6. MEXICO

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6.1. Introduction

The International Atomic Energy Agency (IAEA) issued an invitation in 2001 for countries to participate in a coordinated research project on Indicators for Sustainable Energy Development (ISED) for the period 2002-2005. In March 2002 the participation proposal submitted by Mexico's Secretariat of Energy (SENER) and the National Institute of Statistics, Geography and Informatics (INEGI) to the IAEA was approved.

This project was conducted by the IAEA with the cooperation of the United Nations Department of Economic and Social Affairs (UNDESA), the Statistical Office of the European Communities (Eurostat), the European Environmental Agency (EEA) and the International Energy Agency (IEA). Its main objective was to develop and test national energy indicators within the social, economic and environmental dimensions needed for the evaluation of current national policies, as well as for the analysis and formulation of sustainable development policies.

As part of the project work plan, participating countries had to submit a final report summarizing the results and findings of the corresponding national case studies. Participating Mexican institutions have prepared the present final report that provides a broad picture of the Mexican energy sector and its relationship with the three pillars of sustainable development. For SENER and INEGI, participation in this project represented a unique opportunity to assess data availability and the technical infrastructure for developing the ISED. For the final report, Mexico has implemented three-quarters of the indicators proposed, and has a clear idea about the information limitations/time frame for elaborating the remaining ones. More important, these indicators will provide an invaluable source of information for assessing current energy policies, and for proposing modifications, elaborations and/or implementation of new policies necessary to address gaps identified during the ISED analysis. This will be discussed in detail in a later section.

The chapter is structured in six sections: 1) an overview of the Mexican energy sector and development; 2) a review of the energy statistical data capabilities of the two national institutions involved in the ISED project, as well as a brief description of data compilation processes for the elaboration of indicators; 3) the identification of selected energy priority areas to be assessed by using the ISED system, and policy measures derived from indicator interpretation; 4) the ISED implementation process; 5) the presentation of all information on each indicator; and 6) an overview of conclusions and perspectives for future work.

6.2. Overview of the Mexican Energy Sector

6.2.1. Structure of the Mexican Energy Sector

Public enterprises of the energy sector, coordinated by the Secretariat of Energy, have a special importance in Mexico. Besides their contributions to the society in economic terms and the services they provide, they include three of the largest businesses of the country: Petróleos Mexicanos (Pemex) and subsidiary agencies, Comisión Federal de Electricidad (CFE) y Luz y Fuerza del Centro (LyFC). It must be said that Pemex is considered one of the ten largest businesses of the world in terms of assets and income.

The energy sector consists of two major subsectors: hydrocarbons and electricity. It includes other companies responsible for providing support and diverse services (Figure 6.1). The Instituto Mexicano del Petróleo (IMP), the Instituto de Investigaciones Eléctricas (IIE) and the Instituto Nacional de Investigaciones Nucleares (ININ) conduct activities in scientific research, providing innovative technological elements, so that Pemex, CFE and LyFC can enhance their competitiveness and offer better products and services. They also promote training of specialized human resources in order to support the national electric and petroleum industries.

Additionally, the activities of exploration and the services of high technological specialization carried out by Compañía Mexicana de Exploraciones, SA, have permitted Pemex to identify hydrocarbon reserves with potential for future exploitation. With regard to the enterprise III Servicios, S.A. de CV, the administrative services and real estate operations provided to Pemex have promoted an increase in the aggregate value of properties and facilitated the operating tasks of the company.

Finally, the commercialization of hydrocarbons, carried out at the international level by PMI Comercio Internacional, SA de CV, is a determinant factor for the generation of foreign exchange and of important fiscal contributions for the federal government.

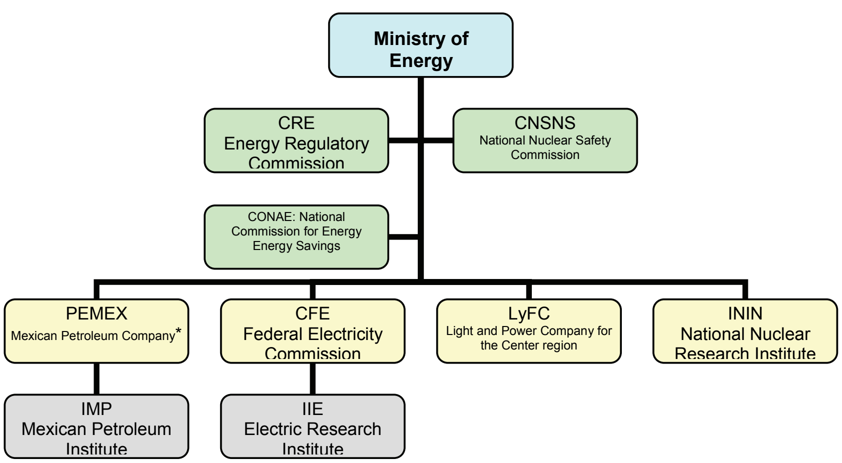

Figure 6.1 Structure of the Mexican Energy Sector
** It comprises the following four subsidiary companies: Pemex Exploration and Production, Pemex Refining, Pemex Gas and Basic Petrochemical, and Pemex Petrochemical.*
Source: Secretaría de Energía (www.energia.gob.mx)

6.2.2. Energy Sector Program 2001-2006

The most important national general plan in Mexico is the National Development Plan 2001-2006 (NDP), which specifies the country's national objectives and priorities. The three essential axes of the NDP are: social and human development, growth with quality, and order and respect.

For the energy sector, one of the specific development strategies stated by the NDP is that this "… sector should include a transparent and modern regulation that guarantees quality in service, as well as competitive prices. Therefore, it is necessary to ensure resources so that the public businesses of the sector can comply with their objectives, to facilitate competitiveness and investment and to promote the participation of Mexican companies in energy infrastructure projects. The public businesses will establish development plans for national suppliers of the goods and services that they require for their management and development"[1]

The Energy Sector Program 2001-2006 (ESP) was created following the principles established in the NDP, which is of federal jurisdiction, and is designed as a strategic tool to prompt the sustainable development of the country. It contains the background, policies, priorities, strategies, specific actions and goals of the energy sector, which serve as reference and guidance for the compliance of commitments made by the Mexican government on energy issues.

Among other strategies of the ESP, natural gas will become a primary source of energy. For power generation, the best alternative will be natural gas due to its high efficiency in combined cycle power utilities, as well as its cleaner combustion compared to petroleum or coal. In addition, the ESP established the necessity of diversifying energy sources, and considered liquefied natural gas to be an important source in the coming years for reaching that goal.

6.2.3. Overall picture of energy production and consumption

The aim of this section is to present a brief summary of Mexico's energy resources related to production and current energy consumption of hydrocarbons and electric power, both by sectors and fuels.

The development of Mexico and many other developing countries has been characterized by the predominance of hydrocarbons in the productive processes. In many countries oil does not surpass 40-50% of the primary energy productive structure, but in some Latin American countries that proportion reaches around 60-70%, Mexico included.

However, the socio-economic development pattern followed by Mexico in the last decades has in general evolved to less energy intensive consumption, with emissions showing a tendency to decrease.

6.2.4. Relevance of the energy sector in Mexico

Mexico supports a considerable extent of its social and economic development through the use of energy. The energy sector has a decisive role in the national life: it generates electricity and hydrocarbons as supplies for the economy and the provision of public utilities; it contributes 3% of the GDP (1.7% coming from hydrocarbons and 1.3% from electricity); oil represents 8% of total exports and oil-related taxes contribute 37% of the Federal Budget; and nearly 40% of public investment is directed to energy projects. Public companies in the oil and power sectors provide employment to approximately 250,000 workers.

Mexico is ranked 9th worldwide in crude oil reserves, 4th in natural gas reserves in the Americas (after the United States, Venezuela and Canada), 7th in crude oil production, and 8th in natural gas production. The national petroleum company (Pemex) is the 7th largest petroleum company by crude oil output worldwide, and one of the most profitable before taxes. In terms of electricity generation, Mexico ranks 16th worldwide, and the national electricity company (CFE) is the 6th largest power

[1] Poder Ejecutivo Federal, *Plan Nacional de Desarrollo 2001-2006*, México, 2001, p. 110.

company in the world. In terms of electricity coverage, 95% of the national population is connected to the grid, which represents one of the most comprehensive coverage ratios in Latin America.

From the environmental perspective, this sector releases 75% of the total of national inventory emissions. Mexico is one of the 13 largest producers of CO_2 emissions in the world (1.3 % of the world). The ecological depletion and degradation costs represent around 10% of total GDP.

6.2.5. Energy sector challenges

During the 2001-2006 presidential period, 120 billion dollars (20 billion per year) were required to expand and modernize Mexico's energy infrastructure; 48 billion in exploration and production, 18 billion in refining, 20 billion in natural gas, and 34 billion in electricity. Resources from the public sector are insufficient to fulfill these requirements, and thus complementary investments from the private sector are necessary.

The main challenges regarding energy are to: 1) guarantee the coverage of future energy demand derived from the economic and demographic growth of the next years, 2) transform the national energy enterprises into internationally competitive entities, and 3) maximize the profits of the energy sector for the benefit of the population in general.

According to forecasts developed in 2002, the energy demand in the following 10 years was expected to increase by 70% for electricity, by 35% for LPG, by 120% for natural gas and by 45% for liquid fuels.

6.2.6. Long term vision of the energy sector

- The population must have full access to energy at competitive prices.
- The public and private energy companies must be competitive at the international level. They must:
  - operate within an adequate legal and regulatory framework;
  - protect the environment and improve efficiency;
  - foster the efficient use of energy and promote the use of renewable energies;
  - promote R&D to maintain an energy sector updated with the most advanced available technologies.

6.2.7. Strategic Objectives of the Energy Sector

- Guarantee a reliable energy supply, according to international quality standards, and competitive prices.
- Provide adequate legislation as an instrument for the development of the energy sector.
- Enhance the participation of Mexican enterprises in energy infrastructure.
- Improve energy efficiency programs and development of renewable energies.
- Foster a safe and reliable use of nuclear energy, maintaining the highest international safety standards.
- Ensure leadership in risk prevention of the productive operations of the energy sector.
- Ensure leadership in the protection of the environment.
- Promote the development and application of advanced science and technology.
- Expand and foster international cooperation on energy matters.
- Improve the service quality of the national energy companies.

6.3. Energy Statistical Data Capability of SENER and INEGI

For several years, SENER has been elaborating a national energy balance that includes indicators on energy production and consumption nationally and by economic sectors: agriculture, industry, transport, and residential-commercial-public service.

SENER has also developed information systems for long-term analysis and research in priority areas such as energy savings/energy efficiency, local/regional and global environmental impacts, safety, and technological development. Information is collected through several networks within the energy sector that have been set in place, so information comes from groups that develop their own programs, policies, and prospective and energy balance studies. Information ranges from the more technical and specific data to the more general of public interest. Additionally, since 1990 SENER has produced several annual prospective studies for the energy sector (electricity, natural gas and liquefied petroleum gas), as well as the annual National Energy Balance.

Institutions within the energy sector -- including the Mexican Petroleum Institute (IMP), the Electric Research Institute (IIE), and the Nuclear Research Institute (ININ) -- participate in modelling efforts on energy, economy and the environment, including diverse topics such as: gas and oil supply/demand (IMP), electricity demand/supply and renewable energies (IIE), and energy efficiency and savings, emissions reductions and renewable energy regulatory frameworks through the National Commission for Energy Savings (CONAE). Additionally, the National Autonomous University of Mexico (UNAM) has modelled the electrical sector expansion, including long-term national energy supply and demand and long-term planning scenarios.

Information generated in multiple research projects must be adequately handled, processed and disseminated. Thus SENER is developing a Centre for Energy Research and Information that coordinates research networks and promotes cooperation agreements between SENER, the research institutes of the energy sector, and (eventually) other national and international institutions, research centres and multilateral agencies.

The IIE together with SENER is currently developing a geographical information system (SIGER), which will include a detailed inventory of renewable energies in the country in terms of installed capacity and resources. The system has already completed its information database for Oaxaca, one of the states with the highest wind resources in Mexico.

The National Institute of Statistics, Geography and Informatics (INEGI) is responsible for producing the Nation's basic statistical information by means of national censuses, sample surveys and administrative records. The Population and Housing Census and the Economic Census are conducted every five years and the Agriculture and Livestock Census is conducted every ten years.

Household surveys are also regularly undertaken to gather information on social, demographic and economic issues, as well as surveys of industrial, commercial and service establishments. A variety of administrative records are used extensively. These records include information on foreign trade flows and demographic events, to mention only a few.

In addition, INEGI integrates and generates derived statistics on social and economic aspects of the country, such as the System of National Accounts, which includes the quarterly Gross Domestic Product, the Integrated System of Economic and Ecological Accounts, which include an estimation of ecological depletion and degradation costs.

INEGI also generates information on the physical milieu, natural resources, infrastructure and territory. Aerial photography and satellite imagery are used and several field activities are carried out, as well as special projects of interpretation and analysis.

INEGI, together with the Secretariat of Environment and Natural Resources (SEMARNAT) and within the environmental sector's Technical Committee, develops and implements conceptual, methodological and normative infrastructure that addresses the production and integration of statistics and geographic information on natural resources, environment and sustainable development under national and international comparability criteria.

Other activities of INEGI include:

- Increasing and improving the availability and quality of natural resources, environment and sustainable development information, as well as obtaining and disseminating new environmental information on strategic areas or sectors for public administration planning and management.
- Working intra- and inter-institutionally for the conceptual and methodological development and production of environmental and sustainability indicators, in order to provide decision-makers with diagnosis and assessment reports on environmental performance according to national and international commitments.
- Producing, in collaboration with national agencies and province governments, publications on environmental statistics and indicators both at the national level and for metropolitan zones.

In summary, SENER and INEGI, having considerable experience and a sound database, have developed the ability for elaborating the proposed indicators on sustainable energy development. The joint project with IAEA contributes to creating an awareness of the need to expand the energy statistics capability, as well as to incorporate the ISED package into national databases, and improve them accordingly.

6.4. Selected Energy Priority Areas to be Assessed by using the ISED System

In order to pave the way for development towards sustainability, Mexico must account for strategic sectors with a national system of indicators. Energy and environment are clearly strategic issues, due to their complexity and the magnitude of impacts on the society at local, regional, national, and global levels.

The ISED package provides a good platform for constructing relevant indicators that allow the adoption of response actions and policy measures. In working within this framework, it has been necessary to identify the selected energy priority areas that need to be assessed through the core indicators. These will allow decision-makers to devise and analyze the driving forces, trends and impacts of current energy policies.

In light of the ten goals of the ESP, the selected national priority areas and corresponding strategies which could be assessed using the ISED system are shown in Box 6.1. Under this scheme, a total of 41 indicators proposed by the IAEA were distributed according to the main topics addressing the socio-economic and environmental dimensions related to energy. These dimensions were broken down into four categories corresponding to the list of indicators and basically keeping in mind the goals of the Mexican energy sector. Response actions and policy measures were identified for each category and targeted indicator.

Eight of the ten ESP Mexican energy sector goals were addressed by the ISED package, as shown in Box 6.1.

BOX 6.1: MEXICAN ENERGY SECTOR GOALS, RELEVANT ACTIONS AND POLICY MEASURES ON TARGETED ISED			
Energy policy issues and goals of Mexican energy sector	**ISED Core Set**	**Response Actions on Targeted Indicator**	**Policy Measures on Targeted Indicator**
I Socio-economic aspects			
Context indicators	1, 2, 4, 7, 19	Monitor macro energy-related socio-economic tendencies and assess current energy policies.	· Implement or adjust energy policies. · Link energy policies to socio-economic concerns. · Eliminate or relocate energy subsidies in order to assist poorest population segments. · Strengthen wealth distribution policies.
II Energy Supply			
Goal 1: "Guarantee a reliable energy supply, according to international quality standards, and competitive prices"	3, 11, 15, 17, 18, 22, 36, 37	Allow decision-making in energy investment, taxes, energy supply, and import policies. Establish a relationship between generation sources and fuel types (development planning and forecasts).	· Increase share of natural gas in fuel mix. · Increase the use of pollution abatement technologies to use existing national energy sources. · Increase the share of renewable sources of energy in fuel mix. · Increase private participation in the Energy Sector, including oil exploration and production.
Goal 2: "Adequate legislation as an instrument for the development of the Energy Sector"	11, 17, 18, 36, 37	Promote an increasing participation of private companies in energy infrastructure.	
Goal 3: "Enhance the participation of Mexican enterprises in energy infrastructure"	17, 18, 36, 37	Contribute to national economic growth.	. Encourage Mexican enterprises by adequate policies that give certain fiscal incentives.
Goal 4: "Improve energy efficiency programs and development of renewable energies"	22	Enhance population access to energy from renewable sources, such as mini-hydro, PV systems, etc.	· Promote sustainable development of poor population by access to (renewable and grid) energy, for households as well as for productive activities.
Goal 10: "Improve service quality of the National energy companies"	22	Increase access of population to the grid.	
III Energy Production and Consumption Patterns			
Goal 4: "Improve energy efficiency programs and development of renewable energies"	5, 6, 8, 9, 10, 12, 14, 16, 20, 21, 35, 40	Evaluate the evolution of the efficiency and energy saving policies, to establish energy supply and renewable energy policies.	· Integrate environmental concerns into energy policies. · Target existing and new energy savings and efficiency programs in the most energy intensive sector. · Optimise economic activity levels through reducing shares of energy intensive areas. · Decrease energy intensities through end-use energy efficiency improvement. · Increase efficiency of energy supply, in particular for electricity generation. · Integrate energy efficiency in sectoral policies. · Implement advanced, environmentally sound technologies with lower specific fuel consumption. · Switch to more environmentally benign fossil

BOX 6.1: MEXICAN ENERGY SECTOR GOALS, RELEVANT ACTIONS AND POLICY MEASURES ON TARGETED ISED			
			fuels, such as natural gas.
IV Environmental protection and safety policies			
Goal 7: "Leadership in the protection of the environment" *Goal 4: "Improve energy efficiency programs and development of renewable energies"* *Goal 2: "Adequate legislation as an instrument for the development of the Energy Sector"*	13, 23, 24, 25, 26, 29, 30, 33, 41	Establish a relationship between emissions and control-mitigation policies to reduce environmental impact. Use cleaner fossil fuels and renewable energy. Measure land efficiency use by energy sector.	· Include externalities in full costs of energy. · Implement legal and regulatory frameworks and enabling environment favouring energy conservation and efficiency. · Promote and increase the use of renewables. · Improve material intensities across sectors.
Goal 6: "Leadership in risk prevention of the productive operations of the energy sector"	34	Risk evaluation and control policies.	
Goal 5: "Foster a safe and reliable use of nuclear energy maintaining the highest international safety standards"	27, 28, 31, 32, 38, 39	Environmental and safety policies. Policies for radioactive waste. Uranium supply.	

Notes: Column 1: Goals 8 and 9 are not addressed because they correspond to international cooperation on energy and improving service quality, respectively. For these matters ISED framework does not provide indicators.
Column 2: Numbers are in correspondence with the 41 original ISED list.
Column 3: Indicates potential and/or concrete response actions on the targeted indicators.
Column 4: Presents more specific policies to follow the issues represented by the ISED.
Source: Adapted from Secretariat de Energía. *Programa sectorial de energía, 2001-2006*, México, 2001, and International Atomic Energy Agency / International Energy Agency. *Indicators for Sustainable Energy Development: A Collaborative Project*, Vienna, 2001.

6.5. ISED implementation

SENER and INEGI have designed a matrix (Box 6.2) for presenting and assessing the results of the indicators implementation process (i.e., information on the state of each indicator; indicator availability; data availability and/or conceptual difficulty; elaboration feasibility; as well as information sources and institution responsible for its development).

Based on the selected energy priority areas mentioned above, the review of energy statistical data capabilities, as well as the analysis and adequacy of methodological sheets for the ISED framework, SENER and INEGI have already constructed an important number of indicators and consider that there is an enormous potential for developing the remaining ones.

According to this assessment, from a total of 41 proposed indicators (ISED package), 33 are now developed in correspondence with the proposed definition (number 7 was an exception, for which an alternative indicator was constructed). Five indicators would be feasible in the medium term (numbers 10, 25, 30, 33, and 41); and the other three might be feasible in the long term (numbers 12, 13, and 39). (See Box 6.2).

The results and information for all indicators are presented according to a thematic structure of four categories, which synthesizes the energy-related environment scope and allows the grouping of indicators in the following manner:

a) *Socio-economic:* a total of five proposed indicators, all fully developed.

b) *Energy Supply:* a total of eight proposed indicators, all fully developed.

c) *Energy Production and Consumption Patterns:* a total of twelve proposed indicators, ten of them developed.

d) *Environmental protection and safety policies:* a total of sixteen proposed indicators, ten of which have been developed.

For some indicators, which have not yet been elaborated, Box 6.2 also provides some explanations about data availability or feasibility of constructing such indicators.

BOX 6.2: ISED FOR MEXICO: ASSESSMENT OF FEATURES AND WORK PROCESS FOR EACH INDICATOR					
No.	IAEA Indicators List[1]	Not available	Data availability and/or conceptual difficulty	Elaborated/ Feasibility	Responsible Institution
1	Population: Total and percentage in urban areas 1950-2000			Elaborated	INEGI
2	Gross domestic product (GDP) per capita			Elaborated	INEGI
3	End-use energy prices with and without tax/subsidy			Elaborated	SENER
4	Shares of sectors in GDP value added			Elaborated	INEGI
5	Distance travelled: Total and by urban transport			Elaborated	SCT, INEGI, CITY GOVERNMENTS
6	Freight transport activity: Total, by mode			Elaborated	SCT, INEGI
7	Floor area per capita (Housing and occupation characteristics -alternative indicator-) 1950-2000			Elaborated	INEGI-SENER
8	Manufacturing value added by selected energy intensive industries			Elaborated	INEGI, SENER
9.1	Energy intensity in Manufacturing			Elaborated	SENER-INEGI
9.2	Energy intensity in Agriculture			Elaborated	SENER-INEGI
9.3	Energy intensity in Commercial and service sector			Elaborated	SENER-INEGI
9.4	Energy intensity in Transportation			Elaborated	SENER-INEGI
9.5	Energy intensity in Residential sector			Elaborated	SENER-INEGI
10	Energy intensity of selected energy intensive products	X	Need to define intensive products more precisely; data not sufficient.	Medium	SENER
11	Energy mix			Elaborated	SENER and others
12	Energy supply efficiency	X	Data not sufficient; it requires estimation exercise.	Long	CFE, LyFC, PEMEX
13	Status of deployment of pollution abatement technologies	X	Data not sufficient; it requires estimation exercise.	Long	SENER, CFE, PEMEX, LyFC
14	Energy use per unit of GDP			Elaborated	SENER-INEGI
15	Expenditure on energy sector			Elaborated	PEMEX, CFE, LyFC, INEGI
16	Energy consumption per capita			Elaborated	SENER, INEGI
17	Indigenous energy production			Elaborated	SENER
18	Energy net import dependency			Elaborated	SENER
19	Income inequality			Elaborated	INEGI
20	Ratio of daily disposable income/ private consumption per capita of 20% poorest population to the prices of electricity and major household			Elaborated	INEGI

BOX 6.2: ISED FOR MEXICO: ASSESSMENT OF FEATURES AND WORK PROCESS FOR EACH INDICATOR					
No.	IAEA Indicators List[1]	Not available	Data availability and/or conceptual difficulty	Elaborated/ Feasibility	Responsible Institution
	fuels				
21	Fraction of disposable income/ private consumption spent on fuel and electricity			Elaborated	INEGI
22	Fraction of households heavily dependent on non-commercial energy and without electricity			Elaborated	INEGI
23	Quantities of air pollutant emissions			Elaborated	SENER (CFE)
24	Ambient concentration of pollutants in urban areas			Elaborated	SEMARNAT
25	Land area where the acidification exceeds critical load	X	There is no information on acidified land area caused by air pollution (acid rain). The available data corresponds to general specifications of the acid rain and to the natural acidification of soil.	Medium	SEMARNAT
26	Quantities of greenhouse gases emissions			Elaborated	SEMARNAT
27	Radionuclides in atmospheric radioactive discharges			Elaborated	CNSNS, ININ, CFE
28.1	Discharges into water basins: Oil into coastal waters			Elaborated	CNSNS, ININ, CFE
28.2	Discharges into water basin: Radionuclides in liquid radioactive discharges			Elaborated	CNSNS, ININ, CFE
29	Generation of solid wastes			Elaborated	PEMEX, CFE, LyFC
30	Accumulated quantity of solid waste to be managed	X	According to the General Law for Prevention and Integral Management of Residues, the control and handling of residues generated inside the country, including waste related to energy, corresponds to the Secretary of Environment and Natural Resources. Aggregated data is available at national level but not by source.	Medium	PEMEX, CFE, LyFC
31	Generation of radioactive waste from nuclear power fuel cycle chain			Elaborated	CNSNS, ININ, CFE
32	Accumulated quantity of radioactive waste awaiting disposal			Elaborated	CNSNS, ININ,
33	Land area taken up by energy facilities/infrastructure	X	There are only available data on linear kilometres of pipelines and electrical lines. Land area taken up by energy facilities is not available.	Medium	PEMEX, CFE, LyFC
34	Fatalities due to accidents with breakdown by fuel chain			Elaborated	SENER, PEMEX
35	Fraction of technically exploitable capability of hydro power currently not in use			Elaborated	SENER (CFE)
36	Proven recoverable fossil fuel reserves			Elaborated	SENER
37	Lifetime of proven fossil fuel reserves			Elaborated	PEMEX
38	Proved uranium reserves			Elaborated	CNSNS, ININ, CFE
39	Lifetime of proved uranium reserves	X	Because no exploitation has occurred in Mexico for over a decade, it is not	Long	CNSNS,

BOX 6.2: ISED FOR MEXICO: ASSESSMENT OF FEATURES AND WORK PROCESS FOR EACH INDICATOR					
No.	IAEA Indicators List[1]	Not available	Data availability and/or conceptual difficulty	Elaborated/ Feasibility	Responsible Institution
			possible to calculate the lifetime.		ININ, CFE
40	Intensity of use of forest resources as fuelwood			Elaborated	SENER
41	Rate of deforestation	X	The available information does not consider specific data of the forest area that has changed as a result of the wood extracted to be used as fuelwood. This practice, considered minimal, does not substantially affect the deforestation phenomenon.	Medium	PEMEX, CFE, LyFC, SEMARNAT

Medium: Medium term feasibility.
Long: Long term feasibility.
[1] IAEA, "Methodology Sheets for Elaborating Indicators of Sustainable Energy Development", Workshop on Indicators for Sustainable Energy Development Project, International Centre for Theoretical Physics (ICTP), May 13 - 17, 2002, Trieste, Italy.
Source: SENER and INEGI.

6.6. Information on Indicators

All of the indicators elaborated by Mexico have been constructed using the conceptual framework and the methodology sheet of the IAEA's Indicators for Sustainable Energy Development project, which was presented and discussed in the first Workshop carried out in the International Centre for Theoretical Physics (Trieste, Italy, 2002).

The statistical information for the 33 indicators implemented is presented in four basic areas of the energy sector: 1) Socio-economic, 2) Energy Supply, 3) Energy Production and Consumption Patterns, and 4) Environmental Protection and Safety Policies.

6.6.1. Socio-economic Indicators

The socio-economic indicators developed in this study are:

- 1. Population: Total and percentage in urban areas, 1950-2000
- 2. Gross domestic product (GDP) per capita
- 4. Shares of sectors in GDP value added
- 7. Housings and occupation
- 7. Housings and occupation characteristics, 1950-2000
- 19. Income inequality

6.6.1.1. INDICATOR 1

Population: Total and percentage in urban areas, 1950-2000 (%)

Definition: The whole number of people or inhabitants in a country or region; and the ratio of population living in defined urban areas to total country population.

Purpose: The indicator is a basic socio-economic indicator and measures the size of population in a country or region. Knowing the size of a country's population, its changing rate, and share of urban population is important for evaluating the welfare of the country's citizens, assessing the productive capacity of its economy, and estimating the quantity of goods and services produced per each inhabitant. Thus governments, businesses, and anyone interested in analyzing economic performance must have accurate population estimates; and in particular its share in urban areas, which measures the size of formal and informal urban settlements by their population.

TABLE 6.1 POPULATION: TOTAL AND PERCENTAGE IN URBAN AREAS, 1950-2000

	Population					Growth Rate (%)			
	1950	1970	1990	1995	2000	1950-70	1970-90	1990-95	1995-2000
Total Population (Thousands of inhabitants)	25,779	49,050	81,249	91,158	97,483	3.3	2.5	2	1.6
Semi-urban Population (Cities with 2,500 to 14,999 inhabitants)	3,940	7,407	11,284	12,370	13,341	3.2	2.1	1.6	1.8
Urban Population (Cities with more than 15,000 inhabitants)	7,209	22,004	46,675	54,633	59,419	5.7	3.7	2.8	2

Source: For 1950 and 1970, Luis Unikel, El desarrollo urbano de México: Diagnóstico e implicaciones futuras, México, 1976; for 1990 and 1995, INEGI, XI Censo General de Población y Vivienda 1990, Conteo de Población y Vivienda 1995, México, 1996. INEGI, XII Censo General de Población y Vivienda 2000, México 2001.

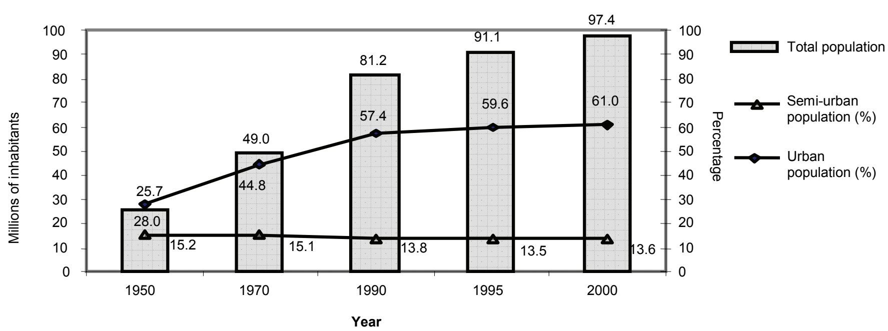

Figure 6.2 Population: total and percentage in urban areas, 1950-2000

Trends: The total population of Mexico increased during the 1950-1970 period at an annual growth rate of 3.3%, and slowed down in the past 32 years to reach an annual growth rate of 1.6% between 1995 and 2000. In 1950, the semi-urban and urban population of Mexico represented 43.2% of the total, while by 2000 it accounted for more than 64% of total population. The percentage of urban population has grown steadily between 1950 and 1990, but importantly slowed down over the last decade. On the other hand, the percentage of the semi-urban population decreased slightly between 1970 and 1990, remaining almost constant for the next 10 years. Statistics show that immigration has preferentially occurred from rural areas to large cities. For instance, the total population of Mexico City's Metropolitan Area was 2.95 million inhabitants in 1950, and by the year 2000 it reached 17.8 million. Official estimates project that Mexico City will reach a population of 20.3 million by 2010, according the Consejo Nacional de Población.

Indicator construction and limitations: The indicator provides only a general scope and some implications for the environment if the current tendency of population growth patterns continues, which is concentrating in the largest and middle size cities. In general, it provides some signals about the demographic tendencies and pressures on the environment.

A limitation of the indicator is that it is not directly tied to environmental impacts. Data should be updated more frequently in order to present a general comparison with data on natural and environmental performance.

6.6.1.2. INDICATOR 2

Gross domestic product (GDP) per capita (USD of the base 1990 year per capita)

Definition: Levels of GDP per capita are obtained by dividing annual or period GDP both at current market prices and/or prices based on purchasing power parity by population. A variation of the indicator could be the growth of real GDP per capita which is derived by computing the annual or period growth rate of GDP in constant basic producers' or purchasers' prices divided by corresponding population.

Purpose: The indicator is a basic economic growth indicator and measures the level and extent of total economic output. It reflects changes in total production of goods and services.

TABLE 6.2 GDP PER CAPITA 1980-2004

Year	GDP per capita. constant prices (1993-MEX)	GDP per capita constant prices 1993-USD
1980	13,614.83	4,371.15
1981	14,458.43	4,642.00
1982	14,118.89	4,532.98
1983	13,227.56	4,246.82
1984	13,410.54	4,305.56
1985	13,470.58	4,324.84
1986	12,709.29	4,080.42
1987	12,670.52	4,067.97
1988	12,579.26	4,038.67
1989	12,851.40	4,126.05
1990	13,242.58	4,251.64
1991	13,536.18	4,345.90
1992	13,767.18	4,420.07
1993	14,282.48	4,585.51
1994	14,647.94	4,702.84
1995	13,501.47	4,334.76
1996	13,981.59	4,488.90
1997	14,714.95	4,724.36
1998	15,241.71	4,893.48
1999	15,575.25	5,000.56
2000	16,439.13	5,277.92
2001	16,089.09	5,165.53
2002	15,969.02	5,126.99
2003	15,962.57	5,124.91
2004	16,271.80	5,224.20

Source: International Monetary Fund, World Economic Outlook Database, September 2003.
OCDE. 2004. Purchasing Power Parities (PPP) Statistics.

Trends: Measured in 1993 market prices, Mexico's GDP per capita has grown 19.5% in the period 1980-2000 and dropped four times (1982-83, 1986-88, 1994-95 and 2000-2003). Three of these episodes coincide with the end of presidential terms, where economic crises due to political instability have had a negative effect on the economy. It is important to mention that even though an increase of GDP per capita is observed, the wealth distribution has not improved (as will be observed later). Thus wealth distribution policies, access to energy, education, services and jobs must all be improved.

Indicator construction and limitations: Construction of this indicator was accomplished with IMF/OECD information in order to maintain consistency of data and international comparability.

6.6.1.3. INDICATOR 4

Shares of sectors in GDP value added (%)

Definition: This indicator measures the contribution of the various economic sectors to total production. It is obtained by dividing the value added in a specific sector by the total GDP value-added at constant 1990 prices.

Purpose: The relative size of sectors is a significant indicator of the state of the economy. The relative size of manufacturing also hints at basic driving forces associated with sustainable development.

TABLE 6.3 SHARES OF SECTORS IN GDP[a] (1988-2002)

Year	Agriculture[b]	Manufacturing[c]	Commerce and Services[d]	Transportation[e]
1988	8.1	19.8	56.3	9.2
1989	7.8	20.5	56.1	9.2
1990	7.8	20.8	55.8	9.1
1991	7.7	20.6	56.3	9.0
1992	7.4	20.7	56.3	9.2
1993	7.4	20.2	56.7	9.4
1994	7.1	20.1	56.6	9.7
1995	7.8	20.4	56.3	9.9
1996	7.7	21.5	54.7	10.1
1997	7.2	22.1	54.3	10.4
1998	7.0	22.6	54.0	10.6
1999	6.9	22.8	53.6	11.0
2000	6.5	22.8	53.8	11.3
2001	6.9	22.0	54.2	11.7
2002	6.8	21.7	54.6	11.9

[a] GDP at 1990 prices and purchasing power parity.
[b-e] International Standard Industrial Classification (ISIC) revision 3.
Source: INEGI. Sistema de Cuentas Nacionales de México (SCNM), 1988-1999 y 1996-2002. Aguascalientes, México 2000 y 2003.

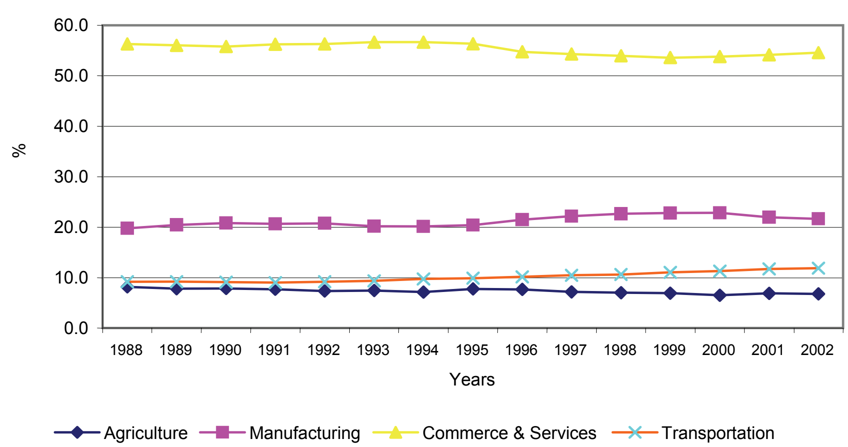

Figure 6.3 Shares of sectors in GDP at PPP, 1988-2002

Trends: In the 1980s, Mexico started an economic policy of openness towards international trading directed to displace the existing mono-export model based on hydrocarbons. The objective was to try to diversify the national productive base, and was accompanied by a strategy of deregulating the decentralized entities (including those of the energy sector) of the economy and the governmental system. Mexico's economic and social development in the years to come will have to rely on sectors and industries of greater dynamism in international trade, a trend that was strengthened in 1994 with the signing of the North American Free Trade Agreement.

A consequence of this scheme of commercial openness has been the greater interrelation of the Mexican economy with that of the United States, which has implied, among other things, the reduction of agricultural subsidies, the insertion of foreign industries in activities basically directed towards exports, a growing flow of commodities and persons (fundamentally to the United States), and in general greater competition between national and northern (i.e., foreign) firms.

In this context, during the 1988-2002 period, the Commerce and Service sector has maintained a share higher than 50%, followed by Manufacturing (which accounts for around 21%), Transportation (with approximately 10.5%) and, in last place, Agriculture (with 6.8 per cent).

Taking the sectoral structure as a whole, Transportation increased its share, from 9.2% in 1988 to 11.9% in 2002; on the contrary, Agriculture displays an almost steady decrease, passing from 8.1% to 6.8%. The remainder of the sectors has shown erratic performances.

In the future, the trends in the Mexican economy point to a greater diversification of its productive base regarding international markets.

Indicator construction and limitations: The historical series could only be constructed from 1988, since the methodology used by INEGI is similar to the one shown until 2002. That is, before 1988 the data published by the Institute does not exist with the required detail for this indicator (by sector).

This construction included only the categories and sectors noted in the methodology sheet (ISED Methodology Sheet).

For the manufacturing sector, divisions 15 to 37 were included, in order to visualize the sector as a whole.

For the conversion to the purchase parity power (PPP), numbers for basic values in current prices were taken and turned into 1990 constant prices, since the official numbers are in 1993 constant prices.

The official numbers of the commerce and services sector presented for this indicator do not include the participation of the informal sector in the economy. This is an important component that, in agreement with official estimations of the INEGI in the matter, represents about 10% of the national GDP.

6.6.1.4. INDICATOR 7

Housing and occupation characteristics, 1950-2000 (sq. m per person)

Definition: Defined as the median usable living space per person.

Purpose: This is a key indicator of housing quality, which measures the adequacy of living space in dwellings. A low value for the indicator is a sign of overcrowding.

TABLE 6.4 HOUSING AND OCCUPATION CHARACTERISTICS, 1950-2000

	1950	1960	1970	1990	1995	2000
Housings (millions)1	5.3	6.4	8.3	16.2	19.4	21.9
Occupants (millions)	25.8	34.9	48.2	80.9	90.9	97
Average occupants per housing	4.9	5.4	5.8	5	4.7	4.4
Average occupants per room2	NA	2.9	2.5	1.9	1.6	1.6
Average occupants per bedroom	NA	NA	NA	2.7	2.3	2.2

NA: Not available.
[1] For 1990, 1995 and 2000, information is of particular housings.
[2] Kitchen room is not considered as bedroom in dwellings.
Source: INEGI, Indicadores sociodemográficos de México, 1930-2000, México, 2001.

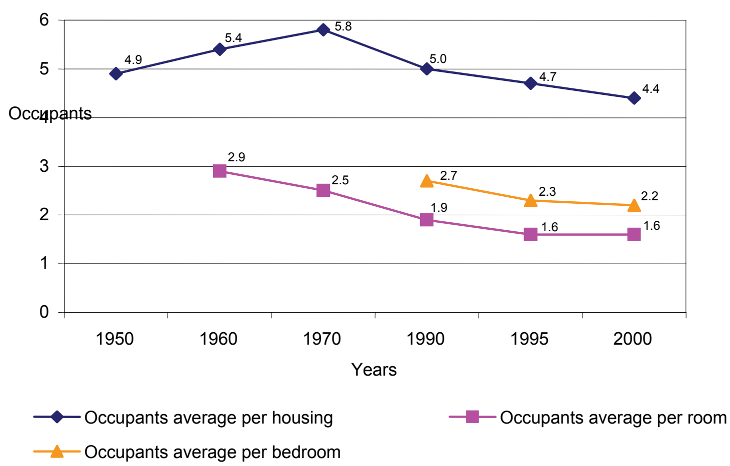

Figure 6.4 Housings and occupation characteristics, 1950-2000

Trend: This is an alternative indicator to the one proposed by the methodology sheet. It shows that there is a general tendency for the average occupants per housing, room and bedroom to drop between 1960 and 2000. In turn, the population growth rate also diminished between 1970 and 2000 (see indicator # 1) from 2.5% (1970-1990) to 1.6% (1995-2000), while the number of houses grew more than 180% between 1970 and 2000.

Indicator construction and limitations: The data in which this indicator is based was only updated to the year 2000, since the last National Census was done in that year.

6.6.1.5. INDICATOR 19

Income inequality

Definition: Ratio of disposable income (after allowing for taxes and social security transfers) or private consumption in terms of individual (per capita) available to the groups of poorest 20% and richest 20% of the population.

Purpose: This indicator provides a measure of income or resources inequality within a population highlighting the picture of how levels of economic welfare are evolving in a society.

TABLE 6.5 NATIONAL INCOME DISTRIBUTION, 1996-2002

Year	Poorest 20% households[1]	Richest 20% households[2]
1996	3.8	55.28
1998	3.14	56.61
2000	3.51	56.51
2002	3.69	53.86

1 Referred to 20% of households (stratums I y II) with least quarterly monetary current income.
2 Referred to 20% of households (stratums IX y X) with highest quarterly monetary current income.
Source: Encuesta Nacional de Ingreso-Gasto de los Hogares (ENIGH), 1996, 1998, 2000, 2002. Aguascalientes, México 1998, 2000, 2001, 2003.

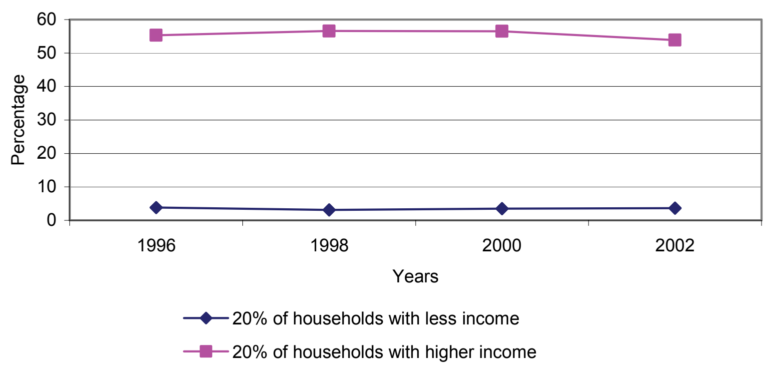

Figure 6.5 National income distribution, 1996-2002

Trends: In the last two decades, governmental policies successfully accomplished macroeconomic stability, moderating public investment, containing inflation and adjusting wage rises.

These policies resulted in restricted purchasing power and led to an increase in the social strata with lower income.

In the period 1989-2002, the 20% of the population in households with the least income absorbed between 3.14% and 3.85% of the national income, whereas the 20% with the highest income obtained between 51.26% and 57.54%. Except during 1984, in all other years the difference between these groups of households was always above 50%, reaching in 1994 the highest value, 54.26 percent.

The greatest distance (or inequality) in income between these two groups occurred in 1998: the quintile of population with the highest purchasing power received 18 times more income than the poorest quintile, a proportion that was reduced to 14.6 times in 2002.

Indicator construction and limitations: For this indicator, the principal source provides, among other advantages, stability and conceptual and methodological coherence over time. The National Income-Expenditure in Households Survey (ENIGH) groups the distribution of population by household according to their income.

The deciles I and II contain the 20% of the population with the lowest income (i.e., it is assumed that these deciles represent the poorest segment), while deciles IX and X contain to the richest 20 percent.

More detailed studies (i.e., those considering well-being levels or the poverty line) were not considered, since they are not available for the levels needed by this indicator. For the calculation of this indicator, the current monetary quarterly household income (which corresponds to the deciles mentioned above and defined by INEGI) was taken, since it is the most recommended and suitable source to establish income concentration.

6.6.2. Energy Supply Indicators

This section groups eight indicators covering different aspects of the energy supply sector. They should show the extent to which secure, diverse and sustainable supplies of energy to consumers at competitive prices are ensured. The trends shown by these indicators might address measures and policies on important energy development fields, such as: energy efficiency, conservation, intensity, and environmental problems.

6.6.2.1. INDICATOR 3

End-use energy prices with and without tax/subsidy (USD in PPP/Toe)

Definition: Actual prices paid for energy by final consumers.

Purpose: This indicator reflects the extent to which energy becomes more or less expensive over time. In the developed world this should measure the disincentive to increase consumption, but for the developing world it would be a measure of affordability of energy, on the one hand, and of incentive for energy conservation and efficiency improvement, on the other.

Consumption of fossil fuels is a major contributor to global warming and air pollution. Fossil fuel resources should also be conserved to support long-term development. Energy prices can be regulated to internalize environmental and social costs, to manage demand, and to encourage development of alternative renewable energy sources.

For developing countries there is a need to increase energy availability and affordability, in particular for the lower income groups of the population, so as to improve social and economic development. At the same time, the energy use practices in the developing countries are generally less efficient and often wasteful. Appropriate pricing mechanisms may be used to overcome these deficiencies.

TABLE 6.6 END-USE ELECTRICITY PRICES (USD/KWH)

Year	Industrial	Agricultural	Residential	Public service
1980	0.045497097	0.023945840	0.064653769	0.044898451
1981	0.046776541	0.023945840	0.068085854	0.044697583
1982	0.043828379	0.007533003	0.060606430	0.038349832
1983	0.039204054	0.003733719	0.050405212	0.033603475
1984	0.059771394	0.013634208	0.073283868	0.056241108
1985	0.061265050	0.015075693	0.069444415	0.058298025
1986	0.076303386	0.015817843	0.085510787	0.076020082
1987	0.071467925	0.014212601	0.066102769	0.073087594
1988	0.083133310	0.023134573	0.075365803	0.090480951
1989	0.087357498	0.019382176	0.071693395	0.108271657
1990	0.082988415	0.021192522	0.078098863	0.126190616
1991	0.091496079	0.039974584	0.093840630	0.142138368
1992	0.092032961	0.051813090	0.101519274	0.155973856
1993	0.086817268	0.061389063	0.099107811	0.157965316
1994	0.078181335	0.058929239	0.098777245	0.155854699
1995	0.068123929	0.046028943	0.067323096	0.142007457
1996	0.074036756	0.044677812	0.084959775	0.146608230
1997	0.082333537	0.045170691	0.086222404	0.150722378
1998	0.077823411	0.045576810	0.088209277	0.166234355
1999	0.078048597	0.045689581	0.087403068	0.168078727
2000	0.084894380	0.046391873	0.090380877	0.170573006
2001	0.084422411	0.049003166	0.095081190	0.177626504

Source: SENER.2003. Statistical Compendium of the Energy Sector.

TABLE 6.7 END-USE ENERGY PRICES OF VARIOUS FUELS

Year	LPG Residential use USD/L	Motor LPG USD/L	Residential NG USD/m3	Industrial rest of the country NG USD PPP/m^3	Industrial Border Zones NG USD/m^3
1980	0.05986460	0.05986460	0.05986460		
1981	0.10394787	0.10394787	0.05197393	0.05197393	0.05197393
1982	0.13696368	0.13696368	0.03424092	0.06848184	0.06848184
1983	0.11201158	0.11201158	0.11201158	0.11201158	0.11201158
1984	0.08521380	0.08521380	0.15825419	0.15825419	0.15825419
1985	0.12830377	0.22453160	0.24858855	0.24858855	0.24858855
1986	0.26913942	0.56660930	0.23608721		
1987	0.36442568	0.77136769			
1988	0.18893935	0.39992161			
1989	0.16618583	0.32806633			
1990	0.16054361	0.26594399			
1991	0.14125915	0.26669259			
1992	0.16981025	0.37473558	0.18605752	0.15199065	0.15199065
1993	0.21349313	0.38438557	0.26931473	0.13171939	0.13171939
1994	0.24567318	0.38005456	0.26414485	0.12098942	0.10436492
1995	0.25841287	0.47170604	0.32404154	0.18218791	0.16065351
1996	0.34900380	0.47688305	0.42093588	0.31490266	0.22991624
1997	0.39647100	0.39647100	0.30603971	0.19029687	0.18408404
1998	0.36501779	0.36501779		0.17424054	0.17262720
1999	0.40328951	0.40328951		0.14360089	0.14661846

TABLE 6.8 END-USE ENERGY PRICES OF VARIOUS FUELS

Year	86 Octane Unleaded Fuel Border Zones USD /L	86 Octane Unleaded fuel rest of the country USD/L	93 octane unleaded fuel US-Mex border USD/L	93 octane unleaded fuel Rest of the country USD/L	Jet Fuel Mexico City USD/L
1980	0.41905221	0.41905221	-	-	0.35918761
1981	0.51973934	0.59864601	-	-	0.36381754
1982	1.02722762	1.02722762	-	-	0.68481841
1983	0.76541246	1.40387775	-	-	0.80274965
1984	0.65736358	0.65736358	-	-	0.63301678
1985	0.84199349	1.27820695	-	-	0.32877841
1986	0.84991395	0.84991395	-	-	0.42495698
1987	1.16008841	2.70555942	-	-	0.53651558
1988	0.60145692	0.60145692	-	-	0.28655801
1989	0.53213909	0.64869175	-	-	0.34442660
1990	0.69801571	0.69801571	-	-	0.45929434
1991	0.52283471	0.87251964	-	-	0.28310445
1992	0.53563603	0.63940896	-	-	0.26257696
1993	0.48623550	0.68657847	-	-	0.25070753
1994	0.52182461	0.62341878	-	-	0.24382601
1995	0.73148617	1.03441339	-	-	0.39103747
1996	0.73530571	0.76727552	0.80990194	0.80990194	0.44970871

1997	0.74784141	0.90314723	0.82837817	0.82837817	0.30557950
1998	0.82078587	0.85708598	0.90346946	0.90346946	0.21659067
1999	0.81296917	0.96598632	0.89462109	0.89462109	0.39228425
2000	0.81497043	0.85216154	0.91360772	0.91360772	0.38969816
2001	0.84000063	0.90713970	0.94167668	0.94167668	0.24402253
2002	0.82418046	0.86130570	0.92367612	0.92367612	0.37719250

Trends: In general, prices for all fuels have increased between 1980 and 2001. Differences in electricity prices are due to subsidies; agricultural tariffs have the highest ones, while public services (e.g. municipalities) and general services receive the lowest subsidies. In the case of municipalities, different options are being considered (such as self supply schemes) to prevent increases in existing debt. For companies providing services, the promotion of energy efficiency programs is an important option.

Heavy taxation is applied to fuels in Mexico, which makes them an important source of income for the government. In the case of some fuels, prices in the northern and southern border regions differ from prices in the rest of the country (e.g. 86 octane gasoline). That policy is designed to prevent Mexican nationals from crossing into the U.S. or Central America in search of cheaper gasoline. Data on domestic NG stopped being reported in 1998 because private companies began its distribution at that time.

In terms of price increases (especially of gasoline), another important factor has also played a key role—the improvement of quality. In fact, there are plans regarding further improvements in order to comply with national and international regulations and market demands.

Indicator construction and limitations: Complications regarding data management for this indicator include: changes in price calculation methodologies for some fuels (e.g., LPG); privatization in distribution (i.e., domestic NG); improvement/changes in fuel quality, such as the disappearance of leaded gasoline; initiation of production and distribution in 1996 of high octane gasoline; and differentiated prices in border zones vs. rest of the country.

6.6.2.2. INDICATOR 11

Energy mix

Definition: The structure of energy supply in terms of shares of energy sources in final energy consumption, primary energy supply, and electricity generation.

Purpose: This indicator measures the structure of energy consumption, the proportion of energy mix between fossil fuels, renewables, and nuclear energy sources. Regarding the economic dimension, energy supply mix is a key determinant of energy security. This implies that the "right energy mix" relies on a well-diversified portfolio of domestic, or imported, or regionally traded fuels and sources of energy. Also, the energy supply mix has a major effect on environmental performance because the environmental impact of each energy source differs greatly.

TABLE 6.9 ENERGY CONSUMPTION BY SECTORS (PJ) 1965-2002

Year	Agriculture	Transportation	Residential, Commercial and Public	Industrial	Energy sector
1965	41.27	275.11	302.89	326.36	401.27
1966	42.97	297.43	312.97	360.82	433.86
1967	43.88	323.85	320.13	390.55	400.14
1968	45.93	356.54	331.02	410.63	453.00
1969	47.28	381.94	339.10	456.58	555.83
1970	48.67	409.75	351.02	475.23	514.35
1971	47.91	431.86	358.49	486.78	532.90
1972	51.61	480.96	373.87	526.49	635.28

1973	53.94	525.15	389.29	566.18	751.16
1974	61.58	576.76	396.79	618.90	767.27
1975	70.08	613.59	430.99	661.15	747.15
1976	73.11	669.57	448.39	711.61	782.19
1977	76.39	711.28	455.65	712.03	923.14
1978	81.38	773.47	475.81	816.84	1,039.80
1979	88.27	876.03	495.37	874.41	1,194.28
1980	95.80	981.51	542.73	890.00	1,447.07
1981	98.40	1,091.16	560.37	982.23	1,459.89
1982	104.70	1,085.71	593.58	1,025.73	1,719.99
1983	90.46	975.23	588.07	1,074.61	1,510.85
1984	90.06	1,029.30	604.29	1,036.27	1,512.33
1985	92.38	1,040.42	622.11	1,089.83	1,498.19
1986	91.8	1,033.92	624.34	989.85	1,475.37
1987	98.33	1,059.71	643.08	1,068.22	1,551.95
1988	102.79	1,072.33	651.81	1,021.22	1,607.85
1989	96.21	1,183.66	665.05	1,031.13	1,740.70
1990	92.58	1,275.31	702.60	1,100.46	1,626.04
1991	93.87	1,360.49	726.10	1,120.66	1,670.45
1992	91.21	1,372.60	769.45	1,117.07	1,671.97
1993	92.56	1,403.33	795.89	1,139.23	1,644.71
1994	91.05	1,471.73	823.03	1,203.92	1,669.17
1995	93.54	1,399.08	816.35	1,255.45	1,647.24
1996	101.4	1,418.83	838.02	1,282.54	1,869.69
1997	106.92	1,478.14	841.22	1,288.47	1,987.51
1998	106.56	1,527.26	869.44	1,320.65	2,034.83
1999	116.88	1,548.04	803.30	1,242.10	2,206.86
2000	115.52	1,614.33	833.58	1,274.03	2,359.14
2001	110.33	1,611.12	838.63	1,206.46	2, 978.60
2002	106.41	1,634.32	850.00	1,238.16	2,225.75

TABLE 6.10 FUEL CONSUMPTION FOR ELECTRICITY GENERATION (PJ)

Year	Natural gas	Heavy fuel oil	Diesel	Coal
1965	48.53	31.09	3.95	0.16
1966	48.95	31.17	4.41	0.18
1967	52.28	37.34	4.12	0.62
1968	52.81	49.92	3.99	1.50
1969	58.87	61.63	8.47	1.98
1970	58.52	80.71	10.37	2.21
1971	69.67	107.98	7.82	1.63
1972	66.70	130.51	11.77	2.27
1973	67.27	147.75	17.76	2.10
1974	62.62	176.32	27.09	2.27
1975	88.34	192.77	49.81	1.98
1976	71.87	227.42	44.97	2.21
1977	69.10	254.56	35.10	2.21
1978	91.42	301.97	46.56	0.00
1979	128.01	297.36	47.18	0.00
1980	118.80	363.80	45.83	0.00
1981	107.36	355.46	44.24	0.15
1982	118.25	407.03	33.36	11.96

1983	97.45	463.33	12.62	23.86
1984	78.14	497.96	16.27	30.90
1985	81.93	515.96	10.69	37.29
1986	106.68	551.53	8.94	61.50
1987	115.11	604.47	13.17	70.42
1988	107.07	634.67	7.67	77.15
1989	113.04	668.21	12.02	78.13
1990	143.70	659.38	15.61	76.05
1991	168.89	665.75	17.20	78.47
1992	156.62	656.44	12.31	81.39
1993	153.37	665.61	11.73	103.30
1994	180.06	794.10	13.30	128.26
1995	185.38	696.54	10.45	140.12
1996	191.37	718.91	9.53	170.54
1997	207.93	823.13	13.27	171.55
1998	246.21	903.74	19.36	176.11
1999	272.97	887.53	17.54	178.69
2000	333.38	954.59	25.15	183.06
2001	400.38	915.19	18.57	226.99
2002	529.03	787.56	15.18	264.10
2003	611.66	677.95	29.59	307.98

Source: SENER. 2003. National Energy Balance.

TABLE 6.11 PRIMARY ENERGY SUPPLY (PJ)

Year	Total	Coal	Crude oil	Condensates	Non associated gas	Associated gas	Hydro power	Geo thermal power	Nuclear	Cane bagasse	Wood	Wind
1965	1,483.98	28.88	679.53	0.12	397.16	33.35	118.97	0.0	0.0	46.46	179.51	0.0
1966	1,580.98	30.81	733.15	0.52	409.89	38.74	135.84	0.0	0.0	49.70	182.33	0.0
1967	1,635.20	37.80	799.52	0.53	364.48	45.12	144.66	0.0	0.0	57.90	185.20	0.0
1968	1,741.49	39.62	852.83	0.45	377.78	51.63	176.43	0.0	0.0	54.64	188.12	0.0
1969	1,895.21	40.17	895.90	0.86	468.10	61.77	178.44	0.0	0.0	58.88	191.10	0.0
1970	1,965.55	45.05	945.05	0.25	453.65	71.75	200.23	0.0	0.0	55.45	194.12	0.0
1971	1,947.75	56.55	941.52	0.15	480.99	26.21	187.82	0.0	0.0	57.73	196.78	0.0
1972	2,099.28	62.50	1,040.03	0.17	447.23	95.71	197.74	0.0	0.0	56.40	199.49	0.0
1973	2,275.88	67.01	1,139.01	0.12	457.39	130.99	209.82	2.10	0.0	67.21	202.23	0.0
1974	2,438.22	74.03	1,261.45	0.12	448.31	161.84	212.69	5.93	0.0	68.82	205.03	0.0
1975	2,523.89	85.03	1,307.50	0.22	412.42	242.06	197.23	6.80	0.0	64.78	207.87	0.0
1976	2,693.20	65.25	1,482.49	0.15	374.55	271.09	219.54	7.44	0.0	61.94	210.76	0.0
1977	2,983.85	93.85	1,693.59	0.46	305.29	371.83	234.37	7.29	0.0	63.47	213.70	0.0
1978	3,283.84	97.85	1,843.54	5.45	335.39	509.56	194.65	7.25	0.0	73.47	216.69	0.0
1979	3,678.77	96.13	1,983.18	15.56	254.12	803.28	214.98	12.28	0.0	79.51	219.73	0.0
1980	4,331.57	97.34	2,425.76	0.60	349.27	948.71	200.07	10.94	0.0	76.06	222.83	0.0
1981	4,691.29	86.04	2,598.56	1.34	370.98	1,037.19	291.95	11.51	0.0	69.87	223.84	0.0
1982	4,912.81	103.04	2,565.69	30.05	345.83	1,290.17	263.60	15.03	0.0	74.54	224.87	0.0
1983	4,768.35	117.30	2,410.28	74.71	308.21	1,304.89	232.41	15.28	0.0	79.36	225.91	0.0
1984	4,869.25	117.64	2,570.69	167.63	263.22	1,155.68	267.49	16.25	0.0	83.70	226.95	0.0
1985	4,936.28	127.52	2,631.56	172.21	208.98	1,173.52	292.40	18.39	0.0	83.70	228.01	0.0
1986	4,714.67	140.61	2,502.37	155.37	197.04	1,139.03	219.06	37.41	0.0	94.71	229.08	0.0
1987	4,889.13	135.98	2,660.64	160.07	184.97	1,175.14	198.36	48.15	0.0	95.64	230.17	0.0
1988	4,945.31	128.70	2,664.62	177.05	174.94	1,208.15	224.60	50.38	0.0	85.61	231.26	0.0
1989	5,100.83	142.46	2,725.87	179.38	188.44	1,236.31	260.79	50.38	3.94	80.90	232.37	0.0
1990	5,122.98	141.27	2,758.32	141.64	243.68	1,187.56	251.80	55.30	31.05	78.88	233.49	0.0

1991	5,214.46	136.64	2,850.56	188.31	232.10	1,147.83	232.72	58.19	45.93	86.73	235.46	0.0
1992	5,193.73	138.18	2,822.02	185.80	219.16	1,131.50	275.80	61.34	41.86	80.61	237.46	0.0
1993	5,349.40	155.85	2,906.86	139.86	188.27	1,241.72	274.17	61.42	53.07	88.69	239.49	0.0
1994	5,382.12	188.35	2,946.91	140.79	202.53	1,273.86	208.51	58.22	47.78	73.60	241.54	0.04
1995	5,308.08	209.73	2,764.81	148.02	217.44	1,202.66	283.87	58.46	92.99	86.43	243.61	0.06
1996	5,544.10	240.48	2,756.98	148.26	285.86	1,314.97	322.32	58.73	85.58	85.82	245.07	0.05
1997	5,532.40	240.71	2,765.51	148.31	281.18	1,315.95	271.15	56.08	112.50	94.44	246.54	0.04
1998	5,600.40	246.05	2,852.71	145.91	362.86	1,235.05	252.96	58.13	100.47	98.19	248.02	0.05
1999	5,765.72	250.37	2,863.99	124.87	422.17	1,259.20	336.15	57.78	108.26	90.98	251.90	0.06
2000	5,663.87	257.58	2,829.35	130.70	434.80	1,176.99	342.07	61.03	90.33	87.08	253.87	0.08
2001	5,691.78	293.94	2,869.87	137.65	430.62	1,168.56	291.82	57.13	96.70	91.98	253.44	0.07
2002	5,647.00	316.28	2,842.74	121.02	445.65	1,156.21	259.05	56.25	106.97	87.68	255.09	0.07

Source: SENER, 2003, National Energy Balance

Trends: Total energy consumption has increased 4.5 times in the 1965-2002 period, with the Energy Sector (oil and electricity) assuming the largest share, followed by the Transport Sector and the Industrial Sector (including manufacturing). All sectors have shown dramatic increases in the period considered.

In terms of primary energy supply, crude oil is by far the highest source of energy, even though many other sources of energy are supplied. It is important to note that in the period considered, associated gas showed the highest increase. This is due to the fact that PEMEX, recognizing its value for productive uses, stopped flaring it in oil fields. Hydropower refers mainly to large hydro, even though large potentials for mini hydropower have been estimated by CONAE in several states of the country, such as Puebla and Veracruz. Other sources of renewable energy such as wind are still marginal, thus further efforts must be made in order to comply with what has been proposed in the energy sector forecast.

In terms of energy consumption for electricity generation, various sources of energy are used, the two most important being heavy fuel oil and natural gas. As can be observed, natural gas used in combined cycle power plants is continuing to grow, even though Mexico is not self-sufficient in this fuel. Heavy fuel oil use for this purpose is decreasing, even though oil extracted in Mexico presents a higher amount of heavy fractions. Other alternatives such as efficient emission control equipment should be contemplated, in order to use what is being produced in the country. Further exploration and production of NG is required.

Indicator construction and limitations: Data generated by SENER is readily available so construction of this indicator presented no difficulties. Fuelwood data still needs to be accounted for.

6.6.2.3. INDICATOR 15

Expenditure on energy sector

Definition: Expenditure on energy sector refers to economic resources spent by public sector and industry in forms of investments and current expenditures to secure national energy supply in an environmentally benign manner.

Purpose: The indicator provides an indication of a level of the efforts undertaken by a country to secure national energy supply. Alternatively, it can be interpreted as a measure of the economic cost or financial overburden imposed by a society to match its energy demand in short and long terms.

TABLE 6.12 FEDERAL PUBLIC INVESTMENT TOTAL DISCHARGED, ON ENERGY SECTOR AND OIL AND ELECTRICITY INDUSTRIES 1997 - 2002 (MILLIONS OF PESOS)

Year	Total (1)	Energy sector (2)	Oil industry (3)	Oil Share in total %	Oil Share in energy sector %	Electricity industry	Share of electricity in total %	Share of electricity in energy sector %
1997	102,445	42,280	28,675	28.0	67.8	13,605	13.3	32.2

1998	106,870	46,317	30,561	28.6	66.0	15,755	14.7	34.0
1999	118,916	43,332	25,136	21.1	58.0	18,196	15.3	42.0
2000	142,721	51,707	31,304	21.9	60.5	20,403	14.3	39.5
2001	144.548	49,208	31,389	21.7	63.8	17,819	12.3	36.2
2002	152,616	56,353	32,739	21.5	58.1	23,614	15.5	41.9

Source: SHCP.Cuenta de la Hacienda Pública Federal, 1997-2002. México

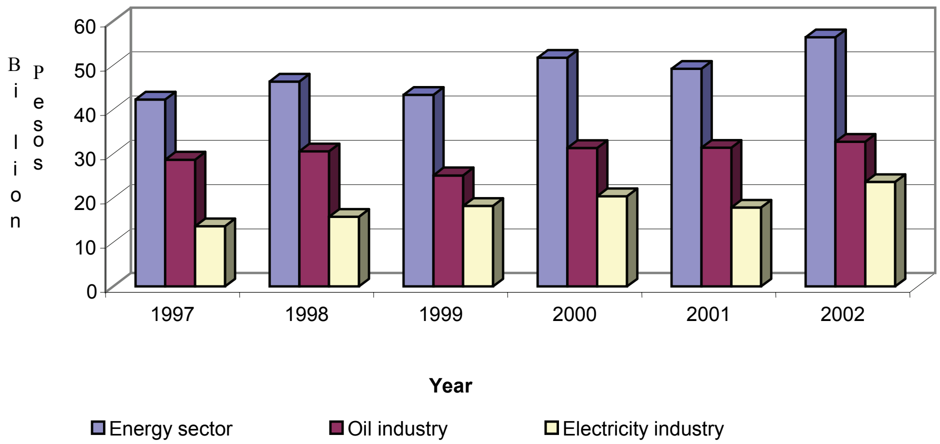

Figure 6.6 Investments in energy sector and oil and electricity industries, 1997 - 2002

TABLE 6.13 EXPENDITURE: SAFETY AND ENVIRONMENTAL PROTECTION, 1999-2003 (MILLION PESOS)

Year	Operation				Investment			
	Industrial safety	Environmental protection	Clean products	Total	Industrial safety	Environmental protection	Clean products	Total
1999	3,379	2,062	102	5,543	2,671	2,520	104	5,295
2000	3,689	1,421	75	5,185	5,406	6,525	92	12,023
2001	5,232	2,598	19	7,849	4,942	5,200	201	10,343
2002	6,330	3,433	507	10,270	4,327	2,907	228	7,462
2003	7,120	3,634	1,464	12,218	3,263	2,732	353	6,348
Total	25,750	13,148	2,167	41,065	20,609	19,884	978	41,471

Note: These allotted values include both direct and indirect expenses.
Source: PEMEX. Informe de Gastos en Seguridad y Protección Ambiental, años 1999-2003

TABLE 6.14 ENVIRONMENTAL PROTECTION EXPENDITURE AND GDP, 1997-2002 (MILLION PESOS)

Year	GDP	Oil			Electricity, Gas and Water	
		GDP (Oil sector)	Current expenditure	Fixed expenditure	Current expenditure	Fixed expenditure
1997	3,174,275	25,956	2,318	330	147	9
1998	3,846,350	28,624	2,900	210	163	916
1999	4,593,685	39,902	2,719	2,298	64	827
2000	5,490,757	48,162	1,528	5,053	64	1,941
2001	5,811,346	51,638	2,810	4,432	78	1,237
2002	6,256,382	55,619	4,033	2,907	131	1,364

Note: Expenditures carried out by the Federal Government and Federal District, as well as companies of direct control.
Source: INEGI. Sistema de Cuentas Económicas y Ecológicas de México 1997-2002, México, 2004

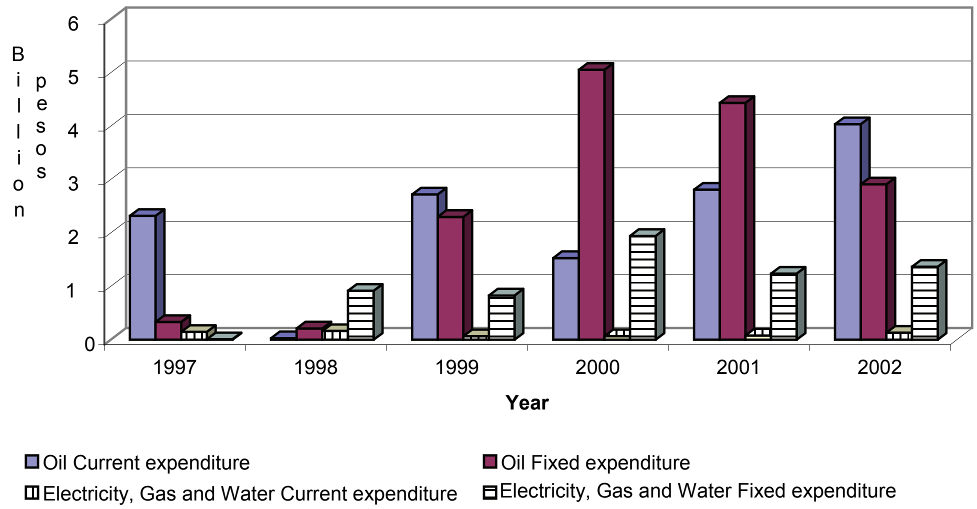

Figure 6.7 Environmental Protection Expenditure

Trends: The Energy Sector Program 2001-2006 has the strategic objective—in addition to guaranteeing energy in a timely manner and of high quality—of being a sector leader in the protection of the environment.

The environmental politics of the sector has direct implications for the quality of the air, on a local, regional and global basis. Additionally, companies in the sector carry out actions with regards to water and soil, the handling of dangerous residuals, and protection of biodiversity.

Environmental management carried out by companies in the sector has two main objectives: to minimize the impacts generated by the companies, and to prevent new impacts.

Since 1993 Petróleos Mexicanos has been carrying out environmental audits whose main objective is to ensure the execution of environmental legislation. In 1997 it developed a system to quantify the costs from the relative activities of industrial safety, environmental protection and clean products.

Indicator construction and limitations: Data availability is scarce and dispersed. Companies in the sector are working on the implementation of their environmental management systems, and three of the main ones (Pemex, CFE and LyFC) undertook environmental administrative activities beginning in the mid-1990s. However, obtaining figures related to expenses made in investment for safety and environmental protection is complicated. Adequate statistics concerning economic resources and work guided towards protection of the environment within the energy sector are still lacking.

6.6.2.4. INDICATOR 17

Indigenous energy production and electricity generation

Definition: Amount of indigenous primary energy produced nationally in a given year in total and by fuel types, such as: coal, oil, natural gas, nuclear, hydro, all converted into oil equivalent, and combustible renewables & waste (CWR) all converted into oil equivalent; and amount of total electricity produced domestically from all primary energy sources.

Purpose: The indicator is a widely used measure of extent to which indigenous energy production is economically and environmentally competitive with imported energy in an increasingly global energy market.

TABLE 6.15 GROSS INDIGENOUS ENERGY PRODUCTION (PJ) 1965-2002

Year	Coal	Crude oil	Condensates	Non Associated gas	Associated gas	Hydro	Geothermal	Nuclear	Cane bagasse	Wood	Wind
1965	24.684	710.48	0.119	422.783	88.879	118.967	0	0	48.647	179.509	0
1966	25.388	729.221	0.521	442.249	108.458	135.841	0	0	51.763	182.329	0
1967	29.091	800.441	0.533	462.94	135.43	144.662	0	0	59.758	185.199	0
1968	31.259	855.295	0.449	473.649	127.92	176.429	0	0	56.444	188.12	0
1969	33.689	899.066	0.863	494.34	141.463	178.439	0	0	60.951	191.095	0
1970	41.195	948.255	0.247	529.79	165.925	200.226	0	0	57.528	194.123	0
1971	47.952	939.355	0.147	531.049	139.172	187.823	0	0	59.444	196.783	0
1972	49.897	976.867	0.167	469.813	233.262	197.739	0	0	58.15	199.486	0
1973	58.318	996.977	0.123	479.459	241.182	209.819	2.101	0	69.115	202.234	0
1974	70.401	1,261.04	0.123	468.848	332.02	212.693	5.932	0	70.287	205.028	0
1975	69.832	1,550.93	0.215	430.01	424.629	197.227	6.804	0	66.179	207.87	0
1976	59.379	1,749.68	0.151	389.774	453.139	219.538	7.439	0	63.382	210.76	0
1977	70.282	2,132.51	0.457	317.302	507.253	234.368	7.289	0	64.865	213.7	0
1978	72.131	2,629.071	5.449	348.122	691.292	194.645	7.245	0	74.987	216.69	0
1979	73.074	3,168.128	15.564	263.633	940.952	214.975	12.28	0	81.179	219.733	0
1980	72.235	4,301.425	0.601	361.027	1,110.096	200.074	10.936	0	77.833	222.829	0
1981	71.145	5,129.298	1.336	382.653	1,309.184	291.953	11.513	0	71.236	223.844	0
1982	85.547	6,065.357	30.051	348.238	1,602.11	263.598	15.03	0	75.991	224.869	0
1983	108.636	5,871.447	74.714	310.614	1,511.992	232.411	15.277	0	80.886	225.906	0
1984	118.361	5,938.347	181.006	265.487	1,286.553	267.491	16.245	0	85.339	226.954	0
1985	121.44	5,793.614	185.421	211.158	1,269.367	292.395	18.393	0	85.264	228.013	0
1986	131.527	5,371.927	167.288	199.028	1,211.217	219.06	37.407	0	96.463	229.083	0
1987	145.985	5,651.436	172.121	186.842	1,253.831	198.362	48.152	0	97.429	230.166	0
1988	130.337	5,592.41	182.892	176.71	1,253.28	224.6	50.383	0	87.153	231.26	0
1989	140.023	5,594.783	185.954	190.343	1,272.279	260.786	50.379	3.936	82.33	232.367	0

1990	141.757	5,573.458	227.789	244.152	1,232.918	251.804	55.297	31.054	80.259	233.486	0
1991	128.723	5,854.583	256.98	233.201	1,188.458	232.717	58.187	45.925	88.229	235.463	0
1992	119.562	5,844.317	268.22	220.559	1,176.727	275.798	61.342	41.855	81.991	237.463	0
1993	129.415	5,861.197	151.585	190.045	1,302.149	274.165	61.417	53.072	90.174	239.487	0
1994	175	5,755.278	141.47	203.475	1,333.956	208.505	58.221	47.781	74.826	241.536	0.042
1995	172.707	5,554.085	148.713	238.07	1,275.606	283.872	58.459	92.986	87.858	243.609	0.062
1996	191.191	6,079.177	148.4	286.903	1,432.514	322.316	58.729	85.581	87.211	245.068	0.051
1997	189.709	6,463.785	148.303	281.251	1,489.9	271.153	56.075	112.495	95.971	246.538	0.041
1998	199.411	6,562.912	145.902	362.929	1,490.161	252.956	58.132	100.471	99.277	248.021	0.051
1999	203.846	6,351.474	124.917	422.171	1,456.595	336.146	57.778	108.26	91.979	251.898	0.062
2000	226.702	6,619.787	130.705	434.83	1,371.203	342.066	61.03	90.331	88.037	253.868	0.083
2001	223.201	6,811.686	137.659	430.619	1,317.402	291.822	57.132	96.699	92.996	253.444	0.071
2002	220.268	6,798.976	121.988	445.646	1,271.959	259.054	56.246	106.972	88.646	255.087	0.072

Source: SENER. 2003. National Energy Balance

TABLE 6.16 NATIONAL GROSS ELECTRIC GENERATION (GWH) 1980-2003

Year	Total	Private and mix production	Geo-thermal	Coal	Nuclear	Wind	Hydroelectric	Dual	Internal combustion	Combined Cycle	Vapor	Turbogas
1980	66,956	5,088	915				16,740		310	3,267	37,012	3,624
1981	73,490	5,611	964	33			24,446		251	3,456	35,527	3,202
1982	80,578	7,353	1,296	1,278			22,729		187	5,272	40,025	2,438
1983	82,272	7,441	1,353	2,424			20,583		107	4,281	44,822	1,261
1984	86,971	7,464	1,424	3,132			23,448		100	4,122	46,342	939
1985	93,404	8,052	1,641	3,852			26,087		43	4,554	48,322	853
1986	97,241	7,858	3,394	6,337			19,876		63	5,866	53,247	600
1987	104,002	7,692	4,418	7,289			18,200		63	7,440	58,298	602
1988	109,862	7,957	4,661	8,035			20,778		73	7,046	60,838	474
1989	117,744	7,643	4,675	7,890	372		24,200		98	7,150	65,087	629
1990	122,757	8,432	5,124	7,774	2,937		23,338		80	7,487	66,916	669
1991	126,962	8,550	5,435	8,077	4,242		21,737		186	7,748	70,328	659
1992	130,342	8,586	5,804	8,318	3,919		26,095	59	237	7,214	69,829	281
1993	135,316	8,750	5,877	10,500	4,931		26,235	2,148	277	7,981	68,339	277
1994	146,722	9,200	5,598	13,037	4,239	4	20,048	7,770	249	9,099	77,023	456
1995	150,638	8,294	5,669	14,479	8,443	6	27,528	6,053	455	10,399	68,948	364
1996	160,494	8,605	5,729	17,735	7,878	5	31,442	2,775	419	10,661	74,805	440
1997	170,519	9,134	5,466	17,575	10,456	4	26,430	7,001	460	11,233	82,102	657
1998	180,491	9,509	5,657	17,956	9,265	5	24,616	12,692	314	13,184	86,206	1,088
1999	192,234	11,317	5,623	18,251	10,002	6	32,714	11,234	382	15,526	85,104	2,077
2000	205,631	12,910	5,901	18,696	8,221	8	33,075	13,569	419	17,712	89,891	5,229
2001		ND	5,567	18,567	8,726	6.51	28,465	14,109	466	25,377	90,395	5,457
2002		ND	5,398	16,152	9,747	6.67	24,862	13,879	555	44,765	79,300	6,395
2003		ND	6,282	16,681	10,502	5.37	19,753	13,859	755	55,047	73,743	6,929

Source: SENER,2003, Statistical Summary of the Energy Sector

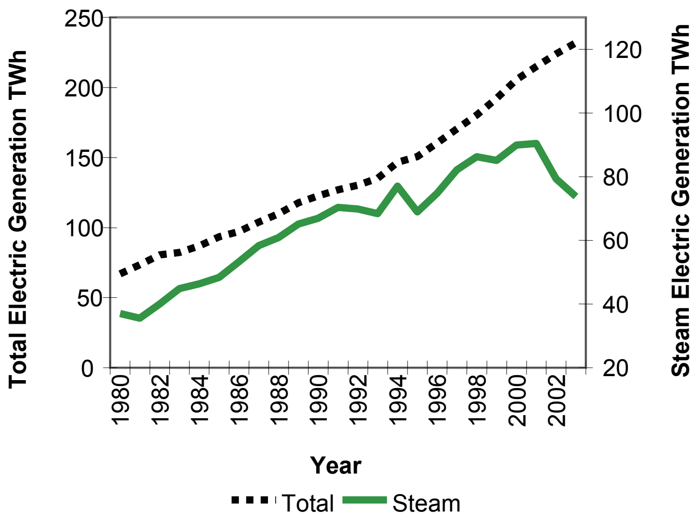

Figure 6.8 National Gross Electric Generation 1980-2002

Trends: Gross indigenous energy production has increased 6 times in the 1965-2002 period, hydrocarbons representing the main source of production contributing 89.7% of the total in 2002.

Electricity generation has gone from 66,956 GWh in 1980 to 205,631 GWh in 2000, which represents a three-fold increase, with thermal representing 40% of the total. Other significant technologies for electricity generation are coal-based, hydroelectric and combined-cycle. Nuclear technology's contribution will not change since there is only one nuclear plant in Mexico and there are no further expansions being considered. For the year 2000, geothermal electricity represents 3% of total generation. Mexico is the third largest geothermal producer of electricity, after the U.S. and the Philippines. Renewable sources of energy (i.e., principally hydro and geothermal) represented 19% of total generation in 2000, which is a significant contribution. Other sources such as biogas, wind and mini hydro, need further encouragement in order to promote more energy diversification and security, reduce pollutant emissions, and promote local development (among others).

Indicator construction and limitations: Data generated by SENER are readily available, so construction of this indicator presented no difficulties.

6.6.2.5. INDICATOR 18

Energy net import dependency (%) or net energy imports and exports

Definition: The ratio of net import (imports minus exports) to consumption of primary energy in a given year in total and by fuel types such as: oil & petroleum products, gas, coal; and electricity in particular. The indicator can also be represented in terms of net energy imports and exports.

Purpose: This indicator measures the extent to which a country relies on imports to meet its energy needs. Mexico is a major exporter of crude oil but several petroleum products including natural gas, gasoline, LPG, etc., are important.

TABLE 6.17 ENERGY NET IMPORTS AND EXPORTS (PJ) 1965-2002

Year	Coal	Crude oil	NG	LPG	Gasoline	Diesel	Heavy fuel oil	Gross Electr. generation
1965	6.348	-4.070	-9.133	NA	NA	NA	NA	NA
1966	7.098	0	-8.036	NA	NA	NA	NA	NA
1967	5.947	0	-7.806	NA	NA	NA	NA	NA
1968	6.513	0	-7.057	NA	NA	NA	NA	NA
1969	9.600	0	-6.598	NA	NA	NA	NA	NA
1970	10.746	0	-5.500	NA	NA	NA	NA	NA
1971	15.801	0	-3.001	NA	NA	NA	NA	NA
1972	22.057	0	-1.383	NA	NA	NA	NA	NA
1973	11.758	0	-0.280	NA	NA	NA	NA	NA
1974	15.057	-2.766	-0.052	NA	NA	NA	NA	NA
1975	23.409	-13.146	0	NA	NA	NA	NA	NA
1976	4.448	-11.761	0	NA	NA	NA	NA	NA
1977	25.823	-20.598	-0.286	NA	NA	NA	NA	NA
1978	22.746	-30.191	0.000	NA	NA	NA	NA	NA
1979	29.251	-36.466	0.000	NA	NA	NA	NA	NA
1980	32.768	-42.763	-6.885	NA	NA	NA	NA	0.092
1981	27.534	-47.489	-6.126	NA	NA	NA	NA	0.046
1982	21.727	-54.329	-4.939	NA	NA	NA	NA	0.001
1983	7.382	-57.662	-4.200	6.709	-6.749	-10.922	-8.610	-0.009
1984	5.683	-56.793	-3.317	18.413	-11.058	-4.638	-13.373	-0.010
1985	13.976	-54.527	0.100	20.182	-7.793	-6.103	-14.456	-0.010
1986	5.316	-53.121	0.130	13.398	-6.996	-10.259	-3.062	-0.140
1987	-0.569	-52.943	0.142	8.344	-4.413	-4.708	2.834	-0.185
1988	0.372	-52.129	0.156	8.886	-6.107	-3.644	4.252	-0.166
1989	-0.225	-50.837	1.102	9.312	6.609	-4.897	10.454	-0.112
1990	3.763	-50.121	1.047	8.550	7.064	-12.045	10.140	-0.112
1991	0.547	-51.150	4.115	8.339	15.765	-8.206	9.382	-0.110
1992	15.257	-51.272	6.519	12.181	18.090	-13.569	7.566	-0.081
1993	1.749	-50.015	2.236	11.870	14.673	-16.429	3.267	-0.082
1994	4.769	-48.676	2.377	11.974	9.941	-7.150	18.459	-0.057
1995	19.650	-49.862	3.455	14.499	11.236	-6.069	3.819	-0.052
1996	20.454	-54.011	0.933	21.621	9.481	-2.134	9.540	0.006
1997	28.216	-56.942	1.373	34.193	15.372	3.010	18.784	0.086
1998	28.566	-56.709	2.154	35.026	15.443	3.877	20.137	0.079
1999	29.436	-53.457	0.557	40.404	8.084	6.791	10.384	0.027
2000	28.581	-54.852	5.082	52.801	5.304	8.750	22.637	0.043
2001	39.089	-54.693	7.144	42.772	16.416	-1.094	17.338	0.003
2002	69.573	-52.389	13.694	42.715	6.089	3.354	-8.211	ND

Source. SENER. 2003. National Energy Balance

Trends: Mexico exports more than 50% of its crude production, and it is self-sufficient in terms of electricity. Import dependence on coal, LPG, NG, and gasoline has grown in recent years. This is due to lack of investment in the sector, as mentioned before; even though there are significant gas and oil reserves, the necessary infrastructure to process them does not exist. Demand for gas both by the electric sector and the private sector has increased significantly in recent years.

Indicator construction and limitations: Data generated by SENER are readily available so construction of this indicator presented no difficulties.

6.6.2.6. INDICATOR 22

Fraction of households heavily dependent on non commercial energy and without electricity (%)

Definition: Proportions of households with lack of access to commercial energy sources, in particular to electricity, and heavily dependent on "traditional" non-commercial energy sources, such as fuel-wood, crop wastes and animal dung.

Purpose: To monitor progress in the access of the population to commercial fuel and electricity as an important prerogative for alleviating poverty.

TABLE 6.18 SHARES OF HOUSEHOLDS DEPENDING ON TRADITIONAL ENERGY AND WITHOUT ELECTRICITY 1960-2000 (%)

Year	Without electricity	Dependent on non commercial energy	Non commercial energy and without electricity
1960	65.70	64.20	NA
1970	41.10	44.20	NA
1980	21.80	28.60	NA
1990	12.40	21.10	9
2000	4.50	17.10	3.5

NA. Not available.
Source: VIII, IX, X, XI, y XII Censo General de Población y Vivienda 1960, 1970, 1980, 1990, 2000. México 1962, 1972, 1986, 1991, 2001.

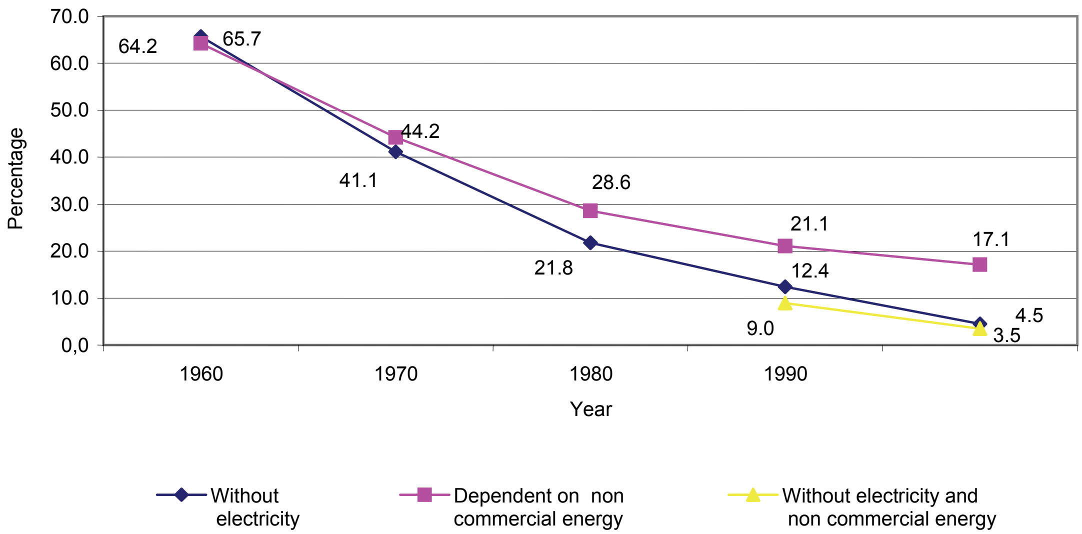

Figure 6.9 Households dependent on traditional energy and without electricity 1960-2000

Trends: In 1960, 65.7% of households, belonging mostly to the rural sector, didn't have electric power, a proportion that decreased to 4.5% in 2000. This is a result of the adoption of a governmental policy of electrification of the country.

It is equally important (although not in the same proportion as the case for electricity) that there was a decrease in the proportion of households dependent on non-commercial fuels (e.g., fuelwood, charcoal), from 64.2% to 17.1%.

The proportion of households without electricity access and that use non-commercial energy decreased significantly.

These tendencies reflect in general a modification in consumption patterns, which benefits the population and is a less degradable use of forest resources.

Since 2000, resources allotted to electrification, previously managed by the Federal Commission of Electricity, have been transferred directly to municipalities to be managed in development programs they considere appropriate. The results of this program remain to be seen.

It is expected that in upcoming years, as public and private companies coexist in the electric sector operating inside an appropriate regulatory framework, electricity coverage to the population will increase, with better conditions of quality and price. In this context, the federal government is aware that 5% of the population, for the most part indigenous and rural, still lives without access to electrical services.

A goal for the 2001-2006 period is to reach 97% of total national coverage for electricity. Electric generation from renewable sources (i.e., photovoltaic systems, wind, mini-hydro and biomass) will also be promoted in those isolated communities.

Indicator construction and limitations: Households that use electricity and consume coal and wood for cooking have been excluded from the analysis; thus, to know the real consumption of such non-commercial energies, 17% of the country's total households should be considered in addition to that included in the indicator. To be more precise, the Census of Population and Housing inquires into the type of fuel for cooking, with wood and coal being the only two non-commercial energy options specified there.

For some censuses, one obstacle is that the information was not at the household level, and therefore refers to the general population. Also, the 1960 data are estimated.

6.6.2.7. INDICATOR 36

Proven recoverable fossil fuel reserves (Million metric tonnes for coal and oil; billion cubic m for natural gas)

Definition: Proven recoverable fossil fuel reserves are generally defined as those quantities which geologic and engineering information indicate can be recovered with reasonable certainty in the future from known energy resources under existing economic and technical conditions. The indicator consists of such fossil fuels as: oil, natural gas, and coal.

Purpose: The purpose of the indicator is to measure availability of various fossil fuel energy resources.

TABLE 6.19 PROVEN FOSSIL FUEL RESERVES 1980-2003

Year	Total (Mbl) a/	Crude oil (Mbl) b/	Condensates (Mbl) c/	Dry gas crude equivalent (Mbl) b/
1980	45,803	30,616	2,944	12,243
1981	60,126	44,161	3,063	12,902
1982	72,008	48,084	8,914	15,010
1983	72,008	48,084	8,914	15,010
1984	72,500	49,911	7,185	15,404
1985	71,750	49,260	7,150	15,340
1986	70,900	48,612	6,981	15,307
1987	70,000	48,041	6,839	15,120
1988	69,000	47,176	6,934	14,890
1989	67,600	46,191	6,821	14,588
1990	66,450	45,250	6,733	14,467
1991	65,000	44,292	6,633	14,075
1992	65,050	44,439	6,786	13,825
1993	64,516	44,043	6,733	13,740
1994	63,220	43,127	6,648	13,445
1995	62,058	42,146	6,650	13,262
1996	60,900	42,072	6,400	12,428
1997	60,160	41,392	6,430	12,338
1998	57,741	41,064	5,875	10,803
1999	58,204	41,495	6,036	10,673
2000	56,154	39,918	5,574	10,662
2001	52,951	38,286	4,927	9,738
2002	50,032	36,266	4,384	9,382
2003	48,041	34,389	4,229	9,423

a/ Information from the beginning of each year. Includes condensate and raw natural gas. Staring on 1 Jan. 1995, reserves are expressed according to definitions, methods and procedures accepted by international oil companies and include proven, probable and possible reserves; therefore, starting in that year data cannot be compared to prior information.
b/ For 2002 data are estimates based on real data up to September.
c/ Includes liquids from processing plants.
Source. SENER. 2003. Statistical compendium of the Energy Sector.

Trends: It is not possible to interpret trends for the overall 1980-2003 period. For the time period starting in 1995, a decreasing trend is observed in the proven fossil fuel reserves. Nevertheless reserves are still sufficient for at least two decades.

Indicator construction and limitations: Changes in ways for estimating reserves make it difficult to compare numbers.

6.6.2.8. INDICATOR 37

Lifetime of proven fossil fuel reserves (Years)

Definition: Lifetime of proven energy reserves, known as the production life index, is the ratio of energy reserves remaining at the end of any year to the production of energy in that year.

Purpose: This indicator provides an indication of the length of time that proven reserves would last if production were to continue at current levels.

TABLE 6.20 LIFETIME OF PROVEN FOSSIL FUEL RESERVES (NG AND PETROLEUM) 1980-2003

Crude oil, condensates, Dry gas	
Year	Coefficient Reserves/ production (years) a/
1980	58
1981	59
1982	60
1983	52
1984	54
1985	54
1986	54
1987	55
1988	52
1989	54
1990	53
1991	50
1992	50
1993	49
1994	48
1995	48
1996	43
1997	39
1998	39
1999	41
2000	38
2001	35
2002	33
2003	30

a/ For 2002 data are estimates based on real data up to September.
Source. SENER. 2003. Statistical compendium of the Energy Sector.

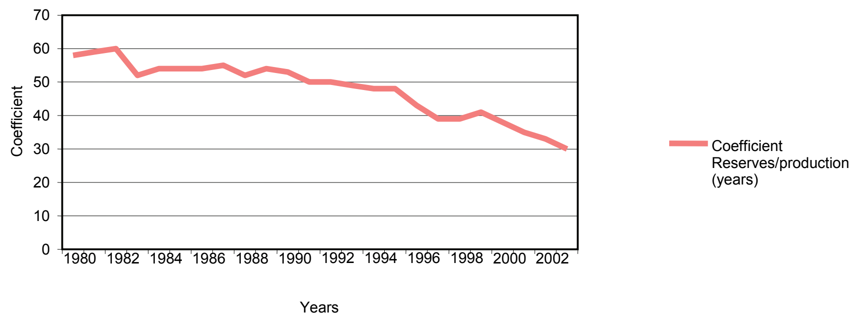

Figure 6.10 Coefficient Reserves/production 1980-2003

Trends: Proven reserves dropped 20 years from 1980 to 2002 due to a lack of investment in oil exploration. It is a result of the economic dependence of PEMEX on the national budget. This is a negative trend and needs to be reversed by adequate national energy policies.

Indicator construction and limitations: Data generated by SENER are readily available so construction of this indicator presented no difficulties. Crude oil, condensates and gas are the fuels considered in the index.

6.6.3. Energy Production and Consumption Patterns

The indicators on energy production and consumption patterns are:

- 5. Distance travelled: total and by urban transport
- 6. Freight transport activity: total, by mode
- 8. Manufacturing value added by selected energy intensive industries
- 9.1 Energy intensity in manufacturing
- 9.2 Energy intensity in agriculture
- 9.3 Energy intensity in commercial and service sector
- 9.4 Energy intensity in transportation
- 9.5 Energy intensity in the residential sector
- 14. Energy use per unit of GDP
- 16. Energy consumption per capita
- 20. Ratio of daily disposable income per capita of 20% poorest population to the prices of electricity and major household fuels, 1996-2002
- 21. Fraction of disposable income/private consumption spent on fuel and electricity
- 35. Fraction of technically exploitable capability of hydropower currently not in use
- 40. Intensity of use of forest resources as fuelwood

6.6.3.1. INDICATOR 5

Distance travelled per capita: total and by urban transport

Definition: The number of kilometres travelled per person in a given year in total and by urban transport, and in particular by electrically driven vehicles in urban public transport.

Purpose: This indicator can contribute to monitoring fuel consumption for travelling and the environmental impact of the systems for personal mobility in a particular country or area.

TABLE 6.21 DISTANCE TRAVELLED PER CAPITA: METRO, 1995-2004

Year	Distance travelled (Thousands of kilometres)		Passenger transport (Thousands of passengers)		Kilometres per year per capita	
	Metro Mexico City[a]	Metrorey Monterrey	Metro Mexico City[b]	Metrorey Monterrey	Metro Mexico City	Metrorey Monterrey
1995	1,159.0	3,065	48,456.4	36,934	23.92	82.99
1996	1,158.6	3,035	46,740.3	31,372	24.79	96.74
1997	1,172.1	2,872	44,774.6	34,606	26.18	82.99
1998	1,171.9	2,649	44,173.9	32,935	26.53	80.43
1999	1,204.0	2,640	41,864.8	36,077	28.76	73.18
2000	1,264.4	2,750	45,665.6	40,047	27.69	68.67
2000	1,312.8	2,615	47,131.8	45,456	27.85	57.53
2001	1,288.6	2,991	45,899.8	47,764	28.07	62.62
2002	1,246.6	6,985	45,237.1	51,678	27.56	135.16
2003	1,279.3	6,435	47,267.9	52,420	27.06	122.76

[a] average number of kilometres travelled daily.
[b] average number of passengers moving daily by Metro.
Source: INEGI. Banco de Información Económica (BIE), www.inegi.gob.mx.

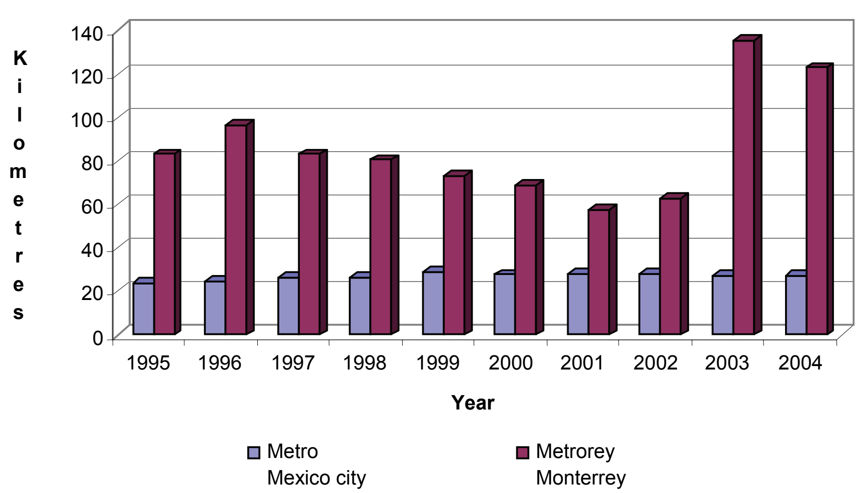

Figure 6.11 Distance travelled per capita: metro, 1995-2004

TABLE 6.22 DISTANCE TRAVELLED PER CAPITA: TROLLEYBUS, 1995-2004

Year	Distance travelled (Thousands of kilometres)		Passenger transport (Thousands of passengers)		Kilometres per year per capita	
	Trolleybus Mexico City[a]	Trolleybus Guadalajara	Trolleybus Mexico City[b]	Trolleybus Guadalajara	Trolleybus Mexico City	Trolleybus Guadalajara
1995	21,017	NA	142,589	NA	147.40	NA
1996	21,814	NA	143,932	NA	151.56	NA
1997	22,369	3,671	79,347	13,828	281.91	265.48
1998	20,252	3,609	62,528	13,288	323.89	271.60
1999	19,981	3,126	64,470	12,299	309.93	254.17
2000	22,089	3,516	81,434	12,594	271.25	279.18
2001	20,504	3,516	82,490	12,184	248.56	288.58
2002	20,465	3,516	66,380	10,380	308.30	338.73
2003	22,878	3,516	63,613	9,708	359.64	362.18
2004	23,403	3,516	68,713	7,755	340.59	453.38

Source: INEGI. Banco de Informacion Economica (BIE), www.inegi.gob.mx.

TABLE 6.23 DISTANCE TRAVELLED PER CAPITA: ELECTRIC TRAIN, 1995-2004

Year	Distance travelled (Thousands of kilometres)		Passenger transport (Thousands of passengers)		Kilometres per year capita	
	Electric train Mexico City[a]	Electric train Guadalajara	Electric train Mexico City[b]	Electric train Guadalajara	Electric train Mexico City	Electric train Guadalajara
1995	1,404	NA	25,796	NA	54.43	NA
1996	1,634	NA	32,399	NA	50.43	NA
1997	1,697	4,705	19,678	47,098	86.24	99.90
1998	1,649	4,725	15,730	48,969	104.83	96.49
1999	1,754	4,739	17,121	46,865	102.45	101.12
2000	1,732	4,757	17,877	48,488	96.88	98.11
2001	1,480	4,958	16,438	51,621	90.04	96.05
2002	1,387	5,306	15,139	51,623	91.62	102.78
2003	1,444	5,476	15,749	53,577	91.69	102.21
2004	1,506	5,372	17,498	57,036	86.07	94.19

Source: INEGI. Banco de Informacion Economica (BIE), www.inegi.gob.mx.

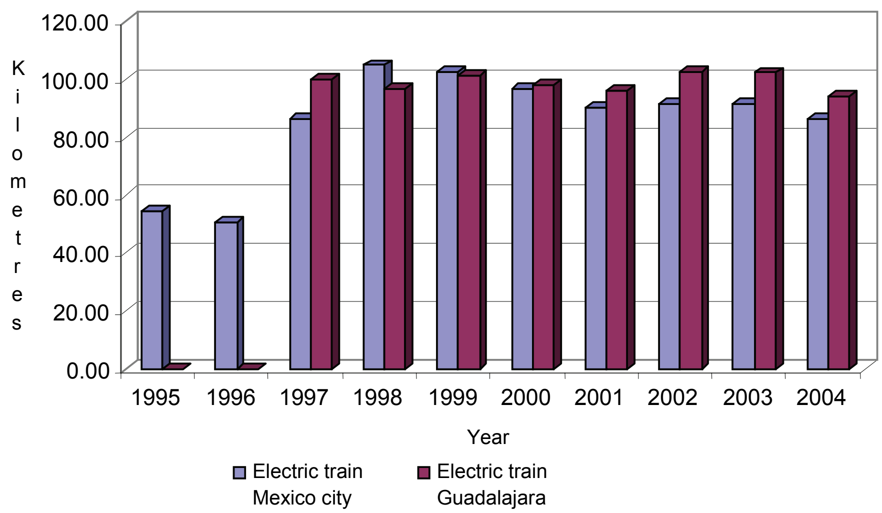

Figure 6.12 Distance travelled per capita: electrically train, 1995-2004

Trends: Electric transport systems (metro) for Mexico City and Monterrey show a sustained growth from 1994 to 2004, both in terms of the average travelled kilometres per day and the average number of passengers transported daily. In contrast, the trolleybus of Mexico City and Guadalajara present an important decrease in the number of transported passengers, and lower growth is registered for the low speed train.

Indicator construction and limitations: The information for the total urban transport does not allow for type and modal analysis in order to have an overall picture.

6.6.3.2. INDICATOR 6

Freight transport activity: total, by mode (Billion tonne-km per year for total freight activity, and percentage for share of different modes)

Definition: The indicator reflects production aspects of transportation and is defined as the number of tonnes of freight transport multiplied by the distance transported, by different modes of transport, such as truck, train, inland water, and pipelines.

Purpose: This indicator can contribute to monitoring fuel consumption for freight transport and the environmental impact of the systems for freight activity in a particular country or area.

TABLE 6.24 FREIGHT TRANSPORT ACTIVITY: TOTAL BY MODE 1995-2002

(Millions of tonnes) Transportation mode	1995	1996	1997	1998	1999	2000	2001	2002[4]
Total	606.1	650.7	613.7	694.7	702.9	734.7	727.4	734.7
Road	419.5	441.8	393.7	456.9	471.1	490.1	483.0	485.7
Road Motor Vehicles[1]	367.0	383.0	332.0	381.0	394.0	413.0	409.0	411[4]
Rail[2]	52.5	58.8	61.7	75.9	77.1	77.1	74.0	74.7[4]
Air	0.3	0.3	0.3	0.4	0.4	0.4	0.3[5]	0.3[5]
Maritime[3]	186.3	208.6	219.7	237.4	231.4	244.2	244.4	248.7

[1] Including general and special freight.
[2] Including national movement, export and import.
[3] Including coastal and height movement.
[4] Estimated.
[5] Preliminary.
Source: Gobierno de los Estados Unidos Mexicanos, 2º Informe de Gobierno, 1º de septiembre 2002, México, 2002.

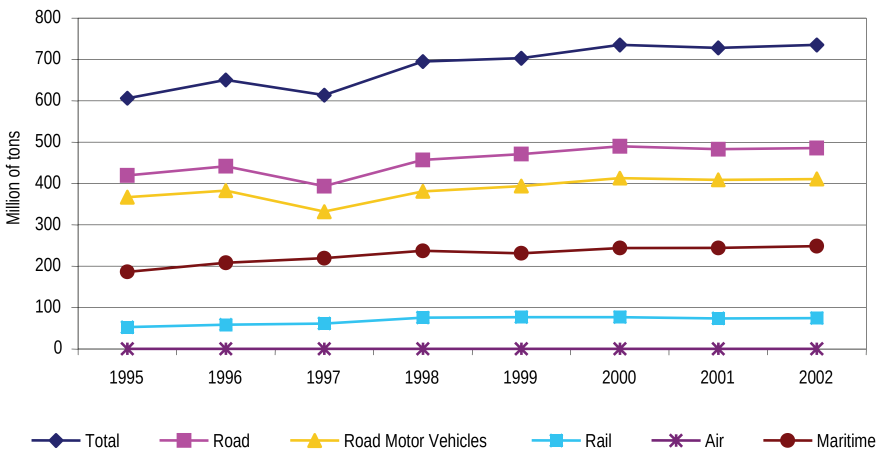

Figure 6.13 Freight transport activity: Total, by mode 1995-2002

Trends: Transportation activity has grown more than 20% between 1995-2002, with road motor representing 56%, railway 10%, and maritime 33.6% in the year 2001. Maritime is the transportation mode which experienced the largest growth (33.5%) between 1995-2002.

Indicator construction and limitations: Data availability limited the disaggregating of the indicator to the desired level. And measurement and interpretation became complicated by differences among products within category, such as size, utilization, etc.

6.6.3.3. INDICATOR 8

Manufacturing Value Added by Selected Energy Intensive Industries (%)

Definition: This indicator measures the contribution of the various manufacturing energy intensive industries in total manufacturing output. It is obtained by dividing the value added in a specific manufacturing branch by the total net value-added in manufacturing at constant 1990 prices.

Purpose: The indicator is designed to monitor the relative size of energy intensive industries in manufacturing. The relative size of energy intensive industries also hints at basic driving forces associated with level of energy use per unit of GDP.

TABLE 6.25 SHARES OF MANUFACTURING VALUE ADDED OF ENERGY INTENSIVE INDUSTRIES IN TOTAL GDP 1988-2002

Year	Iron and steel	Non-ferrous metals	Basic chemicals	Non-metallic minerals	Paper and pulp	Refined petroleum products
1988	4.85	1.59	4.45	2.10	1.02	3.58
1989	4.60	1.51	4.33	1.98	1.08	3.62
1990	4.73	1.45	4.26	1.91	1.11	3.72
1991	4.35	1.32	4.25	1.92	1.15	3.45
1992	4.25	1.33	4.17	1.98	1.12	3.35
1993	4.51	1.26	4.12	2.05	1.15	3.30
1994	4.72	1.21	4.09	2.15	1.15	3.37
1995	5.51	1.13	4.34	1.90	1.28	3.41
1996	5.72	1.31	4.18	1.89	1.24	3.06
1997	5.80	1.27	4.05	1.80	1.17	2.65
1998	5.51	1.30	4.08	1.71	1.11	2.46
1999	5.34	1.20	4.08	1.68	1.14	2.32
2000	5.15	1.16	3.83	1.16	1.09	2.15
2001	4.84	1.23	3.82	1.65	1.09	2.14
2002	4.99	1.21	3.83	1.70	1.13	2.13

Source: INEGI. Sistema de Cuentas Nacionales de México (SCNM), 1988-1999 y 1996-2002. Aguascalientes, México 2000 y 2003.

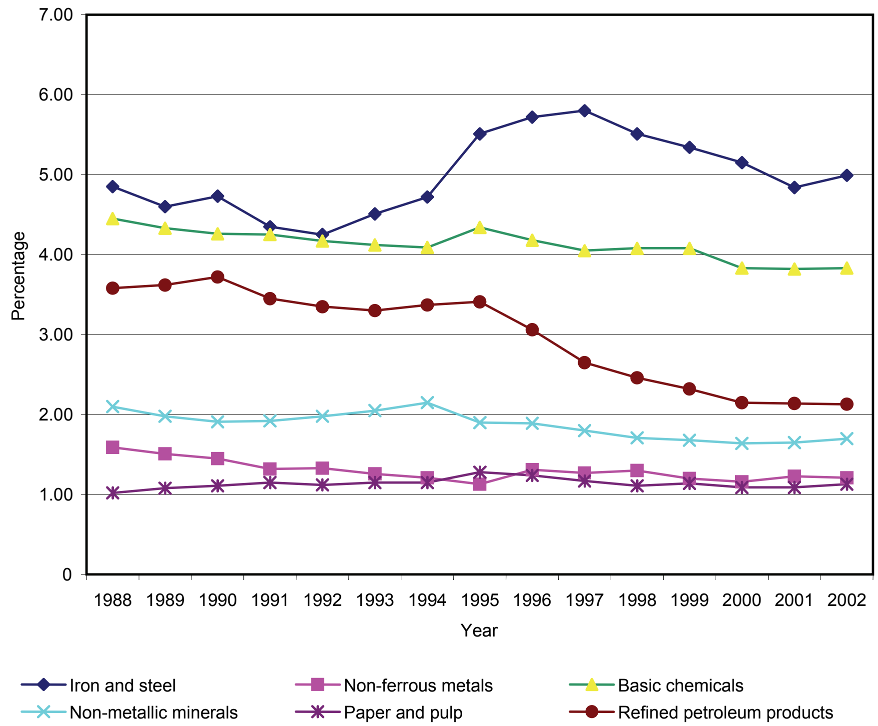

Figure 6.14 Shares of sectors in manufacturing GDP at PPP 1988-2002

Trends: In the period 1988-2002, most of the primarily energy intensive industries displayed a progressive reduction in their fraction of value added in total GDP and in the Manufacturing sector.

This tendency is observed mainly in the following cases: Basic Chemicals from 4.45% to 3.83%; Iron and Steel, after reaching a value of 5.80% in 1997, dropped to 4.99% in 2002; and Refined Petroleum from 3.58% to 2.13 %.

Accordingly, a decrease in the share of the value added of these industries brought about a decrease in the quantity of energy used by these selected industries.

Indicator construction and limitations: For comparison purposes, the historical series is available starting from 1988; information prior to this year is not available with the required detail of the indicator.

For the construction of this indicator, the categories and divisions mentioned in the methodological sheet (ISED Methodology sheet) were included.

The percentage share of the industries is calculated in relation to the total value added of the manufacturing sector.

6.6.3.4. INDICATOR 9.1

Energy Intensity in Manufacturing

Definition: Energy consumption per unit of manufacturing output.

Purpose: The manufacturing sector is a major consumer of energy. This indicator is a measure of the efficiency of energy use in the sector and can be used for analysing trends and making international comparisons in energy efficiency, particularly when the indicator can be disaggregated to specific branches of manufacturing.

TABLE 6.26 ENERGY INTENSITY IN THE MANUFACTURING SECTOR 1980-2002

Year	(TOE/1,000 USD)	(KWh/ USD 2,000)
1980	0.20	0.26
1981	0.19	0.26
1982	0.20	0.30
1983	0.21	0.32
1984	0.19	0.32
1985	0.17	0.32
1986	0.17	0.33
1987	0.16	0.32
1988	0.15	0.32
1989	0.16	0.35
1990	0.16	0.37
1991	0.15	0.38
1992	0.15	0.38
1993	0.15	0.41
1994	0.15	0.43
1995	0.14	0.44
1996	0.13	0.46
1997	0.12	0.48
1998	0.11	0.48
1999	0.11	0.50
2000	0.10	0.53
2001	0.11	0.55
2002	0.11	0.59

Source: INEGI. 2003. National Accounting System
SENER. 2003. National Energy Balance.

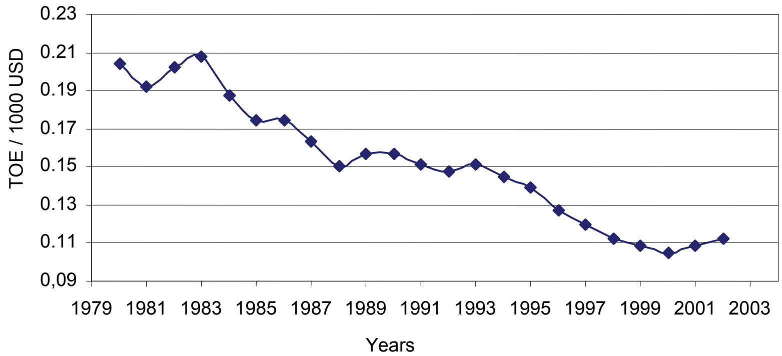

Figure 6.15 Energy intensity in the Manufacturing Sector 1980-2002

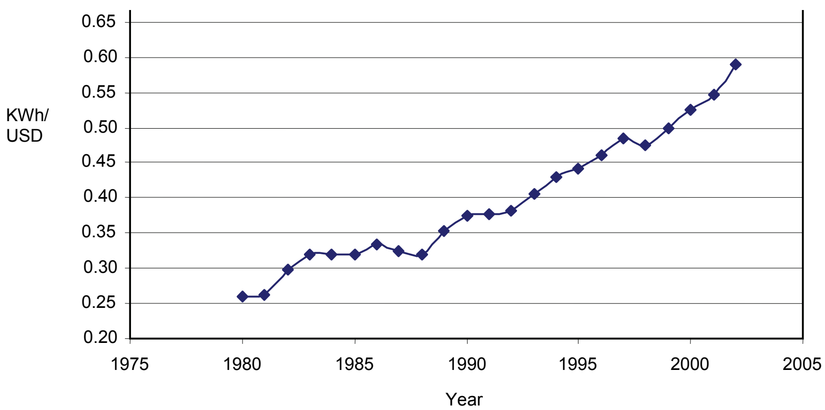

Figure 6.16 Energy Intensity in the Manufacturing Sector: electricity consumption per GDP

Trends: Energy intensities have dropped for total energy consumption. In the last 13 years the paper and cellulose pulp industry has decreased its intensity by 6%, aluminum by 5% and sugar by 3.7%. During the same period, the tobacco industry increased its intensity by 1%. The transformation sector (specifically refineries) has increased operations, thus increasing energy demand. A good approach could be to segregate private and public energy intensities.

Electricity use per GDP follows an increasing trend due to reduced electricity prices in real terms.

Indicator construction and limitations: Some slight changes have occurred regarding the way SENER aggregates sub sectors within the Manufacturing Sector, and the way INEGI estimates value added. Thus SENER provides its own estimates that may not be completely concurrent with INEGI´s official system of national accounts. Efforts have been made to harmonize criteria; unfortunately, no resources have been allocated for this matter.

6.6.3.5. *INDICATOR 9.2*

Energy intensity in Agriculture

Definition: Energy consumption per unit of agricultural output.

Purpose: The agriculture sector is an important consumer of energy. The purpose of the indicator is to provide a measure of the efficiency of energy use in the sector that can be used for analyzing trends, particularly in non-commercial energy consumption, and making international comparisons in energy efficiency.

TABLE 6.27 ENERGY INTENSITY IN AGRICULTURAL SECTOR 1980-2002

Year	(TOE/1,000 USD)	(KWh/USD)
1980	0.059	0.112
1981	0.054	0.105
1982	0.061	0.155
1983	0.059	0.138
1984	0.052	0.128
1985	0.049	0.130
1986	0.049	0.144
1987	0.049	0.165
1988	0.047	0.171
1989	0.043	0.186
1990	0.041	0.159
1991	0.041	0.152
1992	0.044	0.138
1993	0.044	0.147
1994	0.043	0.163
1995	0.048	0.188
1996	0.040	0.184
1997	0.041	0.193
1998	0.042	0.199
1999	0.044	0.221
2000	0.048	0.235
2001	0.050	0.224
2002	0.052	0.222

Source: INEGI. 2003. National Accounting System
SENER. 2003. National Energy Balance.

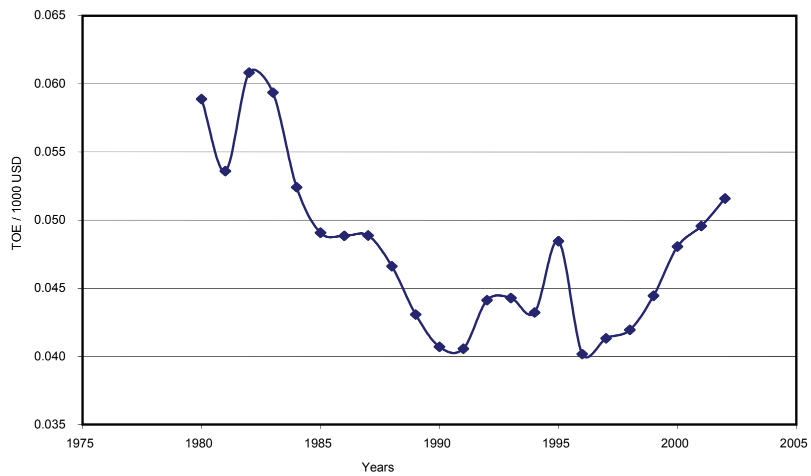

Figure 6.17 Energy intensity agricultural sector 1980-2002

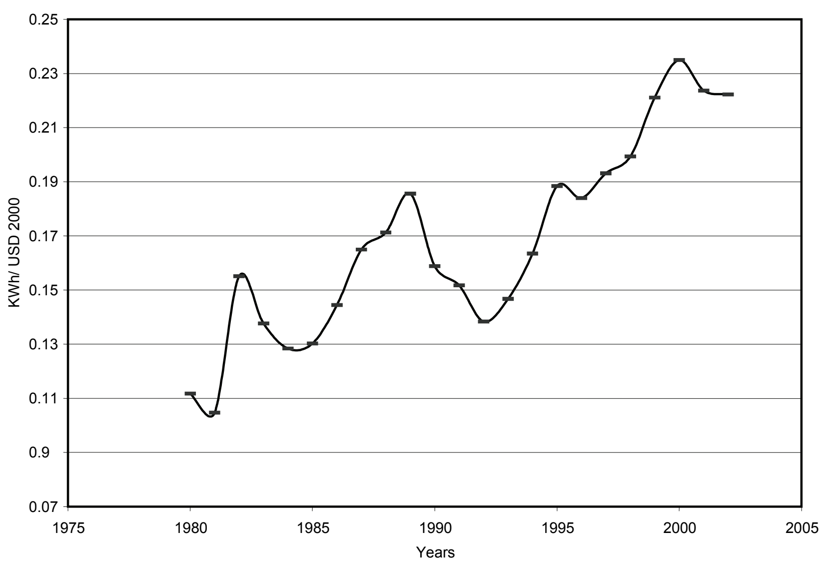

Figure 6.18 Electricity Intensity Agricultural Sector 1980-2002

Trends: Total energy intensity dropped during the 1980s, except for an increase in 1982 (associated with that year's crisis due to political and economic changes in the country). From 1990 to 2002, intensity has grown due to increases in consumption coupled with declining in growth of the sector. A considerable increase was observed in 1995 consistent with that year's crisis. Energy intensity in terms of electricity consumption has doubled during the considered period, basically due to lower real prices for electricity. On the other hand, the price of diesel fuel, which is consumed in large quantities in this sector, has considerably increased because its price is governed by international pricing.

Indicator construction and limitations: Even though information and data are available, the variation in agricultural production due to climate, availability of other inputs, among other factors, also needs to be taken into account.

Energy efficiency in agricultural production needs to be improved at a national level. Policies promoting renewable energy sources need improvement as well, since among many benefits, they will contribute considerably to increased labour efficiency and diversified economic activities in rural areas.

6.6.3.6. INDICATOR 9.3

Energy Intensity in Commercial and Service Sector (toe/1,000$ and kWh/$)

Definition: Energy consumption per unit of commercial and service sector (value added) output.

Purpose: This indicator is used to monitor trends in energy consumption in the commercial/service sector, which is the largest sector of most economies.

TABLE 6.28 ENERGY INTENSITY IN COMMERCIAL SECTOR. 1990-2000

Year	Toe/1,000 USD	kWh/ USD
1990	0.02	0.10
1991	0.03	0.11
1992	0.03	0.11
1993	0.03	0.12
1994	0.04	0.12
1995	0.08	0.27
1996	0.09	0.30
1997	0.09	0.30
1998	0.10	0.35
1999	0.08	0.37
2000	0.08	0.34

Source: INEGI, Sistema de Cuentas Nacionales de México (SCNM), 1988-1999 y 1996-2001.

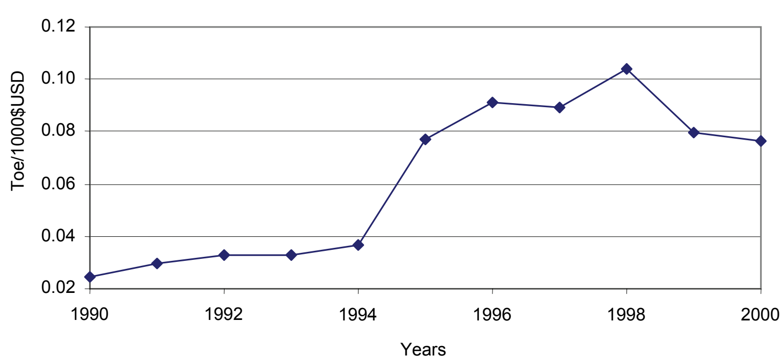

Figure 6.19 Energy Intensity in Commercial Sector 1990-2000

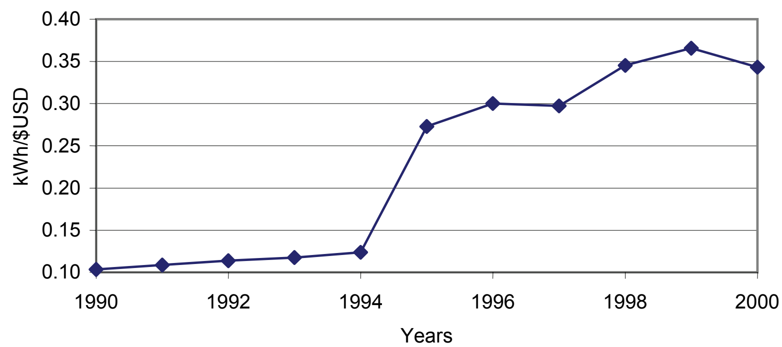

Figure 6.20 Electricity Intensity in Commercial Sector 1990-2000

Trends: The service/commercial sector is a large consumer of electricity. In general, it requires increases in energy efficiency in order to reduce overall energy use. Energy and electricity intensity increased in 1995, in part as a result of a drop in GDP at that time, but the high levels of intensity remained even after the GDP recovered.

Indicator construction and limitations: Time series in this indicator cannot be expanded because of differences in the way SENER and the National Accounts System categorize economic groups.

6.6.3.7. INDICATOR 9.4

Energy Intensity in transportation

Definition: Energy consumption for transportation per unit of transportation sector output and relative to the amount of freight or passengers carried and the distance travelled.

Purpose: Transportation is a major consumer of energy, mostly in the form of fossil fuels, and the share of transportation in energy consumption is generally increasing. The indicator is a measure of how efficiently energy is used for moving goods and people. The indicator can be used to monitor trends in energy consumption for transportation and for international comparisons. Separation of freight and passenger travel is essential.

TABLE 6.29 ENERGY INTENSITY TRANSPORTATION 1990-2000

Year	Toe/1,000 USD	kWh/ USD
1990	1.15	2.35
1991	1.29	2.82
1992	1.32	3.45
1993	1.34	4.15
1994	1.43	5.64
1995	2.79	9.40
1996	3.15	35.70
1997	3.09	16.31
1998	3.50	21.29
1999	3.54	21.37
2000	3.39	22.28

Source: INEGI, Sistema de Cuentas Nacionales de México (SCNM), 1988-1999 y 1996-2001.

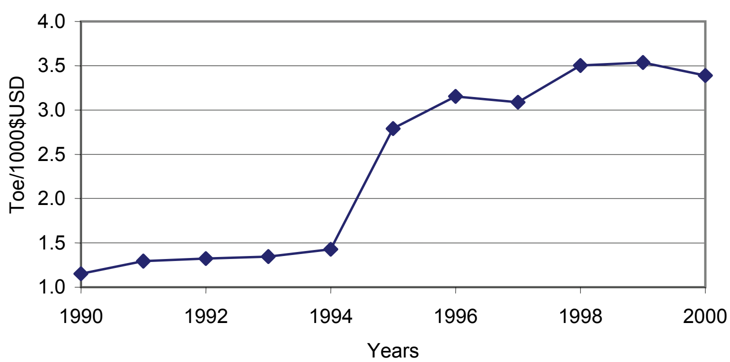

Figure 6.21 Energy Intensity in Transportation 1990-2000

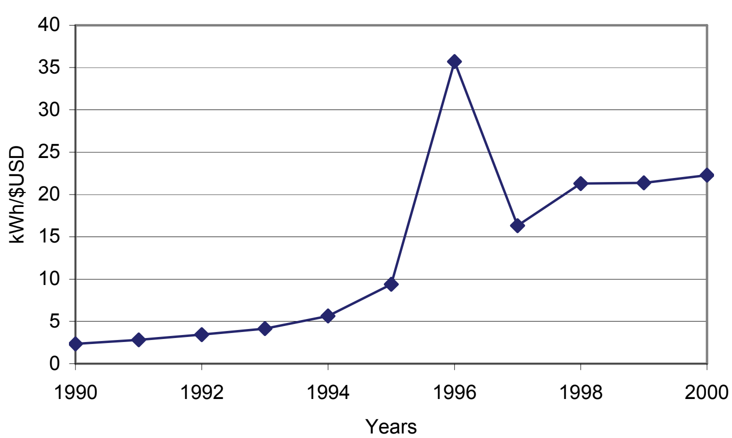

Figure 6.22 Electricity Intensity in Transportation 1990-2000

Trends: Energy intensity in transportation has dramatically increased in the last decade, mainly due to population growth in urban areas and insufficient public transportation systems.

Population growth in urban areas has not been matched by efficient transportation systems. Mexico needs more public transport and a culture of less personal vehicle use, as well as street planning in urban design.

Until major changes in the urban public transportation systems occur, the energy intensity in this sector will continue to increase and result in negative impacts on the environment and human health.

Indicator construction and limitations: Time series in this indicator cannot be expanded because of differences in the way SENER and the National Accounts System categorize economic groups.

6.6.3.8. INDICATOR 9.5

Energy Intensity in the Residential Sector (toe of final energy and kWh of electricity per capita or per household; toe of energy used for space heating per unit of home area)

Definition: Amount of energy or electricity used per person or household and for space heating per unit of home area in the residential sector.

Purpose: The indicator is used to monitor energy consumption in the residential sector.

TABLE 6.30 ENERGY INTENSITY RESIDENTIAL SECTOR 1993-2000

Year	kWh/USD	Toe/1,000$USD
1993	0.20	0.12
1994	0.21	0.12
1995	0.31	0.18
1996	0.27	0.16
1997	0.23	0.13
1998	0.24	0.13
1999	0.23	0.11
2000	0.20	0.09

Source: INEGI, Sistema de Cuentas Nacionales de México (SCNM), 1988-1999 y 1996-2001.

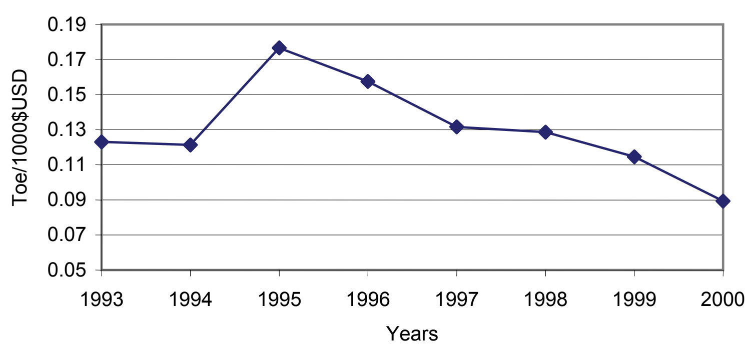

Figure 6.23 Energy Intensity Residential Sector 1993-2000

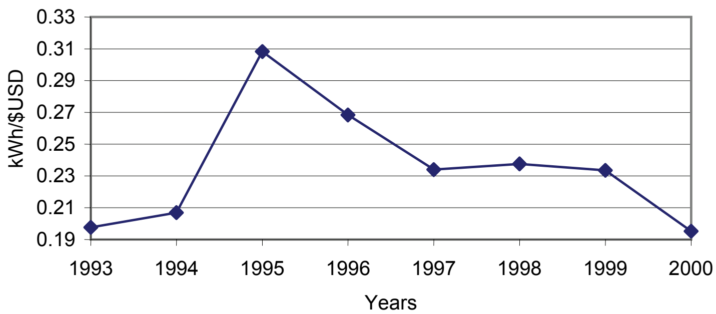

Figure 6.24 Electricity Intensity Residential Sector 1993-2000
Note: The data available cover only the period from1993 to 2000. The exchange rate for dollars is based on Bank of Mexico data for each year.

Trends: The residential energy intensity index has generally trended downward by an average of 8% since 1995, with the greatest declines observed in the mid 1990s (due to the economic crisis of 1994). Other than that, residential energy use appears to grow in lockstep with increases in households.

Indicator construction and limitations: Time series in this indicator cannot be expanded because of differences in the way SENER and the National Accounts System categorize economic groups.

The improvement of energy efficiencies in this sector is an important priority for Mexico. Many policies addressing these issues are being formulated for this sector, in order to balance energy consumption increases due to the industrialization of rural areas.

6.6.3.9. INDICATOR 14

Energy use per unit of GDP

Definition: Ratio of energy consumption to GDP in real US dollars.

Purpose: Trends in overall energy use relative to GDP indicate the general relationship of energy consumption to economic development and provide a rough basis for projecting energy consumption and its environmental impacts with economic growth. For energy policy-making, however, sector or sub-sector energy intensities should be used.

TABLE 6.31 ENERGY USE PER UNIT OF GDP 1980-2002

Year	TOE/1,000 USD /a	KWh / USD /a
1980	0.182	0.172
1981	0.182	0.172
1982	0.187	0.186
1983	0.189	0.196
1984	0.183	0.201
1985	0.184	0.209
1986	0.182	0.224
1987	0.187	0.234

1988	0.182	0.245
1989	0.182	0.254
1990	0.185	0.252
1991	0.185	0.248
1992	0.181	0.247
1993	0.182	0.251
1994	0.181	0.260
1995	0.191	0.287
1996	0.184	0.293
1997	0.175	0.294
1998	0.171	0.294
1999	0.158	0.300
2000	0.152	0.303
2001	0.149	0.308
2002	0.150	0.313

a/ National Accounts base year: 2003.
Source: International Monetary Fund, *World Economic Outlook Database*, September 2003.
SENER. 2003. National Energy Balance.

Trends: Total energy use per unit of GDP remained more or less constant from 1980 until the mid 1990s, and from then on has continuously dropped due to higher shares of non-energy intensive sectors (e.g. services). Peaks are observed and can be explained due to recurrent economic crises, sometimes associated with political change. Electricity consumption has continuously increased (particularly after 1994-1995, due to the economic crisis), yet no sign of recovery is observed.

Indicator construction and limitations: It is important to supplement the energy use of GDP indicator with energy intensities disaggregated by sector, since these are a better representation of energy efficiency developments. This could not be done with the information available.

6.6.3.10. INDICATOR 16

Energy consumption per capita

Definition: The per capita amount of energy – coal, oil, petroleum products, gas, combustible energy & waste, electricity, and heat converted into oil equivalent - available in a given year in a given country or geographical area.

Purpose: This indicator measures the level of energy use on a per capita basis and reflects the energy use patterns and aggregate energy intensity of a society.

TABLE 6.32 ENERGY CONSUMPTION PER CAPITA

Year	TOE per capita /a	KWh per capita/a
1980	0.759	716.232
1981	0.808	763.944
1982	0.810	805.360
1983	0.768	797.095
1984	0.757	831.256
1985	0.762	866.703
1986	0.714	879.141
1987	0.732	916.664
1988	0.708	950.493
1989	0.723	1,007.934
1990	0.758	1,029.308
1991	0.804	1,077.477
1992	0.800	1,089.610
1993	0.803	1,111.001
1994	0.825	1,183.318
1995	0.803	1,207.203
1996	0.803	1,276.728
1997	0.803	1,348.969
1998	0.816	1,407.521
1999	0.766	1,458.236
2000	0.775	1,547.008
2001	0.746	1,543.024
2002	0.746	1,558.067

a/ Estimated population data were used since official data are presented every 10 years
Source: International Monetary Fund, *World* Economic Outlook Database, September 2003.
SENER. 2003. National Energy Balance.

Trends: Electricity consumption per capita grew by 217% between 1980 and 2002, reflecting a considerable growth in the quality of life. Considering Indicator 19, however, there remains an important income inequality, and while energy consumption has significantly increased and per capita consumption levels also have increased, energy consumption remains concentrated in the 20th percentile of households with higher income, according to indicators #19 and #22.

Indicator construction and limitations: The actual value of the indicator is strongly influenced by a multitude of economic, social and geographical factors.

6.6.3.11. INDICATOR 20

Ratio of daily disposable income/private consumption per capita of 20% poorest population to the prices of electricity and major household fuels

Definition: Amount of household energy (electricity; the main fuels used for heating and cooking; and kerosene used for lighting) that a person in the 20% poorest population group could consume per day based on daily disposable income and the actual prices of energy commodities.

Purpose: This indicator provides a measure of energy affordability by poorest households. The indicator is an assessment of the amount of electricity and fuel that could be consumed daily according to current consumer energy prices and available disposal income.

TABLE 6.33 RATIO OF DAILY DISPOSABLE INCOME[1]PER CAPITA OF 20% POOREST[2] POPULATION TO THE PRICES OF ELECTRICITY[3] AND MAJOR HOUSEHOLD FUELS[4]

Year	Electricity kWh/capita/day	Liquefied gas (LP) Gj/capita/day
1989	11.01	0.15
1992	12.13	0.19
1994	16.24	0.14
1996	12.35	0.10
1998	11.50	0.07
2000	15.46	0.09
2002	12.78	0.09

[1] Available income equals annual monetary income based on quarterly income.
[2] Corresponds to households with lowest incomes (stratum I y II).
[3] Unit price of electricity equals annual average based on bi monthly price.
[4] Annual unit price of liquefied gas based on monthly price.
Source: INEGI. Encuesta Nacional de Ingreso-Gasto de los Hogares, 1989, 1992, 1994, 1996, 1998, 2000, 2002. México 1992, 1993, 1995, 1998, 2000, 2001, 2003.
SENER. Balance Nacional de Energía 2002. México, 2003.
www.energia.gob.mx (10 octubre 2004).

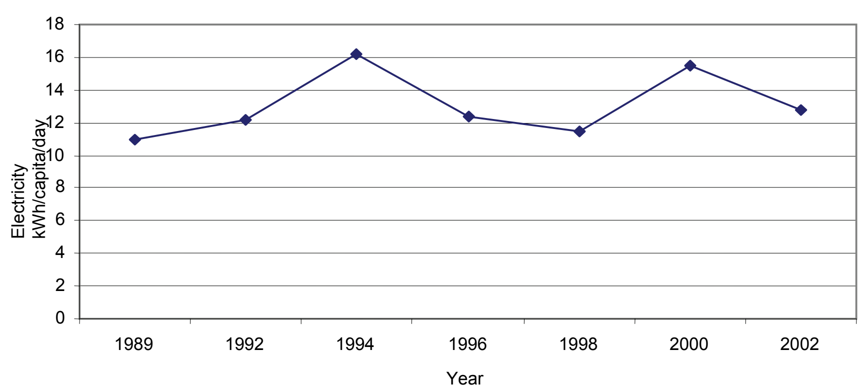

Figure 6.25 Ratio of daily disposable income/private consumption per capita 20% poorest to prices of electricity 1989-2002

Trends: In 1989, the 20% of the population with the lowest income could purchase 11 kWh/day per capita, whereas in 1994 this increased to 16 kWh/day per capita. In 1996 and 1998, as a result of the economic crisis (precipitated at the end of 1994), and because the price per kWh/day was increased from 0.15 pesos in 1994 to 0.43 pesos in 1998, the purchasing power of the poorest declined in its capacity to buy electricity. It recovered again in 2000, at 15.46 kWh/day, and then again decreased in 2002 to 12.78 kWh/day.

If the average consumption in the typical house is 5 to 6 kWh/day, it can be inferred that in 1989 the population with lowest incomes could acquire electricity for a period of approximately 45 days; 13 years later, in 2002, the amount of electricity that could be acquired for this population is for more than 50 days.

An important factor that could explain this performance is the governmental subsidy that homes have received for a considerable period of time, until 2001 when it became selective to those homes that had not exceeded a basic limit of electricity consumption. This means that the lowest income population level was not usually affected, which explains the slight improvement in its level of purchase.

In the case of liquefied gas, there was a decreasing trend in affordability. Whereas in 1989 the population with lowest income could buy 0.15 Gj/day per capita, in 2002 the amount was reduced to 0.09 Gj/day per capita.

The amount of this type of fuel purchased by the poorest segment of the population has decreased due to the constant increase of its price in these past 13 years, which went from 7.41 pesos in 1989 to 106.19 in 2002. Unlike the electric sector, a subsidy policy does not exist in this case.

Indicator construction and limitations: For the year 1989 electricity and gas prices were not available, so the calculations were done with prices from the year 1990 published by Secretariat of Energy (SENER). The household survey data corresponds to l989.

The electricity and Liquefied Gas of Petroleum prices correspond to the residential rate.

Kerosene data are not included because consumption is not significant and is declining.

6.6.3.12. INDICATOR 21

Fraction of disposable income/private consumption spent on fuel and electricity (%)

Definition: The expenditure spent on household fuel and electricity as a percentage of total private consumption per capita by average population and by a group of 20% poorest population.

Purpose: This indicator provides a measure of energy affordability by average population and by poorest households. The indicator is the fraction of household final consumption expenditure that the average population and in particular the group of 20 % poorest population actually spent on household fuel and electricity according to current consumer energy prices and actual consumption level.

TABLE 6.34 FRACTION OF PRIVATE CONSUMPTION[1] SPENT ON FUEL AND ELECTRICITY 1984-2002

Year	% of average expenditure per person on electricity and gas of average population	% of average expenditure per person on electricity and gas of the population with least income[2]
1984	2.98	2.87
1989	3.08	3.28
1992	3.68	4.11
1994	4.29	5.45
1996	4.80	6.00
1998	4.63	5.22
2000	4.63	6.00
2002	5.17	6.00

[1] Available expenditure available equals annual monetary expenditure based on quarterly expenditure.
[2] Poorest 20% of households.
Source: Encuesta Nacional de Ingreso-Gasto de los Hogares, 1984, 1989, 1992, 1994, 1996, 1998, 2000, 2002. México 1985, 1989, 1993, 1995, 1997, 1999, 2001, 2003.
SENER. Balance Nacional de Energía 2002. México 2003.

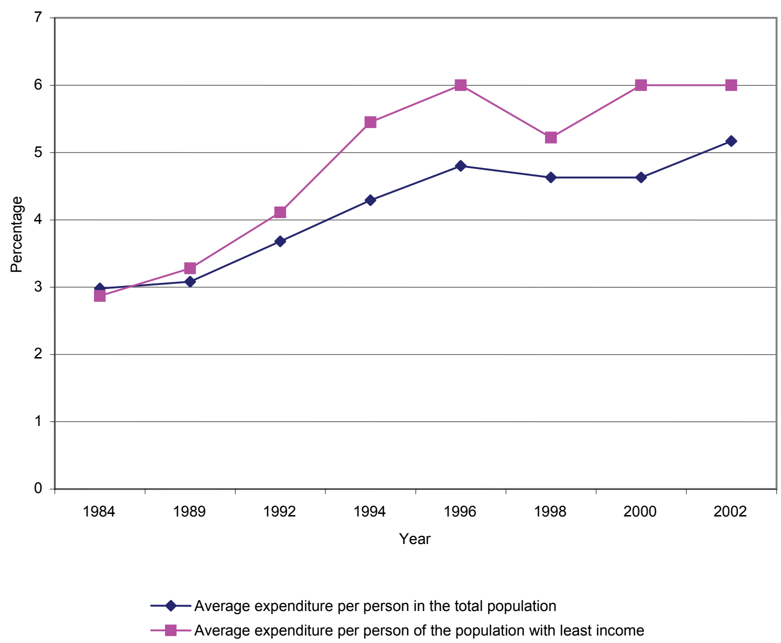

Figure 6.26 Fraction of private consumption spent on fuel and electricity 1984-2002

Trends: Disposable income spent on fuel and electricity grew at a faster pace for the population with least income than for the average population. The share of income required for the purchase of electricity and gas, between 1984 and 2002, grew at an average annual growth rate of 4% for the average population, whereas it grew at 6% for the quintile of lowest incomes.

A factor explaining this situation is the increase of prices for power: the price of a kWh was raised from $0.10 in 1989 to $0.77 in 2002, i.e., a 670% increase, whereas the price for gas was increased

1,433% (from $7.41 to $106) over the same years. Another factor is that the average population had a higher percentage increase in its income than did the poorest quintile.

The tendencies observed for both segments of the population are the following: in the case of the poorest quintile, consumption of gas and electricity in 1989 were 1.8 Gj per capita and 120.77 kWh per capita, respectively; in 2002 the per capita consumption was 1.04 Gj for gas and 209.9 kWh for electricity; thus gas consumption decreased by 11.9%, as a result of the greater increase in its price, while electricity registered an increase of 73%. In the case of the average population, gas and electricity consumption passed from 2.89 Gj and 368.2 kWh per inhabitant in 1989 to 3.09 Gj and 702.7 kWh per inhabitant in 2002.

The differences in the proportions between both groups are the following: for electricity consumption, it was close to 200% in 1989 and 250% in 2002; for gas, the amounts in both years were, respectively, 150% and 200%.

The previous variations could also be seen in the context of the comments for indicator 21: the cancellation of the subsidy for electricity affected the average population but not the poor population. For gas, there has been no subsidy and therefore the price increments have affected both strata.

In recent years, Mexico has followed a policy to ensure economic development while simultaneously diminishing the impact on the environment, through the implementation of energy efficiency, energy savings and diversification of energy sources.

The National Plan of Development also has implications in state policies that define and direct subsidies to the users who need it most and that give support of the public sector to generators that respect environmental regulations and to projects that bring electricity to the excluded areas, as well as foster the use of renewable energy.

Indicator construction and limitations: As regards to incomes for population's strata, the official source is the National Survey of Household’s Income-Expenditure (ENIGH), whose available data only correspond to the period included for this indicator. For gas and electricity, the data are much more readily available.

This indicator includes two calculations: one for the average population and the other for the poorest 20% of the population.

For both groups the numerator refers to the expenditure of those households that consumed electric power and the denominator includes all households, even those that did not report expenses for electricity consumption.

Total expenditures spent only by households that consumed electrical energy is required, so that the percentage of private consumption spent on fuel and electricity is more exact.

A comparable situation exists for the case of Liquefied Petroleum gas.

6.6.3.13. INDICATOR 35

Fraction of technically exploitable capability of hydropower currently not in use (%)

Definition: It is defined as one minus the ratio of total rated capacities of hydroelectric generating units that are installed at all sites, which are generating, to the amount of the gross theoretical capability that can be exploited within the limits of current technology.

Purpose: The purpose of the indicator is to measure availability of technically exploitable capability of hydropower.

This indicator provides a basis for estimating future hydroelectricity supplies, enabling proactive decision making to ensure the efficient use of technical potential of hydroelectricity over the longer term.

Availability of domestic technical hydropower potential allows an increase in renewable energy production, consequently decreasing atmospheric pollution, and increasing energy availability, in particular for the poor in the developing world that have no access to electricity. Small, mini and micro plants (usually defined as plants less than 100MW, 10MW and 20 kW, respectively) play a key role in many countries, often being a mainstay of rural electrification.

TABLE 6.35 FRACTION OF TECHNICALLY EXPLOITABLE CAPABILITY OF HYDRO POWER CURRENTLY NOT IN USE 1980-2004

Year	1- (Installed capacity / potential) * 100
1980	85.49
1981	84.14
1982	84.14
1983	84.18
1984	84.18
1985	84.18
1986	84.18
1987	81.73
1988	81.24
1989	81.21
1990	81.10
1991	80.80
1992	80.80
1993	80.21
1994	77.91
1995	77.41
1996	75.70
1997	75.70
1998	76.51
1999	76.71
2000	76.71
2001	76.71
2002	76.72
2003	76.72
2004	76.75

Source: SENER. 2003. Statistical Compendium of the Energy Sector

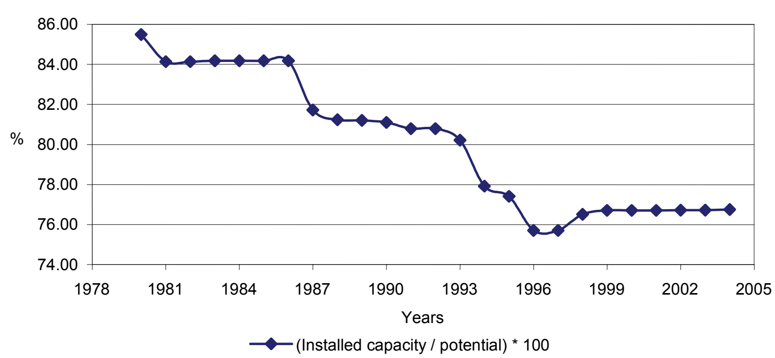

Figure 6.27 Fraction of technically exploitable capability of hydro power currently not in use 1980-2004

Trends: The estimated natural hydropower potential for Mexico amounts to almost 42,000 MW, according to official studies from the CFE. The installed capacity of hydroelectricity grew 21% in recent years.

In 2004 hydroelectricity represented 23% of total hydropower potential. New hydroelectric projects starting in 2003 will increase hydro capacity by more than 1,700 MW.

The potential included both large and small hydro projects. It would be better to subdivide this indicator into large hydro installed capacity/potential and small hydro installed capacity/ potential.

Indicator construction and limitations: Data generated by SENER and CFE are readily available so construction of this indicator presented no difficulties.

6.6.3.14. INDICATOR 40

Intensity of use of forest resources as fuelwood (%)

Definition: The indicator compares the amount of harvested wood to be used for energy needs as a percentage of the Net Annual Increment (NAI) for the national forest, defined as the average annual volume of gross increment less natural losses. If the annual increment is not known, the allowable cut can be used as a surrogate.

Purpose: The indicator aims at assessing whether actual forest harvest to be used for energy needs is compensated for by new growth within the nation's forests. If the indicator is greater than 100, it implies that a country for its energy needs alone is over-harvesting its stock of forest.

This indicator is a proxy, which is relevant for assessing the sustainability of forest stocks management when interpreted over a long time period. The indicator relates sustained yield to actual harvest of fuelwood in terms of a relative balance between forest growth and harvest. The total harvest rate set by a country is a function of the size of its forests, proportion of the forest area dedicated to timber production, the productivity of the forest and its age class structure, and the management objectives and sustained yield policies of the country.

For this study, the data available are for consumption of fuelwood.

TABLE 6.36 USE OF FOREST RESOURCES AS FUELWOOD 1960-2000

Year	Population[1]	National consumption Fuelwood[2] PJ	National consumption Fuelwood[2] Toe	Consumption per capita Toe per capita
1960	34,923,129	316	7,545,381	0.22
1970	48,225,238	342	8,178,084	0.17
1980	66,846,833	341	8,155,632	0.12
1990	81,249,645	340	8,109,296	0.10
2000	9,.483,412	338	8,075,857	0.08

[1] INEGI, 2002 www.inegi.gob.mx
[2] Balance Nacional de Energía 2001 (SENER, 2002)

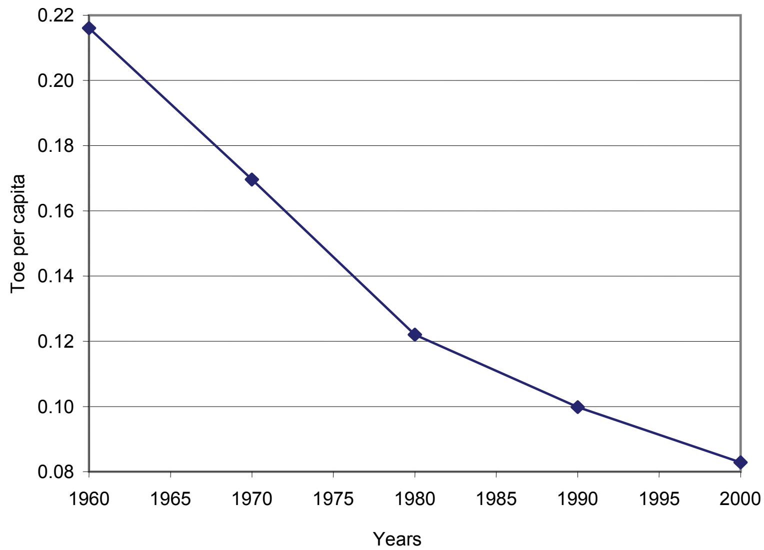

Figure 6.28 Intensity of use of forest resources as fuelwood 1960-2000

Trends: Lately 90% of fuelwood is consumed for household purposes (mainly for cooking and heating), and the remaining 10% is consumed by small-scale industry. Between 1960 and 1970, fuelwood consumption grew by 8.4%, but starting from 1970 consumption has decreased 0.5% annually, due to greater access of the rural population to alternative fossil fuels, and to immigration of the rural population to urban areas (see Indicator #1). On a per capita basis, fuelwood consumption decreased 20% between 1990 and 2000. The southern states of Veracruz (11%), Chiapas (10%), and Oaxaca (9%) exhibit the largest consumption of fuelwood.

Indicator construction and limitations: Accurate data on Mexico's forest area are readily available, as it has been used as a basic indicator for forest resources. It is an essential requirement for forest policy making and planning.

It is worth noting that the indicator does not measure the total rate of deforestation but focuses on deforestation caused by the harvesting of fuelwood.

6.6.4. Environmental protection and safety policies

The indicators on environmental protection and safety policies are:

- 23. Quantities of air pollutant emissions
- 24. Ambient concentration of pollutants in urban areas
- 26. Quantities of greenhouse gas (GHG) emissions from energy related activities
- 27. Radionuclides in atmospheric radioactive discharges
- 28.1 Discharges into water basin: Oil into coastal waters
- 28.2 Discharges into water basin: Radionuclides in liquid radioactive discharges
- 29. Generation of solid wastes
- 31. Generation of radioactive waste from nuclear power fuel cycle chain
- 32. Accumulated quantity of radioactive waste awaiting disposal

- 34. Fatalities due to accidents with breakdown by fuel chain
- 38. Proven uranium reserves

6.6.4.1. INDICATOR 23

Quantities of Air Pollutant Emissions (Tonnes or 1,000 tonnes)

Definition(s): Emissions of air pollutants, which are artificially introduced into the air from all energy-related activities and from both electricity production and transportation in particular. From human health and ecosystem perspectives, main causes of growing concerns are emissions of acidifying substances, such as sulphur oxide (SOx) and nitrogen oxides (NOx); ozone forming gases (ozone precursors), such as volatile organic compounds (VOC), nitrogen oxides, fine particulates and carbon monoxide (CO).

Purpose: The purpose of this indicator is to track the release of air pollutants into the atmosphere. The indicator is used to evaluate the environmental performance of national policies and to describe the environmental pressure in relation to air pollution abatement in energy related activities, and in power generation and in transportation in particular.

The indicator can be used to assess the environmental pressure in relation to energy production and consumption and to evaluate the environmental performance of national policies designed to address four major impacts of air pollutants on human health and the ecosystem:

- the acidification of soil and water by pollutants such as sulphur oxides and nitrogen oxides;
- the damage to buildings sensitive to the same acidifying substances;
- the formation of tropospheric ozone from so-called ozone precursors, e.g. volatile organic compounds, nitrogen oxides and carbon monoxide which indirectly affect human and animal health and vegetation;
- direct effects on human health and ecosystems e.g. through high atmospheric concentrations of particulates, and VOCs.

TABLE 6.37 POLLUTANT EMISSIONS FROM ELECTRIC GENERATION 1995-2001

Year	Generation from Thermal (GWH)	CO2* (tons)	NOx* (tons)	SO2* (tons)	Particles* (TSP) (tons)
1995	100,686	72,175,029	194,990	1,246,175	78,782
1996	106,833	75,642,535	214,291	1,295,413	81,516
1997	119,017	84,783,563	229,393	1,485,541	93,902
1998	131,376	93,596,258	250,042	1,623,374	102,800
1999	132,517	93,851,596	253,806	1,592,876	100,937
2000	143,865	102,626,660	275,873	1,709,404	108,701
2001	152,818	105,197,280	297,309	1,666,711	106,625

Source: CFE.2002.

TABLE 6.38 QUANTITIES OF AIR POLLUTANT EMISSIONS PER GWH 1995-2001

Year	CO2 Ton/GWh	NOx Ton/GWh	SO2 Ton/GWh	Particles (TSP) Ton/GWh
1995	716,833	1,937	12,377	0.782
1996	708,045	2,006	12,126	0.763
1997	712,365	1,927	12,482	0.789
1998	712,430	1,903	12,357	0.782
1999	708,223	1,915	12,020	0.762
2000	713,354	1,918	11,882	0.756
2001	688,383	1,946	10,907	0.698

Source: CFE. 2002.

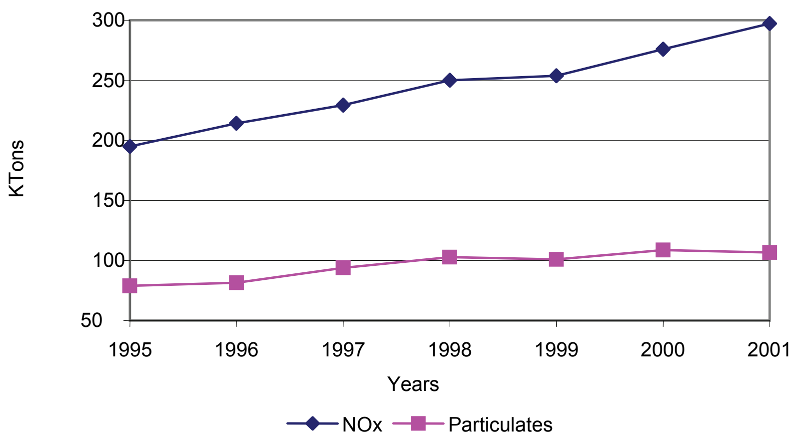

Figure 6.29 NOx and particulates Emissions from electric utilities 1995-2001

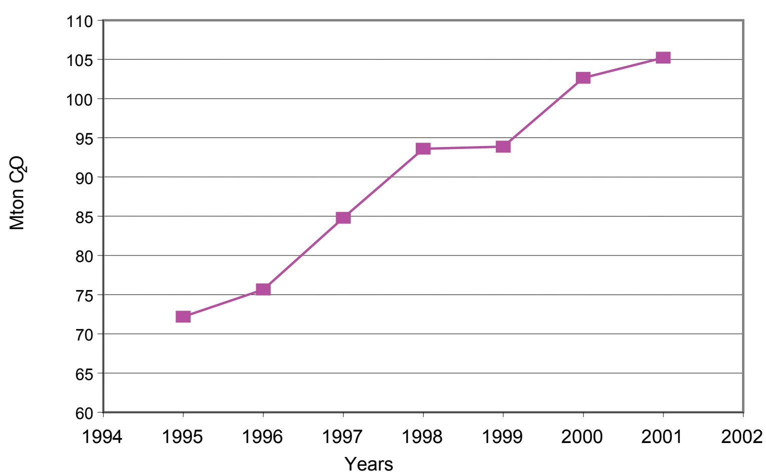

Figure 6.30 CO2 Emissions from electric utilities 1995-2001

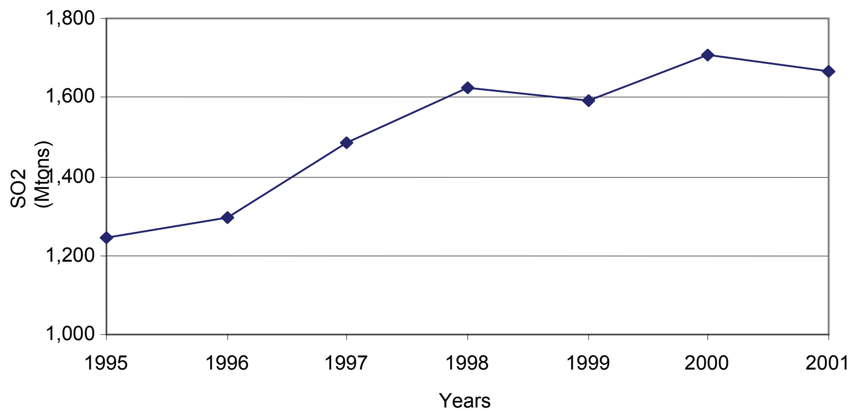

Figure 6.31 SO2 Emissions from electric utilities 1995-2001

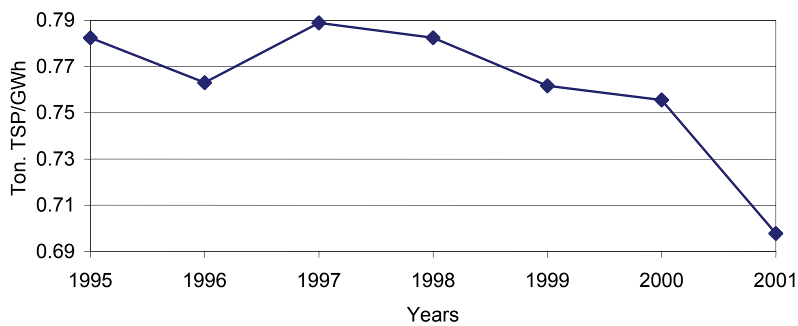

Figure 6.32 TSP emissions per GWh 1995-2001

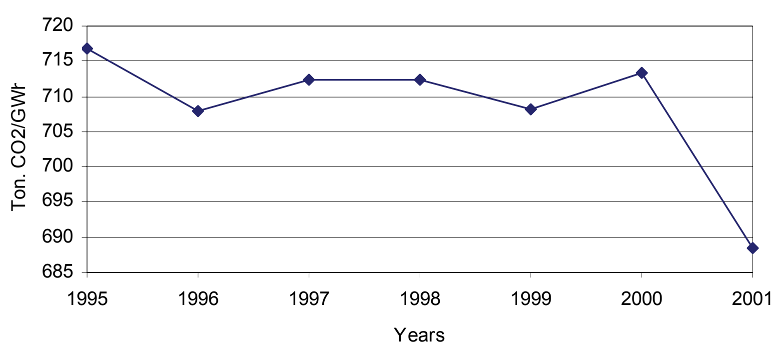

Figure 6.33 CO2 emissions per GWh 1995-2001

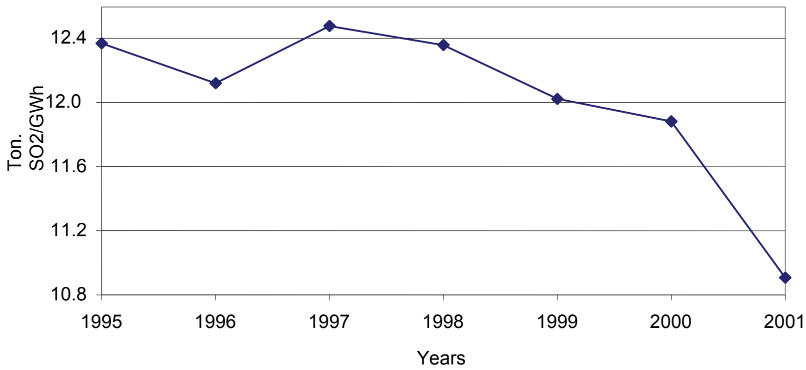

Figure 6.34 SO2 emissions per GWh 1995-2001

TABLE 6.39 AIR POLLUTANT EMISSIONS FROM PEMEX (TON) 1999-2003

Year	SOx	NOx	Total suspended particles	Total organic compounds
1999	685,801	131,533	17,962	179,401
2000	641,535	126,840	16,818	193,320
2001	687,690	86,823	82,832	83,086
2002	496,648	90,163	76,204	78,162
2003	602,930	101,285	86,546	81,895

Source: PEMEX. 1999-2003. Report 1999-2003. Safety, health and environment.

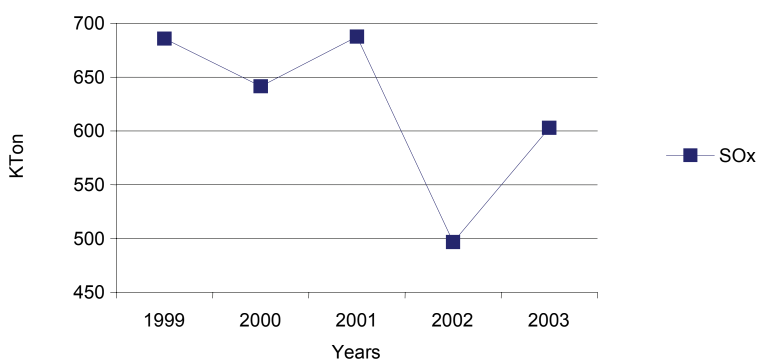

Figure 6.35 PEMEX Air pollutant emissions 1999-2003 SO_x

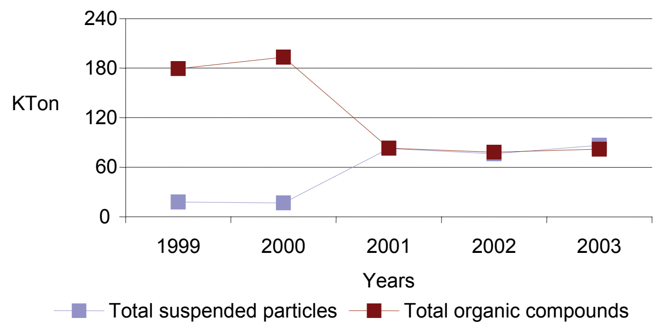

Figure 6.36 PEMEX Air pollutant emissions 1999-2003 TSP; TOC

Trends: The emission intensities for all the pollutants considered have decreased over the last 5 years, due to the increased use of cleaner fuels for electricity generation and improved efficiency in generation.

Power generation grew almost 52% between 1995-2001, and absolute emissions grew during that period, but emission intensity dropped 3.9% for CO_2, 12% for SO_2, and 10.8% for total suspended particles (TSP). Emission intensity for NOx increased slightly (0.46%). This is the result of a technological switch of the Mexican thermal power capacity from conventional power plants to more efficient combined cycle plants. As result of this transformation, the power sector has doubled its consumption of natural gas between 1995 (5,226 Bm3) and 2001 (11,328 Bm3), and began dropping the consumption of high sulfur fuel oil by almost 900 Mm3 between 2000-2001.

Regarding PEMEX, its oil production increased from 3,012 thousand bl/day in 2000 to 3,317 thousand bl/day in 2003, and this also led to increases in oil processing in the four subsidiaries of the company. During 2002 a major reconfiguration occurred in the National Refinery System (note: PEMEX manages the entire Refinery System of the country), increasing operations in 2003. All these events led to reported emission increases.

Indicator construction and limitations: Data for PEMEX and CFE are available for recent years, since both companies began implementation of sound environmental programs in the past decade. Data from previous years might not be available or consistent.

Another important aspect is that the level of detail required for various combustion processes (particularly data related to machinery characteristics) is not readily available for certain activities. Emission factors from existing sources of inventory compilation guidance were used to obtain estimates of the pollution emissions released into the atmosphere.

Concrete actions relating pollution control technologies and policies are needed in order to maintain favourable emission intensity indexes.

6.6.4.2. INDICATOR 24

Ambient concentration of pollutants in urban areas (µg/m3 or mg/m3, as appropriate)

Definition: Ambient air pollution concentrations of ozone, carbon monoxide, particulate matter (PM10, PM2.5, SPM, black smoke), sulphur dioxide, nitrogen dioxide, nitrogen monoxide, volatile organic compounds (VOCs) including benzene and lead.

Purpose: The indicator provides a measure of the state of the environment in terms of air quality and an indirect measure of population exposure to air pollution which is a health concern in urban areas.

TABLE 6.40 MEAN ANNUAL CO CONCENTRATION 1988-2002 (PPM)

Year	MCMA	MMA	GMA	TMA	Cd. Juarez
1988	4.067				
1989	4.447				
1990	5.889				
1991	6.270				
1992	5.689				
1993	3.694	1.101			
1994	3.455	0.977		1.911	
1995	2.560	1.002		1.710	
1996	2.665	1.006	2.041	1.652	1.438
1997	2.445	1.023	2.203	1.524	1.136
1998	2.377	1.048	2.141	1.616	1.301
1999	2.164	0.991	2.026	1.595	1.357
2000	2.261	0.995	2.001	1.442	1.164
2001	1.960	0.863	1.945	1.398	0.961
2002	1.707	0.938	2.129	1.188	3.314

	Decrease	Decrease	Increase	Decrease	Increase
Subtraction (1st year-last year)	2.4	0.2	0.1	0.7	1.9
% of decrease or increase	58.0	14.8	4.3	37.8	130.4

MCMA : Mexico City Metropolitan Area
MMA : Monterrey MetropoIitan Area
GMA : GuadaIajara Metropolitan Area
TMA : Toluca MetropoIitan Area

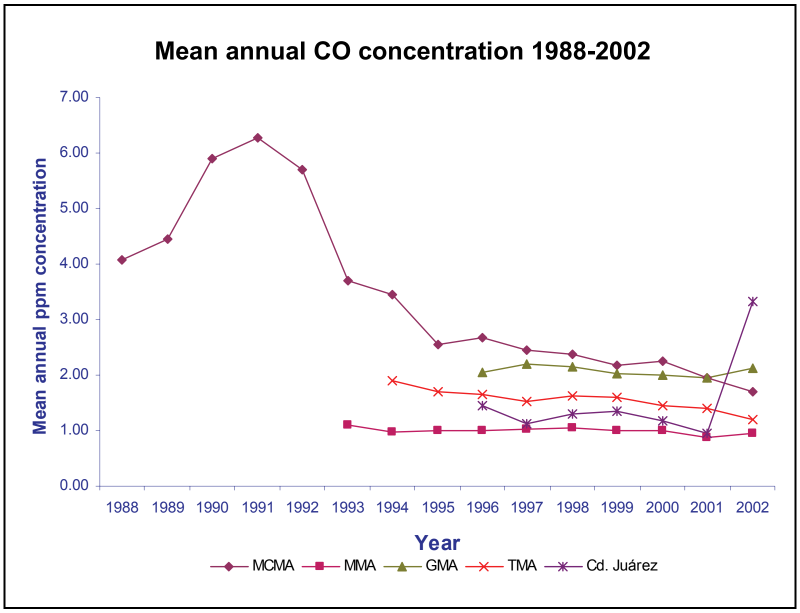

Figure 6.37 Mean annual CO concentration 1988-2002

TABLE 6.41 MEAN ANNUAL NO_2 CONCENTRATION 1988-2002 (PPM)

Year	MCMA	MMA	GMA	TMA
1988	0.038			
1989	0.041			
1990	0.042			
1991	0.041			
1992	0.046			
1993	0.042	0.019		
1994	0.037	0.019		0.024
1995	0.031	0.019		0.018
1996	0.037	0.019	0.044	0.021
1997	0.032	0.019	0.038	0.018
1998	0.029	0.017	0.044	0.022
1999	0.027	0.013	0.038	0.022
2000	0.030	0.015	0.037	0.021
2001	0.026	0.017	0.033	0.021
2002	0.028	0.011	0.039	0.021

	Decrease	Decrease	Decrease	Decrease
Subtraction (1st year-last year)	0.010	0.008	0.005	0.003
% of decrease or increase	26.4	43.3	11.6	13.0

MCMA : Mexico City Metropolitan Area
MMA : Monterrey Metropolitan Area
GMA : Guadalajara Metropolitan Area
TMA : Toluca Metropolitan Area

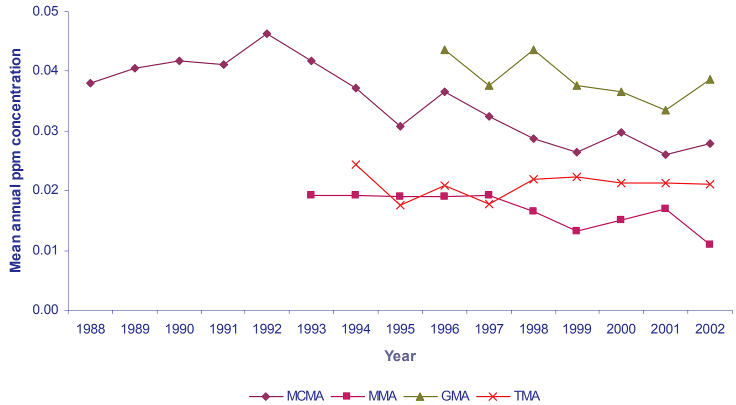

Figure 6.38 Mean annual NO_2 concentration 1988-2002

TABLE 6.42 MEAN ANNUAL PM_{10} CONCENTRATION 1993-2002 (μG/M3)

Year	MCMA	MMA	GMA	TMA	Cd. Juarez
1993		54.4			
1994		62.1			
1995	61.2	51.2			
1996	73.1	55.0	68.5		56.1
1997	73.9	42.3	52.8		48.5
1998	71.1	57.3	74.0	60.0	55.7
1999	51.4	68.3	61.1	59.4	64.9
2000	52.4	59.6	59.1	45.0	68.3
2001	51.2	84.8	56.0	42.7	65.1
2002	50.9	87.0	55.1	51.5	71.0

	Decrease	Increase	Decrease	Decrease	Increase
Subtraction (1st year-last year)	10.3	32.7	13.4	8.5	14.9
% of decrease or increase	16.8	60.1	19.6	14.1	26.6

MCMA : Mexico City Metropolitan Area
MMA : Monterrey MetropoIitan Area
GMA : GuadaIajara Metropolitan Area
TMA : Toluca MetropoIitan Area

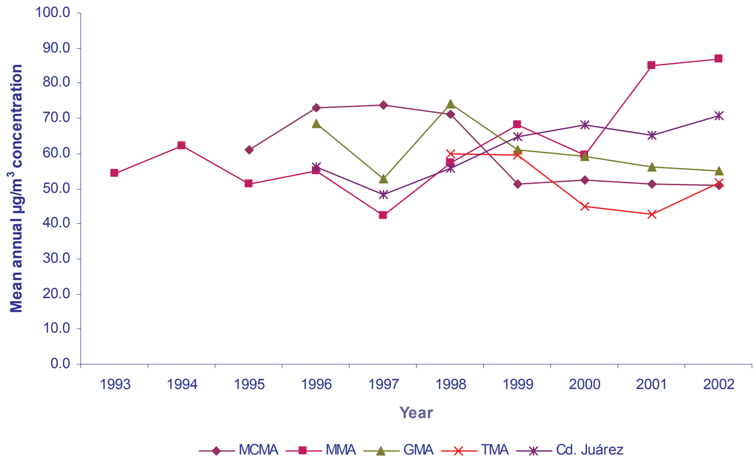

Figure 6.39 Mean annual PM10 concentration 1993-2002

TABLE 6.43 MEAN ANNUAL SO_2 CONCENTRATION 1988-2002 (PPM)

Year	MCMA	MMA	GMA	TMA
1988	0.048			
1989	0.048			
1990	0.052			
1991	0.055			
1992	0.046			
1993	0.021	0.012		
1994	0.020	0.011		
1995	0.017	0.010		0.007
1996	0.016	0.009	0.013	0.011
1997	0.014	0.010	0.011	0.009
1998	0.014	0.010	0.009	0.010
1999	0.013	0.010	0.010	0.011
2000	0.018	0.011	0.009	0.009
2001	0.016	0.011	0.008	0.010
2002	0.012	0.009	0.010	0.009

	Decrease	Decrease	Decrease	Increase
Subtraction (1st year-last year)	0.036	0.003	0.003	0.002
% of decrease or increase	74.4	27.1	24.5	29.6

MCMA : Mexico City Metropolitan Area
MMA : Monterrey Metropolitan Area
GMA : Guadalajara Metropolitan Area
TMA : Toluca Metropolitan Area

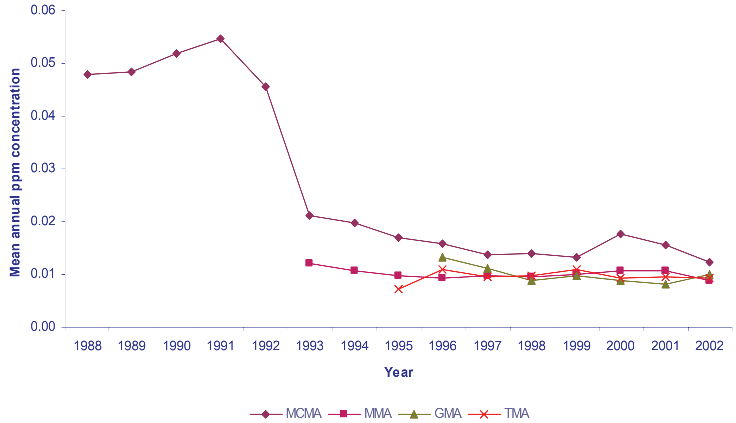

Figure 6.40 Mean annual SO_2 concentration 1988-2002

TABLE 6.44 ANNUAL PEAK OF O_3 HOURLY DATA 1988-2002 (PPM)

Year	MCMA	MMA	GMA	TMA	Cd. Juarez
1988	0.405				
1989	0.493				
1990	0.496				
1991	0.404				
1992	0.475				
1993	0.370	0.141			
1994	0.312	0.152		0.137	
1995	0.349	0.130		0.134	
1996	0.323	0.174	0.336	0.220	0.189
1997	0.318	0.186	0.299	0.167	0.148
1998	0.309	0.137	0.313	0.144	0.262
1999	0.321	0.157	0.228	0.140	0.169
2000	0.282	0.141	0.219	0.180	0.139
2001	0.271	0.224	0.194	0.144	0.141
2002	0.284	0.144	0.233	0.136	0.128
	Decrease starting from 1991	Increase	Decrease	Decrease	Decrease
Subtraction (1st year-last year)	0.121	0.003	0.103	0.001	0.061
% of decrease or increase	29.9	1.8	30.7	0.7	35.8

MCMA : Mexico City Metropolitan Area
MMA : Monterrey MetropoIitan Area
GMA : GuadaIajara Metropolitan Area
TMA : Toluca MetropoIitan Area

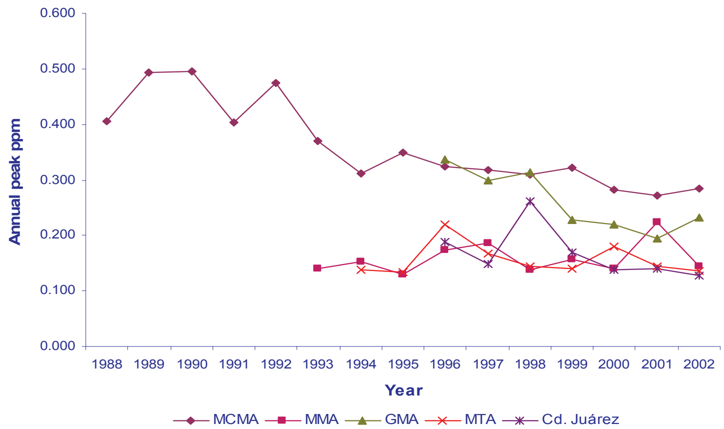

Figure 6.41 Annual Peak of O_3 hourly data 1988-2002

Trends: Air quality levels for most pollutants show a reducing tendency and remain relatively steady in the major cities.

Some trends shown by graphs may be due to the adoption of environmental protection measures for the emissions reduction of Carbon Monoxide (CO), Sulphur Dioxide (SO2), Ozone Concentration (O3), Nitrogen Dioxide (NO2), and Particles smaller than 10 µm (PM10).

For MCMA:

The "Hoy no Circula" ("Not circulating today") and Vehicle Monitoring Programs started in 1988, which means that cars with certain license plates cannot circulate one day of the week.

1989: The surfactant-type additive was replaced by one of the surfactant-dispersant types at a national level, reducing the accumulation of deposits in automobile motors. An oxygenated ingredient was added to gasoline in MCMA aimed at reducing carbon monoxide and hydrocarbons.

1992: The Industrial Emissions Control Program began, aimed at reducing NOx and HC emissions.

1993: Automobiles with a three-way catalytic converter were launched, which required the distribution of Magna Sin gasoline. National Diesel was replaced by non-sulphur Diesel (0.5% sulphur) throughout the country.

1994: The Standards NOM 085 and NOM 086 came into force, setting emission limits for industry and fuel quality. Non-sulphur Diesel was replaced by Pemex Diesel (0.05% sulphur) at the national level.

1997: The distribution of PEMEX's reformulated magna gasoline started as part of the ongoing fuel environmental-improvement program. The Vehicle Monitoring Program became modernized through the use of BAR 97 equipment.

For MMA:

1993: Automobiles with a three-way catalytic converter were launched, which required the distribution of Magna Sin gasoline.

1994: The Standards NOM 085 and NOM 086 came into force, setting emission limits for industry and fuel quality.

Indicator construction and limitations: As a complement of this indicator, the creation of indicator 24A is proposed, which should define the origin of pollutants in urban areas, so different sector contributions could be identified.

6.6.4.3. INDICATOR 26

Quantities of greenhouse gas (GHG) emissions from energy related activities (Annual GHG emissions in megatonnes (Mt); Emissions of CH4 and N2O are to be converted to CO2 equivalents using 100 year global warming potentials (GWPs) provided in the IPCC Second Assessment Report, 1995)

Definition: Emissions related to energy use, less removal by sinks, of the greenhouse gases carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O).

Purpose: This indicator measures the quantities of the three main GHGs emitted from energy sources and which have a direct impact on climate change, less the removal of the main GHG CO2 through sequestration as a result of land-use change, ocean sink and forestry.

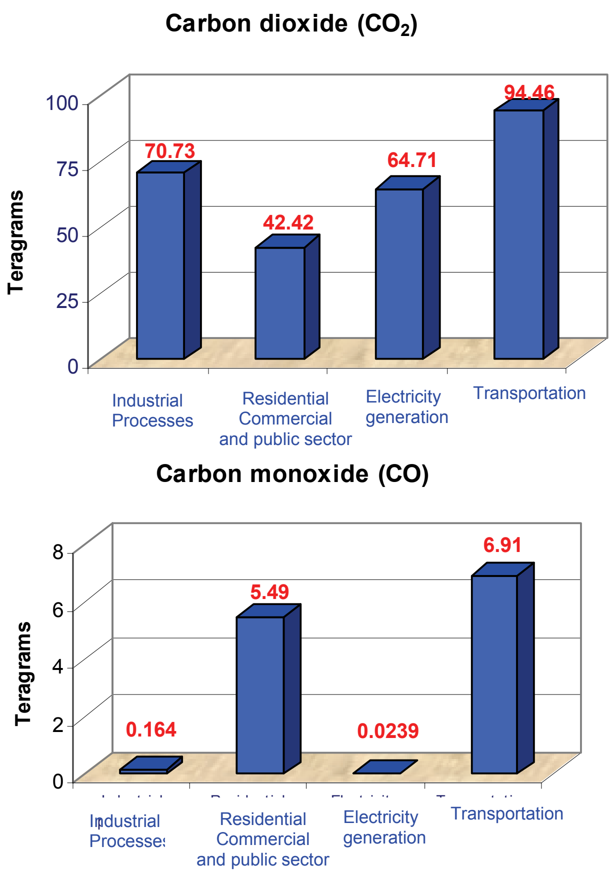

Figure 6.42 CO2 and CO Emissions
Source: SEMARNAP, INE, et al. 1995. Preliminary National Inventory of Greenhouse Gas: Mexico.

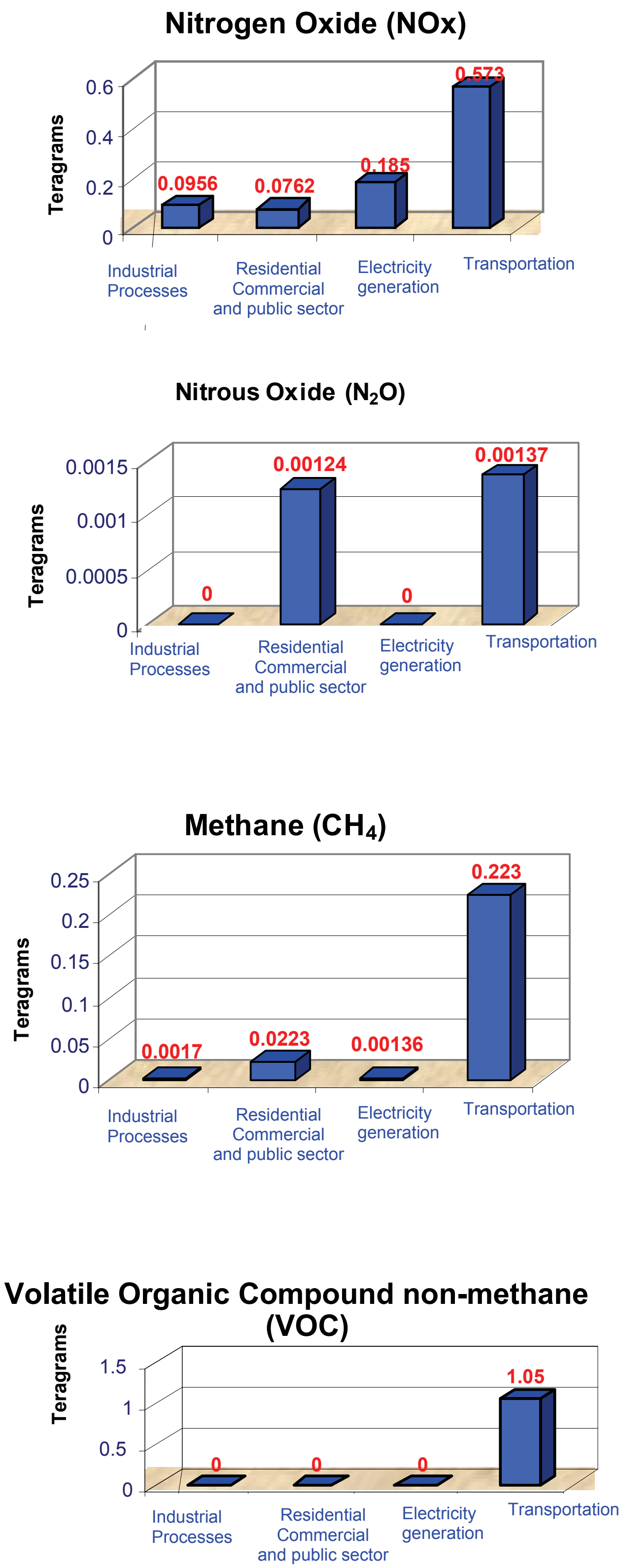

Figure 6.43 NOx, N2O, CH4 and VOC Emissions
Source: SEMARNAP, INE, et al. 1995. Preliminary National Inventory of Greenhouse Gas: Mexico.

Trends: The transport sector is responsible for 34% of the Total CO_2 emissions accounted for. Mexico has developed an important set of actions and policies for climate change mitigation, although all of them cannot be quantified accurately. During the 1990s, the Mexican economy grew under cleaner productive patterns than in the past. Inter-institutional mechanisms were established to contribute to the objectives of the Framework Convention on Climate Change of the United Nations, and by doing so the country avoided significant amounts of GHG emissions during the past decade.

Mexico is committed to continuing to require such actions in due course, independently of multilateral international negotiations. In the present circumstances, the country cannot assume additional commitments to those already accepted. Nevertheless, the establishment of flexible mechanisms derived from the Convention (and in particular the Clean Development Mechanism) will be able to complement the national effort.

Indicator construction and limitations: This indicator shows the quantity of GHGs emitted to the atmosphere from energy use only; it is relevant to note that non-energy sources can also produce significant levels of emissions. It also does not show how the climate will be affected by the increased accumulation of GHGs.

Data were not available for all GHG sources, and it is for 1995, since the last National Communication from Mexico to the Convention was done in 1998. In 2006, Mexico will present a second report.

6.6.4.4. INDICATOR 27

Radionuclides in atmospheric radioactive discharges

Definition: This indicator refers to radionuclides present in planned and controlled aerial discharges into the atmosphere from nuclear fuel cycle facilities in the country and specified by those radionuclides that contribute greater than 5% of the collective dose from discharges (noble gases, tritium, carbon-14, iodine and Cs-137).

Purpose: The purpose of this indicator is to assist in quantifying the pressures on the environment by identifying the aerial radionuclide discharges that contribute most to the collective dose. Whilst not directly related to the impact, the indicator provides a simple tool from which trends and achievements can be gauged.

TABLE 6.45 ANNUAL LIBERATED ACTIVITY IN ATMOSPHERIC DISCHARGES, GIGA BECQUEREL PER YEAR (GBQ/YR)

Isotope	1990	1999	2000	2001	2002	2003
H-3	2.16E+03	1.34E+03	5.83E+02	7.11E+02	6.80E+02	2.91E+02
I-131	4.03E-02	2.22E-02	9.97E-02	9.42E.-3	1.83E-02	8.16E-02
Cs-137	6.25E-04	1.50E-03	2.53E-03	7.37E.-4	1.24E-04	2.77E-03
AR-41	<LLD	4.95E+00	<LLD	<LLD	1.25E-02	<LLD
KR-85	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
KR-85m	6.71E+01	4.84E+02	1.10E+02	<LLD	2.97E+01	2.60E+01
KR-87	3.39E+01	5.67E+01	4.01E+00	<LLD	3.21E+01	2.00E+01
KR-88	2.01E+00	2.09E+02	1.73E+01	<LLD	2.36E+01	<LLD
XE-133	1.40E+01	1.70E+03	7.64E+02	<LLD	1.12E+00	<LLD
XE-133m	<LLD	<LLD	<LLD	<LLD	<.LLD	<LLD
XE-135	1.58E+01	3.21E+02	6.18E+01	<LLD	1.51E+01	2.78E+01
XE-135m	1.60E+01	3.91E+01	1.40E+01	<LLD	3.27E+00	<LLD
XE-138	<LLD	2.46E+01	<LLD	<LLD	3.83E+01	<LLD
Electricity generation (TWh)	9.3	9.6	7.9	8.5	NA	NA

NA: Not available
LLD: Low Line Drive
Source: Comision Federal de Electricidad Gerencia de Generacion Nucleoelectrica 2003.

Trends: For most of these elements a significant increase was observed in 1999 due to a change of the catalyst used in the only nuclear plant in Mexico. An increase in the process efficiency can also be observed, causing a reduction of tritium used.

Indicator construction and limitations: Mexico has only one nuclear power plant, which has a strict control of its emissions. This facilitates the data collection effort.

6.6.4.5. INDICATOR 28.1

Discharges into water basins: Oil into coastal waters

Definition: Total accidental, licensed and illegal discharges of mineral oil to the coastal and marine environment.

Purpose: This indicator shows the amount of oil discharges into coastal waters and has the potential to illustrate the effectiveness of measures designed to reduce these discharges over time in accordance with Regional Seas Conventions and Action Plans.

TABLE 6.46 DISCHARGES INTO MARINE REGION OF CAMPECHE SOUND, DURING OIL PRODUCTION, 2001-2002

Year	Marine region	Oil discharges		
		Total (Number)	Total (Tons)	CO_2 Emissions (tons/10^6)
2001	northeast	28	69	6.09
	southeast	1	369	1.57
2002	northeast	25	8	4.47
	southeast	2	261	1.46

Source: J. Ángel García-Cuéllar et al., Impacto ecológico de la industria petrolera en la Sonda de Campeche, México, tras tres décadas de actividad: una revisión. www.scielo.org.ve

TABLE 6.47 SEVERAL DISCHARGES OF HYDROCARBONS REGISTERED IN PEMEX REPORTS, 1999-2005

Year	Event	Cause	Loss	Site or region
1999	Oil pipeline	Valve leak	113 b crude oil	Rio Sarabia, San Juan Guichicovi, Oax.
2000	Oil pipeline	Pipeline fissure	6,300 b crude oil	Poza Rica-Madero
	Pipeline	Accident by land settle	12,000 b crude oil	Poza Rica-Madero
2001	Oil pipeline 30"	Accident by land settle	14,500 b crude oil	Minatitlán
	Pipeline 12"	Fuel intake clandestine	4,423 b crude oil	Nuevo Teapa. Poza Rica
		Fuel intake clandestine	5,371 b of gasoline	Bajío
	Oil pipeline 48" in Dos Bocas (RMSO)		2,706 b crude oil	
2002	several	Different causes	9,570 tons of hydrocarbons	Different sites
2003	Oil pipeline and gas pipeline 30 "	River avalanche		Nogales y Rio Blanco, Ver.
2004	Oil pipeline 30 "	Oil pipeline break down		Right side of Río Coatzacoalcos
2005	pipeline 4 "	Labor accident in Dam		Poza Rica, Ver.

Source: www.pemex.gob.mx

Trends: The oil intensive activity of Pemex implies pressures on the environment caused by activities and processes related to exploration, production, refining, shipment operations and storage, and accidents (break down of the submarine pipelines, ship-tank accidents, spills and explosions of platforms).

The main areas of hydrocarbons in Mexico are in the Gulf of Mexico and continental platforms, which are: Campeche basin, Veracruz, Macuspana, Chiapas-Tabasco, Sabinas, and Salina. Important natural gas deposits are in Burgos, Gulf of California, in the country's northwest.

Between January and February of 2004, Campeche basin increased its contribution of crude oil by 2.7%, in comparison to the same months of 2003. This amount, that represented 83.6 percent of the national total production, is a feature of the importance of this region. Considering the extraction of big volumes of crude oil, it is of important to note that the number of spills of hydrocarbons and the spilled quantity have diminished considerably.

Indicator construction and limitations: Information about this indicator is still lacking and mainly is related to monitoring activity, which allows distinction between the impacts due to natural factors and those due to anthropogenic factors.

6.6.4.6. INDICATOR 28.2

Discharges into water basin: Radionuclides in liquid radioactive discharges

Definition: This indicator shows radionuclides present in planned and controlled discharges into liquid; discharges into the water basin from nuclear fuel cycle facilities; and those radionuclides that contribute greater than 5% of the collective dose from discharges (noble gases, tritium, carbon-14, iodine and Cs-137).

Purpose: The purpose of this indicator is to assist in quantifying the pressures on the environment by identifying the radionuclides in liquid discharges that contribute most to the collective dose. Whilst not directly related to the impact, the indicator provides a simple tool from which trends and achievements can be gauged.

TABLE 6.48 ANNUAL DISCHARGES INTO WATER BASINS (GBQ/YR)

Isotope	1998	1999	2000	2001	2002	2003
H-3	1.12E+03	1.42E+03	5.59E+02	1.01E+03	1.82E+02	1.85E+02
C-14	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	1.32E-01	2.33E-03	1.71E-02	6.53E-03	1.41E-02	6.91E-03
AR-41	4.47E-03	<LLD	<LLD	<LLD	<LLD	<LLD
KR-85	<LLD	<LLD	<.LLD	<LLD	<LLD	<LLD
KR-85m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
KR-87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
KR-88	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
XE-133	<LLD	7.02E-03	3.85E-04	<LLD	<LLD	1.82E-03
XE-133m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
XE-135	1.97E-03	3.75E-03	2.92E-02	3.71E-03	8.24E-04	8.31E-03
XE-135m	<LDD	<LLD	<LLD	<LLD	<LLD	<LLD
XE-138	<LDD	<LLD	<LLD	<LLD	<LLD	<LLD
Electricity generation (TWh)	9.3	9.6	7.9	8.5	NA	NA

NA: Not available
LLD: Low Line Drive
Source: Comision Federal de Electricidad (Gerencia de Generacion Nucleoelectrica, 2003)

Trends: The indicator represents the planned and controlled liquid discharges from nuclear fuel cycle facilities by type of discharge. This table shows data since 1998, including 2003 for the main discharge.Discharges have been controlled and stable for the past decade.

Indicator construction and limitations: Mexico has only one nuclear power plant, which has a strict control of its emissions. This facilitates the data collection effort.

6.6.4.7. INDICATOR 29

Generation of solid wastes

Definition: Amounts of waste produced from all energy related activities and from thermal power plants in particular on a weight basis at the point of production.

Purpose: The main purpose is to represent the production of solid waste produced from activities related to various fuel chains of energy use.

For this case, within the energy sector PEMEX presents information on the inventories of hazardous residues generated by its four subsidiary companies as the result of their production activities. This information is published in PEMEX's sustainable development reports.

In accordance with the General Law for the Prevention and Integral Management of the Residues, wastes originating from PEMEX's activities are considered to be hazardous residues, which are formed principally of muds and clippings from perforation, and oily muds and worn out oils from refineries and petrochemical complexes.

TABLE 6.49 HAZARDOUS RESIDUES GENERATED BY PEMEX`S OPERATIONS, 1999 – 2003 (TONS)

		PEP	PR	PGPB	PPQ
Initial inventory 1999	344,554	46,067	285,255	199	13,033
Generation	185,001	134,556	32,812	1,085	16,548
Disposal	305,758	135,281	149,011	1,197	20,269
Final inventory 1999	223,799	45,343	169,056	88	9,312
Initial inventory 2000	223,799	45,343	169,056	88	9,312
Generation	185,303	150,443	15,023	1,064	18,773
Disposal	313,014	195,609	95,335	1,056	21,014
Final inventory 2000	96,088	177	88,744	96	7,071
Initial inventory 2001	125,550	101	118,005	1,411	6,033
Generation	278,523	217,758	40,277	1,219	19,269
Reception	11,634	11,481	153	0	0
Treated in situ	68,908	7,078	45,811	167	15,852
Treated by a third party	244,498	206,478	35,629	451	1,940
Transferred intra Pemex	6,556	6,187	87	282	0
Final inventory 2001	95,745	9,597	76,908	1,730	7,510
Initial inventory 2002	95,677	9,585	76,846	1,736	7,510
Generation	384,352	249,032	115,693	1,517	18,110
Reception	20,640	15,805	4,812	23	0
Treated in situ	138,004	15,346	107,998	29	14,631
Treated by a third party	260,775	238,422	19,935	950	1,468
Transferred intra Pemex	25,971	16,114	7,959	1,898	0
Final inventory 2002	75,919	4,540	61,459	399	9,521
Initial inventory 2003	75,859	4,507	61,432	399	9,521
Generation	481,596	381,980	85,959	1,662	11,995
Reception	20,187	19,461	376	0	350
Treated in situ	52,018	2,531	40,068	53	9,366
Treated by a third party	417,873	383,772	31,018	1,144	1,939
Transferred intra Pemex	21,530	13,608	6,960	560	402
Final inventory 2003	86,221	6,037	69,721	304	10,159

PEP: Pemex Exploración y Producción.
PR: Pemex Refining
PGPB: Pemex Gas y Petroquímica Básica.
PPQ: Pemex Petroquímica.
Source: Pemex.Informe de Desarrollo Sustentable, varios años. México, D. F., 2004.

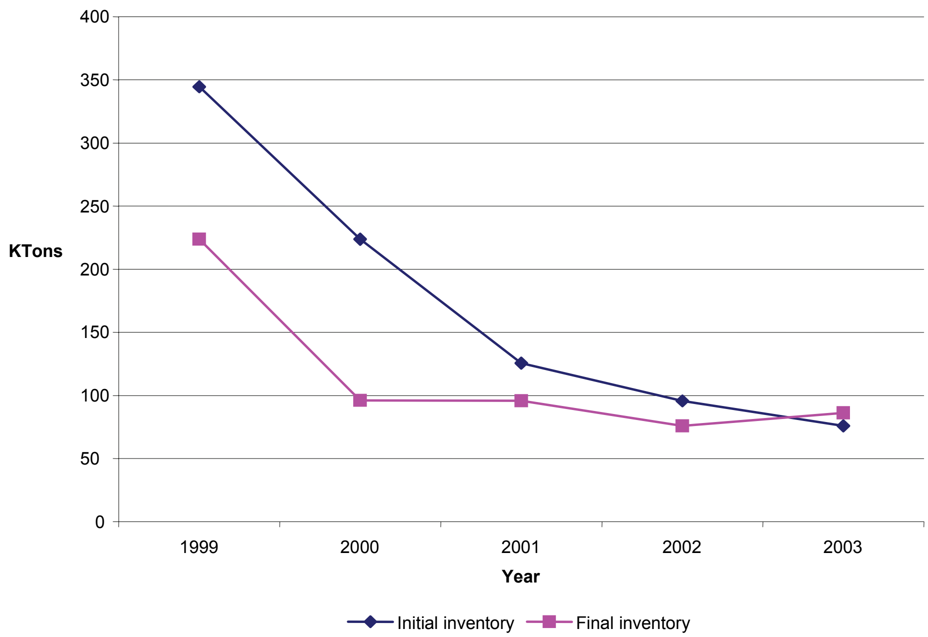

Figure 6.44 Hazardous residues generated by PEMEX´s operations, 1999 - 2003

Trends: The entire inventory of hazardous residues dropped 57%, from 223,799 tons in 1999 to 96,087 in 2000; in 2001, continuing with the efforts of inventories elimination, the disposal of most of the remaining inventory was achieved, obtaining a final inventory of 95,745 tons.

From 2002 the entire inventory increased 13.6%, from 75,919 to 86,221 tons in 2003 as a consequence of an increase in production. This increase in waste generation is principally due to the clippings and muds of perforation in Pemex Exploración and Producción, given the rising operations in the fields of development and exploration; the increase of oily muds in refineries was due to the maintenance programmed in tanks, and the increase of worn out oils was because of lubricant changes in the operation equipment.

Indicator construction and limitations: From the information that PEMEX generates based on its sustainable development reports for several years, it was possible to construct the historical series of the generation of solid hazardous residues resulting from PEMEX's operation.

In the case of the electric sector, data are scattered and not organized on the basis of consistent historical series.

The Comisión Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC) consider the worn out lubricants and the Polychlorinated Biphenyls (PCBs) among other hazardous wastes generated in the electric sector. PCB is one of the twelve organic compounds (POCs) considered to be persistent by the Stockholm Convention.

In 2002 the Secretary of the Environment and Natural Resources authorized the incineration of 32,800 liters per year of wornout oils generated in two thermal power plants. This amount, added to the one authorized in the 1999 – 2001 period for other power plants, represents a total accumulated amount of 5,032,800 liters per year.

Since 1980 the purchase of equipment with PCBs has been banned and the removal of such equipment started, in compliance with the Mexican Official Standard NOM-133-ECOL-2000.

6.6.4.8. INDICATOR 31

Generation of Radioactive Waste from Nuclear Power Fuel Cycle Chain (Cubic metre (m3) per annum for arisings destined for disposal in solid form; and tonnes of heavy metal (tU) per annum for spent fuel)

Definition: Radioactive waste arisings from nuclear power generation and other nuclear fuel cycle related activities, in forms of arisings destined for disposal in solid form, split into three different categories (high level radioactive waste; low and intermediate level radioactive waste, long-lived; low and intermediate level radioactive waste, short-lived); and spent fuel arisings.

Purpose: The purpose is to represent the annual amounts of various radioactive waste streams that arise from the nuclear fuel cycle. Quantitative values are required so that appropriate resources (e. g., financial, human, etc.) for the proper management of these types of waste can be allocated.

TABLE 6.50 SPENT FUEL ARISINGS (TONS HEAVY METAL) 1998-2003

Isotope	1998	1999	2000	2001	2002	2003a
Spent fuel arisings	22	22	22	39	20	20
Electricity generation (TWh)	9.3	9.6	7.9	8.5	NA	NA

[a] Estimated
NA: Not available.
Source: Laguna Verde Power Plant.

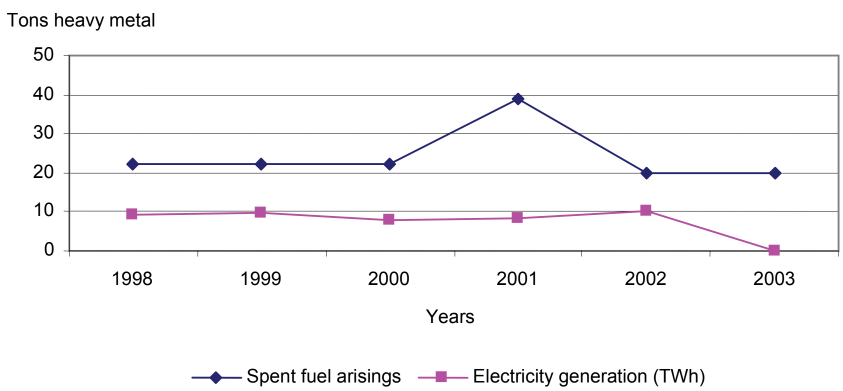

Figure 6.45 Spent fuel arisings 1998-2003

Trends: Data are presented beginning in 1998, when the nuclear plant facility started full operation. No explanation was available for the 2001 increases. Spent fuel is deposited in reactor pools.

Indicator construction and limitations: Mexico has only one nuclear power plant, which has a strict control of its emissions. This facilitates the data collection effort.

Nevertheless, defining the indicator at the overall fuel cycle level requires an elaborated methodology that is not yet fully developed.

6.6.4.9. INDICATOR 32

Accumulated quantity of radioactive waste awaiting disposal (Cubic metre (m3) broken down into the different categories as outlined in the related Driving Force Indicator "Generation of Radioactive Waste from Nuclear Power Fuel Cycle Chain", and tonne of heavy metal (tU) for spent fuel)

Definition: The indicator is a measure, at the national level, of the accumulated quantities of radioactive waste still awaiting near surface or geological disposal. These quantities include all radioactive wastes originating from a full nuclear power chain, including uranium mining, milling, and power generation, split into different categories, such as High Level radioactive Waste (HLW), Low and Intermediate Level radioactive Waste, long-lived (LILW-LL), Low and Intermediate Level radioactive Waste, short-lived (LILW-SL), and Spent fuel.

Purpose: It is recognised that near surface or geological disposal in a safe and environmentally sound manner is the most sustainable solution to the problem of radioactive waste. By giving a measure of the quantities of radioactive waste still awaiting disposal, this indicator shows the sustainable status of the existing radioactive waste management infrastructure. Increasing quantities of radioactive waste awaiting disposal over time would indicate a trend towards a less sustainable situation, thus implying a need to take actions to favour the near surface or geological disposal option.

TABLE 6.51 ACCUMULATED QUANTITY OF RADIOACTIVE WASTE AWAITING DISPOSAL (TEMPORARILY STOCKED RADIOACTIVE WASTE IN THE LAGUNA VERDE NUCLEAR PLANT) 1998-2003

Waste type description	1998	1999	2000	2001	2002	2003
Humid waste						
	BIDONS					
HUMID WASTE VOLUME (CEMENTED)	43.02	0	0	0.19	0	0
TOTAL VOLUME (CEMENTED)	48.2			0.22		
HUMID WASTE VOLUME (ASPHALTED)	249.57	11.87	7.79	1.95	0	0
TOTAL VOLUME (ASPHALTED)	279.62	13.3	8.72	2.18		
	HIC's					
HUMID WASTE VOLUME (MUDS)	240.87	34.47	19.16	22.99	3.82	26.77
TOTAL VOLUME (MUDS)	261.24	38.31	21.28	25.54	4.26	29.79
HUMID WASTE VOLUME (RESINS)	437.69	73.68	45.90	34.42	61.17	49.70
TOTAL VOLUME (RESINS)	480.46	80.88	51.08	38.31	68.10	55.33
Dry Waste						
	BIDONS					
NOT COMPACTABLE DRY WASTE VOLUME	89.65	20.80	7.90	17.06	7.49	8.74
NOT COMPACTABLE DRY WASTE TOTAL VOLUME	94	218.11	8.29	17.88	7.85	9.16
COMPACTABLE DRY WASTE VOLUME	791.02	80.70	79.46	83.62	69.26	13.10
COMPACTABLE DRY WASTE TOTAL VOLUME	829.46	84.63	83.32	87.68	72.63	13.74
	Boxes					
METALLIC WASTE TOTAL VOLUME	2.08	0	0	0	0	151.56
COMPACTABLE DRY WASTE TOTAL VOLUME	2.18					

HIC's: High Integrity Containers
BIDONS : Thermoplastic recipients
Source: Comisión Federal de Electricidad. Gerencia de Generación Nucleoeléctrica, Data from 2003.

Trends: The radioactive waste awaiting disposal has been decreasing over the past 5 years. This is due in part to waste minimization and the systematic management of the storage and disposal of such waste.

Indicator construction and limitations: There is an inevitable time lag between the moment that the waste arises and its disposal. In some cases this time lag can be on the order of decades, and therefore trends should be interpreted carefully.

6.6.4.10. INDICATOR 34

Fatalities due to accidents with breakdown by fuel chain

Definition: This indicator measures the number of annual fatalities in the energy sector as a total and broken down by coal, oil, gas, nuclear and hydro fuel chains. Additionally, fatalities in power generation sectors with breakdown by thermal, nuclear, and hydro power plants are to be specified.

Purpose: The indicator shows the number of fatalities in energy-related severe accidents. The indicator is used to assess the risk to human health derived from energy systems, and in particular by various fuel chains as a basis for their comparative risk assessment.

TABLE 6.52 WORKER FATALITIES DUE TO LABOR ACCIDENTS 2001 - 2003

Subsidiary of PEMEX	2001	2002	2003
Exploration and production PEP	NA	NA	3
Refining PR	NA	NA	2
Gas and basic petrochemicals PGPB	NA	NA	0
Petrochemicals PPQ	NA	NA	1
Corporate	NA	NA	0
Contractors	NA	NA	16
Total	5	13	22

Source: PEMEX. Informe de Desarrollo Sustentable, 2003. México, D. F., 2004.
NA: Not available

TABLE 6.53 ACCIDENT INDEX NUMBER, 1997 - 2003

Area	Frequency							Graveness						
	1997	1998	1999	2000	2001	2002	2003	1997	1998	1999	2000	2001	2002	2003
Pemex	3.96	2.68	1.19	1.19	1.00	1.17	1.09	307	325	180	170	124	132	125
Exploration and production	7.48	4.66	1.66	1.66	1.26	1.14	NA	572	436	180	277	191	154	NA
Refining	2.59	1.92	0.72	0.72	0.69	1.10	0.63	229	350	253	126	85	138	121
Gas and basic petrochemicals	1.04	0.50	0.90	0.90	0.50	1.01	0.92	224	327	118	109	88	114	110
Petrochemicals	2.31	1.48	1.06	1.06	0.53	0.88	1.07	152	175	173	170	139	156	199
Corporate	2.05	1.84	1.49	1.49	1.86	1.79	1.54	38	69	21	32	53	40	52

NA Not available.
Source: PEMEX. Informe de Desarrollo Sustentable, 2003. México, D. F., 2004.

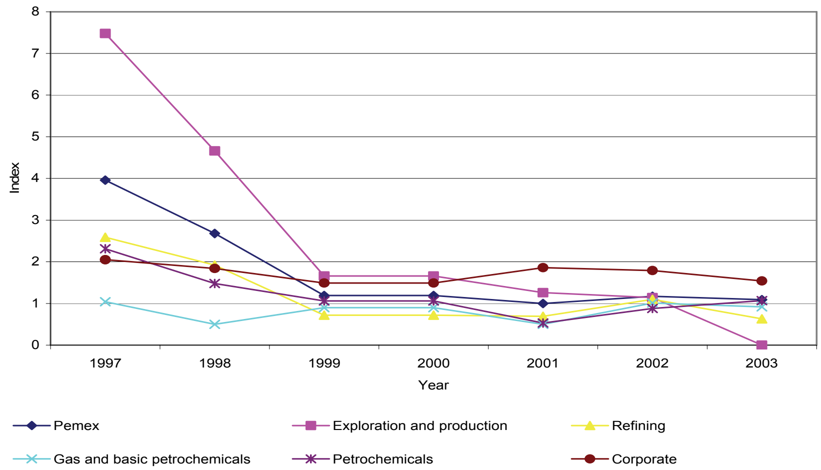

Figure 6.46 Frequency of accident index number, 1997 - 2003

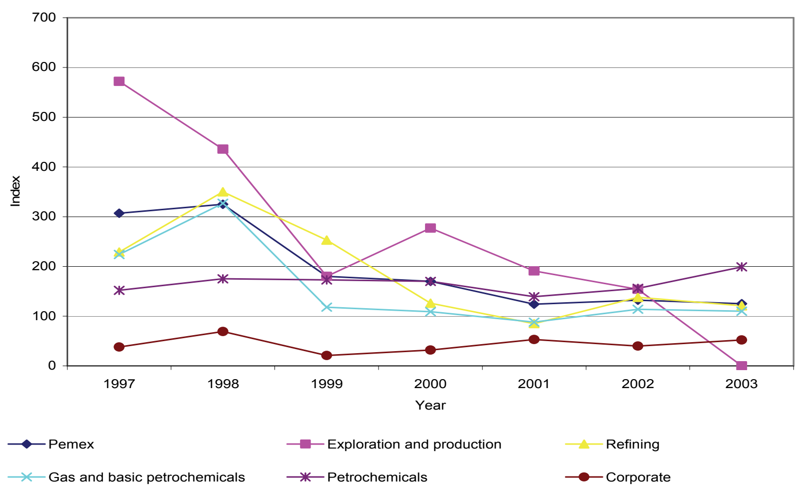

Figure 6.47 Gravity of accident index number, 1997 - 2003

Trends: PEMEX uses indices to evaluate safety performance. These indices, of frequency and gravity, reflect information on the accidents that happened by non-accomplishment of the procedures or because of the company's lack of preparedness. Even when it has advanced in fomenting the habit of reporting any accident in a systematic way, the results of the index just reflect a few accidents. In order to ensure that all accidents are reported, internal controls have been improved. Since March 2000 the information from different sources has been compared to corroborate its consistency.

In 1997, after one of the worst accidents (an explosion in a gas processing plant –Cactus- where six workers died), the Program of Security, Health and Environment Protection of PEMEX was reevaluated and reformulated.

Starting from 1998 the evaluation of the accident frequency for the contractors became evaluated with an index that takes into account the number of accident occurrences per million of man-hours worked in a certain period. This index was 2.7 in 1998, 1.9 in 1999 and 1.8 in 2000.

Indicator construction and limitations: Accidents have not been registered in nuclear energy generation, although evaluations of risk or vulnerability can exist in the facilities of the Laguna Verde plant. That information is not available.

Actually there is a wide source of information about work illness but not those fatalities due to accidents with breakdown by fuel chain.

Number of fatalities in the energy sector represents a considerable matter, although the information to incorporate into this indicator is not enough, as there are no records regarding the differentiated kind of fatalities.

6.6.4.11. INDICATOR 38

Proven Uranium reserves

Definition: Uranium ore bodies or deposits that could be produced competitively in an expanding market.

Purpose: The purpose of the indicator is to measure availability of nuclear fuel resources.

This indicator provides a basis for estimating future nuclear energy supplies, enabling proactive decision making to ensure the efficient use of these resources over the long term. Proven energy reserves represent a basic stock that governments can use to attain higher levels of sustainable development. Availability of domestic energy reserves is a necessary prerequisite to increase indigenous energy production and decrease energy import dependency.

TABLE 6.54 PROVEN URANIUM RESERVES 2003 (CONVENTIONAL RESOURCES RECOVERABLE AT UP TO USD130/KG)

Country	Recoverable at				Total recoverable at up to USD130/kg
	< USD40/kg	USD40-80/kg	< USD80/kg	USD80-130/kg	
	Thousand tonnes of uranium				
Mexico[a b c]	0	0	0	1,275	1,275
Canada	297,264	41,900	333,834	0	333,834
United States	NA	NA	102,000	243,000	345,000
Total North America	397,264	41,900	435,834	244,275	680,109
Total World[d]			2,471,600	809,900	3,281,500

[a] Data for 2001.
[b] Assessment not made for the last 5 years.
[c] *In situ* resources were adjusted by the Secretariat to estimate recoverable resources using recovery factors provided by countries or estimated by the Secretariat according to the expected production method.
[d] It includes 43 countries of a total of 50.
NA Not available.
Source: Nuclear Energy Agency. *Uranium 2003: Resources, Production and Demand.* OECD. France, 2004.
Figures for total world: World Energy Council. *Survey of Energy Resources 1999.* London, 2001.

TABLE 6.55 GEOGRAPHIC DISTRIBUTION OF URANIUM RESERVES OF MEXICO 1981

State	Reserves (tons)
Total	10,600.0
Chihuahua	2,078.1
Sonora	889.6
Durango	258.8
Nuevo León	3,477.0
Others	3,896.5

Source: UNAM-PUE. Compendium of information of the Mexican energy sector 1999. México, 1999.

Trends: Within 43 countries reporting Reasonably Assured Resources (RAR), Mexico contributes 1.25 thousand tonnes, corresponding to 0.19% of the USD 80-130/kgU cost category, and 0.04% of the <USD 130/kgU one.

In accordance with the Survey of Energy Resources 1999, uranium exploration activities in Mexico came to an end in 1983. At that point, known resources totalled 2,400 tonnes recoverable at USD 80-130/kgU, comprising 1,275 tonnes of Reasonable Assured Resources (RAR) and 525 tonnes of Estimated Additional Resources (EAR-I).

Additional undiscovered resources amounted to 12,700 tonnes, the bulk of which (10,000 tonnes) were speculative.

In 1981 there were about 14,500 tons of uranium in Mexico, of which only 10,600 tons is thought to have any possibility of being extracted. This was in the states of Nuevo León and Chihuahua, which have major volumes of 3,477.0 and 2,078.1 tons respectively.

However, currently there is no planned exploration activity, nor any development program of explored uranium reserves in Mexico.

The National Commission to Save Energy through the Federal Commission of Electricity, in a publication from 1997, considers that these reserves would ensure the necessary fuel for reactors of the nuclear electric power station at Laguna Verde during all of its life.

Actually, nuclear fuel used at Laguna Verde is purchased from a foreign firm, because this is cheaper than exploiting Mexican uranium reserves, which could only be done by a state-owned firm.

Today, Mexico follows standardized procedures to ensure that the nuclear and radioactivity industry works with the highest levels of security for the population and the environment. At the same time, Mexico is a member of the Nuclear Energy Agency (NEA) of the OECD and the International Atomic Energy Agency (IAEA). Gross nuclear electric energy generation increased from 8,220.9 GWh during 2002 to 10,501.5 GWh in 2003 (4th Annual Government Report).

Indicator construction and limitations: No exploration has occurred in Mexico for over a decade, and thus the data available comes from relatively old estimates.

6.7. Conclusions and Perspectives

Energy is essential to improving social and economic well-being, and is indispensable to most industrial and commercial wealth generation. Nevertheless, energy is a means to an end, the end being improved human welfare, improved living standards, good social health, a sustainable economy and a clean environment. Accordingly it is important to consider the fact that no form of energy can be tagged as good or bad, per se. All are valuable as an integrated and diversified energy portfolio in the search to deliver this end.

In its quest towards sustainable economic development, Mexico will require the design and implementation of an integrated strategy of resources, technology, appropriate economic incentives and strategic policy planning. An essential tool for this task is standardized monitoring of the impacts of selected policies and strategies measuring Mexico's development. It is crucial to understand the current status concerning energy and economic sustainability, in order to identify what needs to be improved and how it can be achieved.

Methods and indicators for measuring and assessing the current and future effects of energy use are needed, as well as a determination whether current energy use is sustainable—and if not, how it might be changed so that it does become sustainable. This chapter represents the first approach to such a set of tools needed for future policy development towards sustainability. In this respect, the indicators developed by SENER and INEGI (80 percent of ISED total) constitute an excellent starting point.

During recent years the population has increased considerably, reaching a rate of 1.6% per year. This in turn has raised the need for an important increase in additional services, which has a direct impact on Mexico's sustainable development.

Because of an increase in energy efficiency programs, the energy sector has been able to lower energy intensity. From 1993 to 2003, it has decreased by 14%.

Sulphur dioxide emissions (in tons), which are the principal emissions problem within the energy sector (for both CFE and PEMEX) resulting from the fossil fuels used, decreased by 16.5% from 2000 to 2003.

Mexico has been fostering the use of renewable sources of energy, particularly hydro and geothermal electricity, and hydropower represents 23% of the nation's total installed capacity. Mexico is ranked third in the world in terms of installed capacity for geothermal energy.

Nonetheless, a major push is needed for other sources of renewable energy. In 2003, renewable energy accounted for only 6.1% of the national production of primary energy.

Current electricity planning foresees an increase in the dependence on (imported) natural gas. Another potential problem is the increase in vulnerability to price volatility for energy-related services, due to dependence on hydrocarbons (oil and gas).

6.7.1. Potential Strategies for the Future

6.7.1.1. Promotion of renewable energies in Mexico

The Goal #4 of the programme PROSENER is to "Improve energy efficiency programs and development of renewable energies." Further, it stipulates that 1,000 MW (additional to CFE´s expansion program) will be installed by 2006 based on renewable sources such as solar, wind, mini hydro, geothermal and biomass. As presented earlier in this document, there is an enormous potential for energy generation based on renewable sources. By doing so there would be a diversification of the energy supply, an attenuation of impacts on the environment, the possible promotion of specific activities within the manufacturing sector, and an important enhancement of a national technology area that has been working in the country for more than 25 years. Additionally, promotion of renewable energies would increase employment and local development, and would benefit isolated populations.

Based on some ISED indicators, it can be concluded that the 1,000 MW goal has not been accomplished, but some of the factors/actions that have been identified that would help install such renewable capacity are to:

- Consider environmental externalities in electricity prices;
- Establish national and regional policies and programs in accordance with changes in the structure of the energy sector;
- Establish a regulatory base for the promotion of renewable energies and cogeneration;
- Create a National System for the assessment, registration and diffusion of renewable resources in the country;
- Create a financial mechanism to promote renewable energies;
- Allocate resources for research and technological development;
- Maintain and improve cooperation of Mexican institutions with academic, bilateral and multilateral bodies.

Several actions are currently taking place in Mexico towards these purposes; they include:

- Private, public and mixed project development to increase installed capacity for energy and electricity generation.
- Promotion of projects to increase installed capacity for electricity generation (primarily wind), design of a financial mechanism, and capacity building (among others) in the "Large Scale Renewable Energy Development Project" financed by the Global Environment Facility (GEF) – the World Bank.

- Construction of a wind technology research centre with a grant given by GEF – United Nations Development Programme for the development of the "Action Plan for Removing Barriers to the Full-scale Implementation of Wind Power."
- Participation of different sectors in initiatives, forums, and meetings intended to profile a draft document in order to conceive a law entitled: Law for the Promotion of Renewable Energies and Cogeneration.

6.7.1.2. Clean fuels

Based upon environmental criteria, and specifically the Mexican Official Norm "NOM-086-ECOL-1994" that deals with environmental criteria for fossil fuels (liquid and gaseous) used in stationary and mobile emission sources, PEMEX has made changes regarding gasoline quality. In the 1990s, the most remarkable were the phase-out of leaded gasoline, and the introduction of a low sulphur diesel and a high octane (93) gasoline in the Mexican market. These represented investments of 1,700 million USD.

Due to technological advances and existing regulations (that force Official Norms to be reviewed), the sulphur in gasoline and diesel is expected to diminish.

Further, delays in the introduction of cleaner fuels to the market will have negative impacts on health (morbidity and mortality), the environment (acid rain, global warming, etc.), the economy (agricultural impacts, damages to infrastructure, etc.), as well as to the auto industry. The latter impact would affect the exportation of this sector because new American and European technologies are readily available, and some of them cannot operate with existing levels of sulphur, since this element "poisons" pollution control equipment installed in automobiles (for reducing pollutants in exhaust: organic compounds, nitrogen oxides, carbon monoxide and dioxide, etc.).

PEMEX estimates that over 2,380 million USD are needed to make the necessary changes in the National System of Refineries so cleaner fuels can be produced (and not imported, preventing further energy import dependency): for gasoline, 1,300 million USD; diesel, 750 million USD; and for the adequate management of residual gases containing sulphur, 330 million USD (costs are calculated for a five-year period).

Two options are currently being considered for financing this project: budget allocation by the Ministry of Finance and approval by the Legislative Branch, as well as charging investment to consumption.

Analyses regarding the most suitable investment scenario are still being developed, but what is clear is that this improvement has to be made as soon as possible.

Some perspectives on sustainable energy development

The complex interrelationships among changes in population, economic development, and energy consumption appear to reveal some important trends about these three broad factors. How significantly does the size and growth of the Mexican population and economic growth levels affect the demand for energy?

The average annual growth of the total population has been constantly reduced over the past fifty years: 3.3% in 1950-1970, 2.5% in 1970-1990, and 1.6% in 1990-2000. Over the past few decades, Mexico has experienced rapid economic growth; however, in recent years, despite several serious economic crises, this growth has stabilized around 2%. The real GDP per capita (1993 price level and PPP's - $US) had an average annual growth of 1.79% in 1990-2001. Average annual growth of toe energy consumption per capita dropped -0.74% from 1990 to 2001.

From a demographic point of view Mexico experienced unparalleled transformations during the twentieth century. First, it went through cycles of intense population growth and, more recently, of a marked deceleration. Thus, in accordance with the Census figures, the Mexican population went from almost 17 to nearly 26 million people between 1930 and 1950; in the next twenty years, the number of inhabitants almost doubled, and then only required three decades to be doubled again. At the present time, with around 100 million inhabitants, Mexico occupies eleventh place among the most populated nations in the world. It is forecasted that it will maintain that same position for the next several decades.

In recent times, economic growth has not been sufficient to assimilate the reality of the demographic growth throughout the country; the informal economy, underemployment and poverty persist.

Public policies designed to address the above-stated facts are based on the following approaches:

- A. To increase fiscal coverage, starting from a higher base of taxpayers. Mexico is today one of the countries with the lowest fiscal coverage. This prevents the country from having enough resources to deepen social programs, including a primary focus on decreasing poverty. On the other hand, the spread of the application of the value added tax to all products would already allow a larger tax collection for such purposes.
- B. To achieve approval of the structural reforms addressing the standing laws on energy, fiscal management and the labor sector. Another government strategy seeks to achieve the approval of changes in standing legislation that allows private capital to participate in the energy sector (PEMEX, CFE), in order to raise its profitability and to boost this decisive sector in the country's development. In the labor sector, changes are being considered in legislation to encourage the participation of foreign investment, as well as to encourage further domestic investment.
- C. To encourage self-management through credit support for micro and small companies. This would allow the employment of all those who did not have room within the formal economy, as well as provide technical support to impel productive projects.

While Mexican economic performance has been stable, some social conditions for Mexico's growing population need to be improved. It is necessary to pay attention not only to the welfare of society, but also to pollution controls and infrastructure considerations in order to reduce or reverse environmental degradation.

People in rural areas of Mexico gather and use energy, often inefficiently, in the form of fuelwood or dung for cooking and heating. But this consumption pattern is contributing to erosion and the loss of soil fertility and, due to poor combustion, to a widespread incidence of air pollution. While poverty is the primary cause of this practice, limited access to information and the absence or lax enforcement of property rights are factors as well.

Energy use in Mexico's densely populated urban areas shows some positive characteristics. Greater density improves the economics of public transport systems, thereby achieving lower energy use per passenger-kilometer of travel in some cities. Multi-family housing, another attribute of high population density, allows for more efficient energy use than single-family homes.

Though there have been public health elements in previous pieces of legislation, Mexico only began to seriously address environmental protection in the late 1980s and 1990s. The first comprehensive environmental bill, the General Law of Ecological Balance and Environmental Protection (LGEEPA), enacted in 1988, was amended in 1996 to make sustainable development an explicit concern of the federal government.

In summary, social programs, the creation of employment and productive efficiency are the big challenges to tackle in ensuring sustainable development. The resulting efforts should result in a reduction of the inequity of the existing income distribution, decreases in poverty, improvements in the environment, and, ultimately, a better quality of life.

Public policies that raise the agricultural sector's participation in the GDP (which currently has the smallest share of all sectors) under the North America Free Trade Agreement are required. This could be done mainly by promoting policies decreasing cost inputs, to elevate levels of competitiveness and production; promoting and supporting peasant economic organizations; and strengthening their capacity of self-organization in access to markets.

In order to achieve competitive economic development, at the same time it is also necessary to have a balanced regional development. This could be done by strengthening the regional economies; by supporting plans for urban development and territorial regulation; by guaranteeing that ecological sustainability and economic development are addressed in all regions of the country; and by fostering the creation of nuclei of development that discourage regional migration.

Future tasks and proposals

Seeing that the ISED methodology package does not provide institutional dimension indicators or response indicators according to the DSR framework, Mexico should consider the development of some response indicators, such as:

- Quality of fuels by type of main pollutant
- Official ecological standards for regulating environmental pollution from energy
- Conventions ratified
- Energy consumption per capita in urban areas or cities

Other strategic indicators to be developed in Mexico on a long-term basis might include those related to energy production and consumption patterns (mainly in urban areas); the decoupling of energy and the environment; renewable sources; energy consumption in households; energy eco-efficiency; rural energy use; and the energy-poverty relationship, among others.

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ANNEX 6.1: Acronyms and Abbreviations

Acronyms

CONAE = Comisión Nacional para el Ahorro de Energía.

IEA = International Energy Agency.

IIE = Instituto de Investigaciones Eléctricas.

IMP = Instituto Mexicano del Petróleo.

INE = Instituto Nacional de Ecología.

INEGI = Instituto Nacional de Estadística, Geografía e Informática.

ININ = Instituto Nacional de Investigaciones Nucleares.

IPCC = Intergovernmental Panel on Climate Change.

OECD = Organisation of Economic Co-operation and Development.

PEMEX = Petróleos Mexicanos.

CFE = Comisión Federal de Electricidad.

CONASENUSA = Comisión Nacional de Seguridad Nuclear y Salvaguardias.

LFC = Compañía de Luz y Fuerza del Centro.

SCT = Secretaría de Comunicaciones y Transportes.

SEMARNAT = Secretaría de Medio Ambiente y Recursos Naturales.

SENER = Secretaría de Energía.

MCMA = Mexico City Metropolitan Area

MMA = Monterrey Metropolitan Area

GMA = Guadalajara Metropolitan Area

TMA = Toluca Metropolitan Area

WEC = World Energy Council.

Abbreviations

CH_4 = methane – a greenhouse gas.

CHP = Combined heat and power.

CO_2 = Carbon dioxide – a greenhouse gas.

DPSIR = Driving forces, Pressures, State, Impact and Responses.

EAR – I = Estimated Additional Resources I.

EAR-II = Estimated Additional Resources II.

FCCC= Framework Convention on Climate Change (UN).

GBq = Giga Becquerel.

GDP = Gross Domestic Product.

GJ = Gigajoule.

HFCs = Hydrofluorocarbons.

Km = Kilometre.

Ktonnes = Thousand tonnes.

kWh = Kilowatt hour.

Mt = Million tonnes.

Mtoe = Million tonnes of oil equivalent.

NH_4 = ammonia.

N_2O = Nitrous oxide.

NMVOC = Non-methane volatile organic compounds.

NO_X = Nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO_2).

Peta joule (PJ) unit = 10^{15} joules.

PM = Particulate matter.

RAR = Reasonably Assured Resources.

SO_2 = Sulphur dioxide.

Toe = Tonnes of oil equivalent.

tU = Tonnes of recoverable uranium (= approximately 1.3 short tons of uranium oxide).

Short ton U_3O_8 = Tonnes of uranium oxide (= 0.769 tU).

US$ 1 per pound of uranium oxide = US$ 2.6 per kilogram of uranium.

TWh = Terawatt hour.

UNFCCC = United Nations Framework Convention on Climate Change.