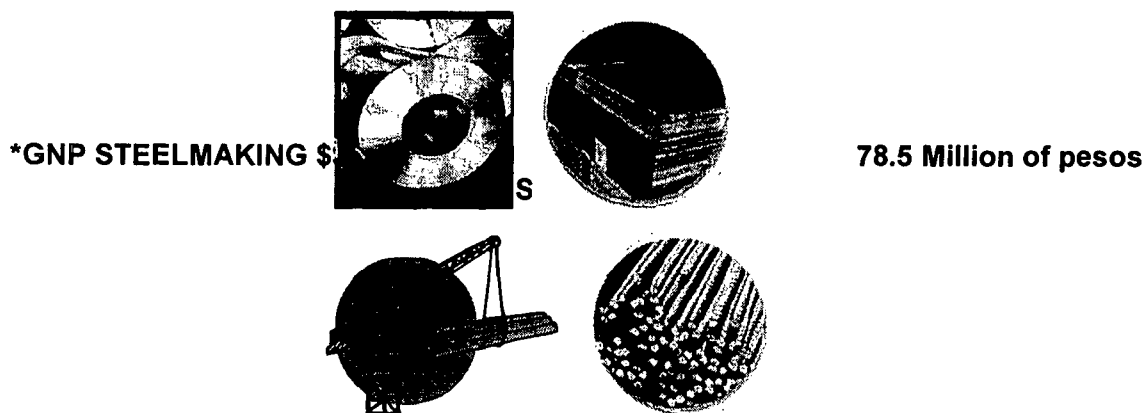
The industry of the iron and of the steel is fundamental in the modern time, since it is the base for making, machineries, apparatuses, cars, railroad cars, etc.

As of 1992 (year of the start of the privatization), the five integrated businesses existing (AHMSA, HYLSA, ISPAT, SICARTSA, TAMSA) in the country contributed to approximately 81% of the total production of steel, and their participation have been maintained similar to that reached before said year, when an important part of the industry was controlled by the State.

By processes, the production of steel by electric furnace has grown in an important way in the present decade, arriving in 2000 to little more than double that of 1991, while the oxygen converter, in spite of having shown an ascending tendency, toward 1996 and 1997 presents a growth average of the 4% annual.

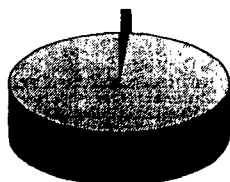
In order to way of visualizing with more clarity the importance of the sector in Mexico, below is described in a statistical way (by means of graphic and boards) the representative of the same in relation to the Gross National Product (GNP), as well as some characteristics of development and consumption. The main indicators are presented like a market of the National industry, as well as its participation in the Latin-American and world production.

economic importance.

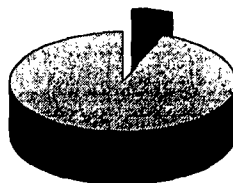


REPRESENT

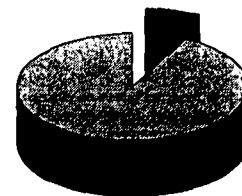
2.0 % OF THE GNP TOTAL



6.0 % OF THE INDUSTRIAL GNP
THE



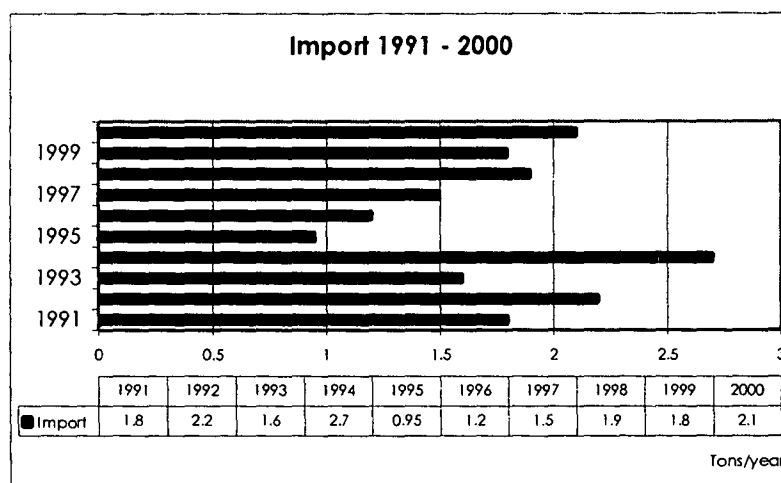
8.0% OF



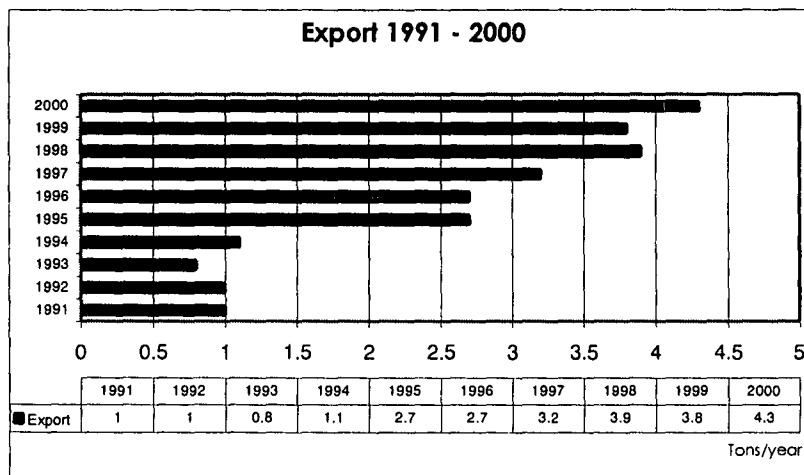
MANUFACTURING GNP

* GNP: Gross National Product (Value of the capital and services making in the country through a determinate time.

Imports of steel products



Exports of steel products



*Source: CANACERO (Ten years of STEELMAKING statistics)

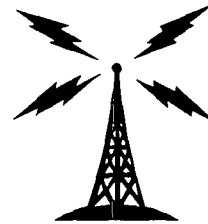
Iron and steel sector

LABOR
54 5000 DIRECTS



555,000 INDIRECT

IT IS THE FIRST ENERGY CONSUMER



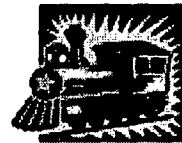
10 % TOTAL NATIONAL

IT IS THE SECOND NATURAL GAS CONSUMER



21.6% TOTAL NATIONAL

IT IS ONE OF THE PRINCIPAL USER OF RAILWAY



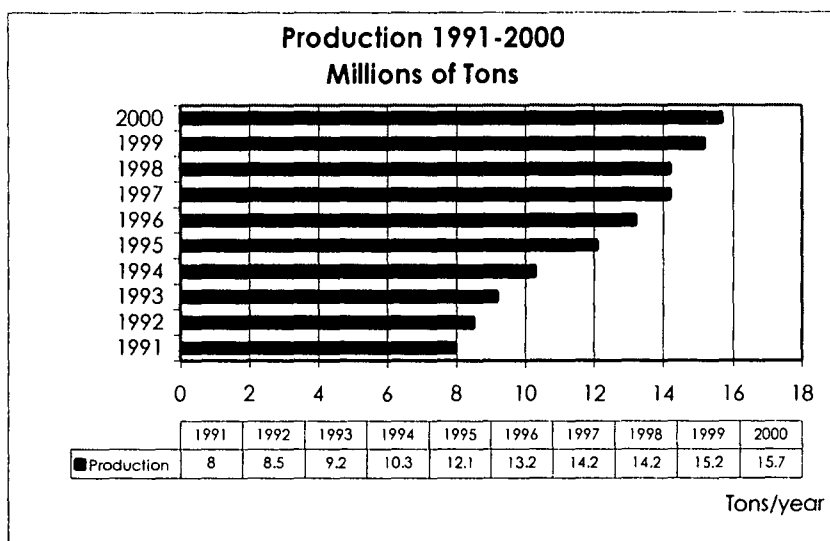
8 % VOLUME OF CHARGE

Production and installed capacity

In the last 5 years the installed capacity of steel itself increased in 37% going from 13.7 millions in 1995 to 19.5 millions in 2000 as result of a vigorous and continuous application of investment in the industry.

The production of steel during the same period grew 25.9% to be located in a total of 15.3 millions tons exceeding the level of production reached in 1999.

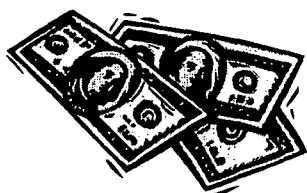
With these results the utilization of the installed capacity recuperate again its growth, once overcome the adverse economic effects of the Asian countries registered in 1998, that caused national production to descend in order to maintain its position in the market.



*Source: CANACERO (Ten years of STEELMAKING statistics)

In the world Mexico is placed as Number 15 steel producer. Mexico is the second producer of steel in Latin America after Brazil that in 2000 produced 26 million of tons.

investment inside of the steelmaking sector 1990 – 2000



PERIOD	MILLIONS OF US DOLLARS
1990 – 1998	4,430
1999 – 2000	930

From 1990, given the demands of the globalization of markets and of the privatization of the Mexican sector (November of 1991) to 1998 the sector registered investments for 4430 million dollars to strengthen and modernize its productive structure, oriented towards the consolidation of their competitive capacity.

In the period of 1999- 2000 the sector has maintained its investments program for modernization and enlargements, at 930 million dollars.

Productivity

Due to greater productive capacity, Steelmaking enterprises have improved their organization and administration systems in order to obtain a considerable increment of their labor. They played an important role it set in motion of processes and intensive technologies in capital, which is characteristic of this industry.

As of the privatization the quality of the Mexican steel products shows a frank tendency of improvement as result of the investments applied, as well as by the setting in motion training and certification programs in base on national and international norms.

The reduction of operation costs of these actions permitted that the larger firms of the sector, to obtain ISO 9000 certification that qualifies them as dependable suppliers and consequently to be able to have access to international markets.

From 1995 to 1999 the level of production per personnel raised from 378 to 510 Kg



2.2 Main technological developments

In Mexico exists five enterprises integrated in vertical form, that is, they include installations from the iron mineral reduction, Up to lamination. Besides, there are 19 semi-integrated firms that it produce steel from the Scrap and they count with installations for part of the process of production and with 33 firms not integrated or rollers, that they manufacture laminated products from billet partially laminated or that they utilize for this process, component parts chosen of scrap steel.

Besides the businesses described, there exist 69 manufacturing firms of pipes, screw, nails and tinplate sheets three producing plants of ferroalloys, that they produce basic materials for the composition of the different classes of steel. As a group, it is calculated that there exist near 300 businesses dedicated to the foundry of scrap smelting to obtain casting iron that are re-utilized industrially, most of them work with old furnaces and traditional technology.

In The actual structure of the national steelmaking industry, the integrated firms have capacity to produce pig iron and sponge iron, through the process of blast furnace and direct reduction.

The production of steel implies the possibility of transforming this material in final products (wire, cable, wire mesh, soft and leaves for springs, connections and accessory for tubing, nails and clamps, screw,, chains, containers, cylinders and tanks ,railroad and accessory, pieces forged, corrugated rod and forged bars) or semi elaborates (laminates final not flat, sheet chroming, flat stainless steel, laminates flat, pipes, seamless pipe and foundries).

In the eighties, 66% of the steel was produced in integrated plant based on blast furnace process that utilizes coal as reductant and the 34% remaining based on direct reduction of mineral with natural gas

At the end of that decade it was expected to modernize the technology in the production of steel, by means of the bigger utilization of the electric furnace, subsequently, the oxygen converter. The steel making of open heart with the furnace Siemens-Martin, were have been revealed as the greater generators of dust contaminants, since its emissions represented approximately 60% of the total. For such reason they were canceled in 1991.

Due to technical and economic characteristics, as well as by management and administrative type that requires this sector, it is not always possible to maintain actualized the technology and less in countries that are not in the first steel production places in the world, what determines a backwardness and gaping of the technology and the equipment in many of the plants, mainly in semi-integrated an not integrated plants.

The energy demand is one of the more critic aspects and it is based on the use of coal, natural gas, petroleum and electric energy; With added to it add problems of inefficient combustion, because of this, the National steelmaking sector has endeavored to modernize its industrial plants to elevate its energy efficiency and its productivity. With particular emphasis, the injection of inert gases, the modernization of the hot rolling processes, the elimination of obsolete units, the rationalization of installations and the rehabilitation and operating elimination of restrictions. A problem to emphasize is the purchase of machinery and equipment of different brands, which complicate their maintenance.

2.3 Description of EST's in Steelmaking Sector

Some of the main EST implemented by firms are summarised in the following tables.
TAMSA

Project ¹	Year start	Year End	Costs in local currency		Environmental impact ²	Annual cost savings due to implemented measures e.g. fuel costs, materials saving, better production efficiency (optional)	Source of project financing % Company
			Total investment	Maintenance/operational costs			
Dust and smoke collecting system	1992 1995	1993 1995	18.9 millions pesos 49.5 millions pesos	---	control and decrease of atmospheric emissions and to comply the environment regulation	greater environment efficiency	Commercial loan Government Other (specify) own resorts
waste water system .	1993	1998	23.4 millions pesos	---	decrease in the water demand	reduction of water 10 m3/tons to 5 m3 / tons. almost 10.8 millions / year	own resort
cyclone for dust collecting	1995	1995	3.9 millions pesos	---	decrease and control atmospheric emissions.	decrease the demand of bag by the system of smoke and dust collection.	own resorts
warehouse to collecting eaf	1999	1999	7.29 millions pesos	---	betterment management of residues	to comply the environment	own resorts

¹ The following categories will need to be used by the national institutions at the time of data analysis: 1. EoP: e.g. waste water treatment / air filters; 2. input material change; 3. better process control; 4. equipment modification; 5. technology change; 6. on-site recovery and reuse; 7. product modification (please refer to annex 1 for a further elaboration of these categories)

² data on reduction in pollution load; reduction in water, energy use; reduction in raw material consumption – these data will need to be classified as per an applicable environmental impact scheme (see annex 2 for an initial example)

dust						regulation and legislation	
------	--	--	--	--	--	----------------------------	--

ACERLAN

environmental audit	2000	2001	1.5 millions pesos	---	to comply the environment regulation	not calculated	own resorts
---------------------	------	------	--------------------	-----	--------------------------------------	----------------	-------------

ACEROS CORSA

Disminución de tiempo de colada en el horno de la acería			N.A	==			
Introducción de energía química en el horno de la acería			N.A	==			
Instalación de planta de tratamiento de agua. Utilización de agua tratada en procesos productivos			N.A	==			
Cambio de paneles de enfriamiento en Horno Eléctrico			N.A	==			
Sustitución de materias primas por materias primas de mejor calidad (más limpias)			N.A				

SIDERURGICA GUADALAJARA

Collecting, Treatment and utilization of municipal water.	1994	1995	22.5 millions pesos	----	Reduction in the demand of municipal water	To 1995 to 1999 28.8 millions pesos	Own resource
Collecting of dust and smoke	1994	1995	5 45 millions pesos		Catching of emissions and reductions ,control of dust and smoke	To comply with the environment regulation.	Own Resources
System Cole-jet for electric furnace in Melt shop	2000	2001	4.2 millions pesos	----	Reduction in the demand of electric energy, most productivity.	Its don't have calculated	Own Resources
Energy utilization of electric furnace	1998	1998	N.A	---	Reduction in the 24 % of energy/ton of product.	----	Own Resources

HYLSA PUEBLA

Melt Shop	1996	2000	N.A		Reduce emissions		Commercial loan
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NKS GROUP

Saving Sands	1999	Continu ous	Equipment for transportati	Gas for transport ation	Reduction in raw material consumption	50 % of silicon sand	None
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			on	equipment and 2 workers			
NKS only use some sand, however is possible to mountain sand recycling plant in order to use all the silicon sand and may be the chromite sand, for this we need to continuous with researched or reviewed market options and get by financial institutions credit to buy and implement the process							
Saving oil (diesel)	1999	Continuous	1.0 million pesos	0.8 million pesos	Reduction in raw material consumption	4 millions pesos	None
The change with more impact will be the change of combustion system to natural gas, for this is necessary to invert more than 10, 000,000 pesos, however the depreciation payment is of 4 years							
Saving energy	1999	Continuous	Partial time for administration		Reduction of use energy	1,300, 000 millions pesos	None
To get more effectiveness will be necessary change old compressors by new (50% consumes energy) and the illumination (work with the FIDE)							

III. METHODOLOGY AND SAMPLE PROFILE

The selection of enterprises was made among the Universe of 191 Enterprises that comprise the Iron and Steel making Sector in Mexico. Over 15 small, medium and large enterprises were contacted in different states in the country. Contact persons were identified and asked to be interviewed. 10 out of those agreed and the interview was developed on the site. Some of them asked for the basis of the questionnaire to be sent in advance. Among the selected firms, 5 of them comprise about 80 percent of the total steel production in the country and four of this responded to the interview with the last one still is to respond.. As can be seen from the Surveys, financing aspects were almost consistently denied to be supplied by firms. Main argument was that information was restricted. The following table shows a summary of the interviewed enterprises

Iron and Steel making Firms

Firm Name	Type	Process	Products	*Annual Production (Ton/Year)	Location (State)
ACERLAN	Foundry	Electric Arc Furnace	Casting and forgings	15 000	Queretaro
ACEROS CORSA			Wire, rod and profiles		DF
ALTOS HORNOS DE MEXICO	Integrated Plant	Blast Furnace	Wire, rod and plate	3 353 000	Coahuila
GRUPO NKS	Semi-integrated plant		Heavy castings and forgings	120 000	Michoacán
HYLSA**	Integrated Plant	Arc electric Furnace	Wire, Rod and flat products	2 820 000	Puebla
ISPAT	Integrated Plant	Arc electric Furnace	Slab	3 650 000	Michoacán
SICARTSA	Integrated Plant	Blast Furnace	Wire and Rod	1 883 000	Michoacán
SIDERURGI CA DE GUADALAJARA	Semi-integrated plant	Arc electric Furnace	Structural profiles, rebar and bar products	770 000	Jalisco
TAMSA	Integrated Plant	Arc electric Furnace	Seamless pipe	779 000	Veracruz

** The Hylsa production considers the Puebla, and Monterrey plants.

Second to Firms, business associations chosen were the National Chamber of Iron and Steel which is the specific organization that gathers most of the iron and steel producers as well as their suppliers and some clients. Also the Mexican Foundrymen Society was contacted and this organization groups many of the foundries that include also iron and steel foundries. The following table shows characteristics of the business associations.

Business Association

Name	Type of organization	Membership	Link with other associations.
CANACERO	National International.	88 members	Association of iron and steel engineers, American iron and steel Institute, Latin-American iron and steel institute, International iron and steel institute.
SOCIEDAD MEXICANA DE FUNDIDORES	National		American Foundrymen Society

Environmental Regulators were chose as requested: one from federal competence that is the Federal Attorney for Environmental Protection (PROFEPA) which is the Environmental Law and Regulations enforcer and two State environmental Secretaries, asd shown in the following table

Regulators

NAME	Type organization	Link with the steelmaking sector	STATE LOCALIZATION
PROFEPA	Federal	Regulates all Steelmaking sector enterprises.	DF (Head office) with representatives in each state
SEDUE MICHOACÁN	State	Together with Profepa Regula tes Michoacán state enterprises: NKS, SICARTSA, and ISPAT	Michoacan
SEDUE PUEBLA	State	Together with Profepa Regula tes Puebla state enterprises: Hylsa	Puebla

Suppliers were chosen one from the main raw material required to produce steel: iron ore pellets and the second from the process consumable which are the graphite electrodes for the Electric arc furnaces; the first one is national supplier and the second is from an international origin. Technology supply Centers were both national: one government and the second of private kind. Characteristics are shown in the following tables

Raw material and technology supplier

Name	Ownership	Product/ Technology	State Location
PENA COLORADA	National	Raw material (Pellet, Iron ore concentrate)	Manzanillo, Colima
UCAR CARBON	International	Electrode and nipples of graphite, for electric furnace.	Nuevo Leon

Technology Centers

