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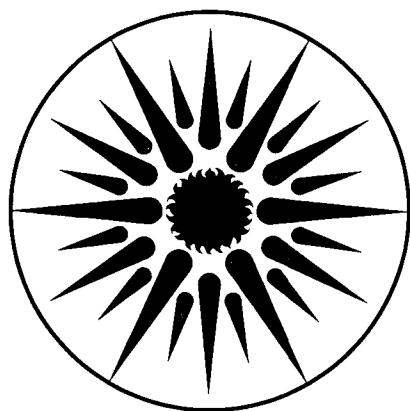
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MEXICAN OIL BALANCE AND OPPORTUNITIES FOR CONSERVATION

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June 1986

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SUMMARY

Mexico's abundant oil reserves spurred the development of a highly oil-intensive domestic economy. While oil demand continues to grow despite the recession of the last four years, the recent drop in oil prices -- and therefore in export revenues -- is limiting the country's capacity to invest in new exploration. At the same time, the country's need to generate foreign exchange to pay its debt service may force an escalation in oil exports. A conflict is emerging between Mexico's need to satisfy the domestic demand for oil and its need to export oil to service the debt. In this context, an oil conservation policy appears to be the only viable alternative, although its potential will be limited by lack of capital. The sectoral analysis presented in this report identifies unexplored opportunities for energy conservation and points to the forces that will drive future patterns of demand.

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For almost a decade Mexico's economy has depended heavily on the oil sector. With the discovery of vast oil reserves in Campeche in 1977 and the subsequent upgrading of reserves from 6 to 72 billion barrels, petroleum propelled the country into a period of unprecedented economic growth.

The economic surge occurred so rapidly that oil revenues alone could not keep pace with domestic investments and consumption. As a result, both the private and public sector turned abroad for additional capital. Foreign loans were easily obtained since expectations about Mexico's ability to generate future income made international bankers compete to lend to Mexico. Oil was thus used as collateral to guarantee repayment of Mexico's ever increasing foreign debt.

Mexico mobilized an all out effort to increase rapidly the levels of oil production, committing most of its investments to develop the petroleum sector. The effect was that other sectors of the economy, and most importantly the non-oil export-producing sectors, stagnated or contracted. Oil thus became increasingly vital as a generator of the foreign exchange needed to repay the increasing debt service.

The dangers of building the entire economy around one resource were exposed when growing interest rates in the early eighties, and the drop in oil prices since 1981, forced Mexico's economy into an unprecedented crisis. With oil prices collapsing in 1986, the country has no other product to turn to. Thus, with annual debt service payments amounting to \$14 billion (the equivalent of 75% of the country's annual oil revenues), Mexico's only alternative to an economic collapse is to go further into debt.

At a time when Mexico's decision makers, as well as foreign creditors, are desperate to find new ways to increase economic efficiency, a thorough analysis of oil demand patterns reveals a significant level of inefficiency in the country's energy system. The oil sector itself appears to hold a tremendous savings potential. Further, significant reductions in the level of consumption can be achieved in each of the major economic sectors.

This report examines the evolution of oil demand in Mexico, analyzing consumption patterns in the principal economic sectors, including the oil sector itself. It describes present levels and historical trends, and compares them with consistent information on other Latin American countries (analyzed in previous studies in this series (1-4)), pointing to the factors that drive oil consumption. It concludes by identifying the most important and realistic potential for savings and substitution, taking into account the fact that Mexico does not presently have resources available to invest in costly conservation schemes. The Appendix reviews the expansion of the oil industry, and discusses its importance for the Mexican economy.

Where Oil Goes Today

Out of a total energy production in 1984 of 214 MTOE, Mexico exported 92 MTOE in the form of hydrocarbons (92% crude, 6.7% products, and 1.3% natural gas). Of the remaining 122 MTOE available for domestic supply, oil accounted for 63% of total energy used, and natural gas for 29%. Hydro (5.3%) and coal (2.3%) covered most of the small remaining share. These shares have been relatively stable since 1978, except for yearly switching in the order of 2-3 percentage points between oil and gas (Table 1).

Table 1. Mexico: Commercial Energy Supply* Sources (%)

Year	Oil	N. Gas	Coal	Hydro	Other**	Total	[Bagasse]***
1970	54.5	31.9	3.0	10.6	0	100	
1975	60.3	28.7	3.3	7.4	0.3	100	
1977	64.7	24.4	2.9	7.7	0.3	100	
1978	63.2	28.1	3.0	5.6	0.1	100	
1979	62.1	29.3	2.6	5.6	0.4	100	
1980	64.8	27.9	2.4	4.6	0.3	100	
1981	63.0	28.7	1.9	6.1	0.3	100	
1982	60.1	32.2	2.2	5.2	0.3	100	[1.5]
1983	59.9	32.5	2.4	4.8	0.4	100	[1.6]
1984	62.7	29.4	2.3	5.3	0.3	100	[1.6]

* Figures include energy use in the oil sector.

** Includes geothermal and imported electricity.

*** Bagasse is given as additional percentage of Total Commercial Energy Supply when known.

Two sectors share the largest component of energy consumption: the *oil sector* (i.e. Petroleos Mexicanos, PEMEX) and the *electric power generation system* (i.e. Comision Federal de Electricidad, CFE). In 1983 these absorbed 30* and 12 percent respectively of all domestic consumption. The other consuming sectors, *Industry, Transportation, Residential & Commercial*, and *Agriculture* accounted for the remaining 58 percent. The following sections analyze the disaggregated distribution of oil products in the major consuming sectors. The analysis begins with the oil industry, which appears to hold a considerable potential for energy conservation.

* - Basic petrochemical industry, vertically integrated within Pemex, accounted for 40% of the oil sector's energy demand, leaving the rest (18.5% of total) to the oil industry.

The Oil Sector

Figure 1 follows the destination of crude oil throughout the oil industry process up to the final destination of each major petroleum product. It displays the distribution of oil products to the major consuming sectors according to the Pemex "sales" categories, therefore considering Power Generation as part of Industrial energy use.

In 1984, some 20 percent of the 1,524 Kbd ('000 barrels per day) that entered Mexico's oil processing system were either (i) used by Pemex, (ii) lost in the transformation process, or (iii) unaccounted for. As shown in Figure 1, the most significant losses are attributed to the evaporation of natural gasolines and condensate products prior to the refining process. The production of natural gas liquids (NGL) and condensates is relatively recent in Mexico, and, according to Pemex, not yet integrated with the crude processing. This induces a loss of around 60 percent of condensates, and 17 percent of volatile natural gasolines. At a later stage in the processing system, additional losses (50 Kbd) are attributed to the refining system, while 35 Kbd are used internally by Pemex, mostly to run the plants. Downstream from the refineries, Pemex also absorbs 112 Kbd of products, an amount equal to 9.3 percent of total fuels for domestic consumption.

The efficiency of the oil industry appears to have dropped to below 80 percent in recent years (Table 2), as refining capacity increased and the load factor of the processing plants declined. Changes in the product mix did not appear to be determinant, as the proportion of light to heavy products did not vary significantly in the same period.** The comparable level of 85.8% efficiency in 1983 for Venezuela reveals the opportunity that the country has to tap the oil waste.

Poor maintenance and administrative control is considered a major cause of inefficiency in the oil sector, and present Pemex plans call for strong action to correct this pattern. This program could be complemented with a number of technical measures, the most important being the cogeneration of steam and electricity, which, unlike in most other countries, is produced separately at present.

** - The relationship of Gasoline+Diesel+Kerosene over Fuel Oil varied only between 1.51 and 1.54 in the 1977-1981 period, and dropped slightly to 1.47 in 1983.

FIGURE 1 - MEXICAN OIL FROM PRODUCTION TO CONSUMPTION, 1984
(in 10³ barrels per day)

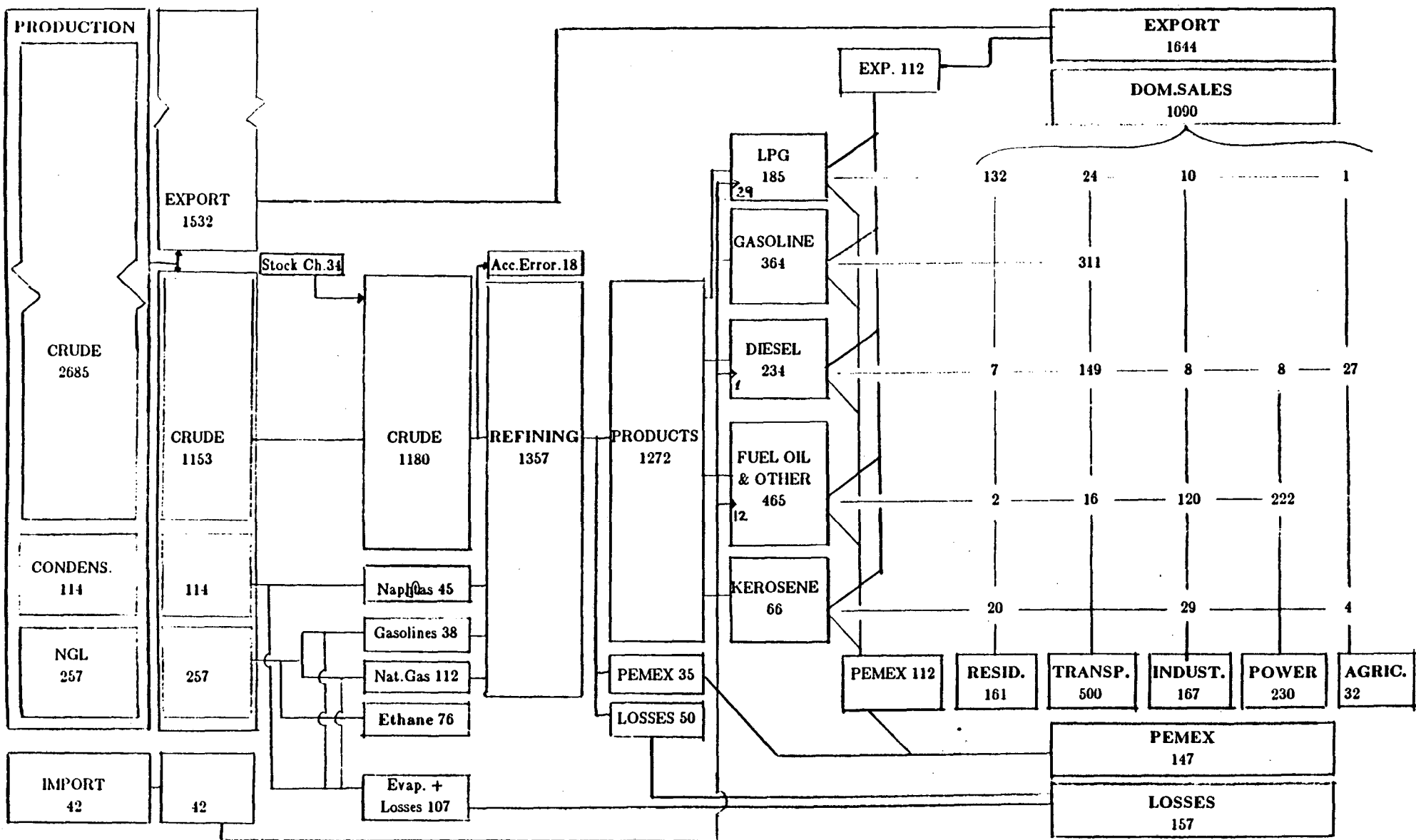


Table 2. MEXICO - Energy Use in the Oil Industry, 1970-1983
(10¹² Kcal)

Year	Primary Source			Energy Used for Transformation	Secondary Source OUT	Efficiency* %
	Oil	Gas	Total			
1970	237.4	131.6	369.0	44.37	355.6	86.03
1975	326.8	169.8	496.7	64.85	482.6	85.94
1977	411.4	185.5	596.9	79.32	562.5	83.18
1979	467.2	286.7	754.0	109.22	689.5	79.89
1981	608.5	382.3	990.9	145.43	911.0	80.17
1983	517.0	421.8	938.9	90.86	800.3	77.72

Notes: [*] calculated as:

$(\text{Secondary Out}) / ((\text{Primary In}) + (\text{Energy for Transf.}))$

Source: Schutz, SEPAFIN, PEMEX.

Changing Price Policies

All during the 1970s, energy prices in Mexico were exceptionally low compared to other countries. Consequently, Mexico's oil consumption increased while the oil crisis forced oil importing Latin American countries to develop innovative schemes to cut oil demand, substitute coal and natural gas for oil, and promote more efficient oil use in all economic sectors.

The energy price gap between Mexico and the rest of the world increased continuously until the early 1980s, when economic austerity forced the government to drastically reduce the subsidies to energy consumption. While the price of natural gas per BTU remained slightly higher than that for fuel oil up to 1981, it was progressively increased to twice the level of fuel oil by 1983. In 1981, before this major policy change, subsidies on oil products amounted to \$11.4 billion.

It should be emphasized that cheap oil prices were maintained as part of a general effort to encourage industrial growth, and maintain social peace (e.g. subsidizing of transportation and tortilla production). But with energy prices kept artificially low, conservation investments appeared not to be cost-effective, and there was little incentive to saving or substituting fuels. As a result, production methods tend to be less energy efficient in Mexico than in other countries. However, to compete with other countries'

products, Mexico needs now to control the cost of energy inputs in its production processes.

Power Generation

Electricity generation increased nearly threefold between 1970 and 1984. Annual growth persisted at 8-10 per cent per year until 1983, when it declined to 2%.

As thermal generating capacity grew faster than hydroelectric capacity, oil input to the generation process increased steadily from 25% in 1970 to 55% in 1984, while the contribution of hydro and gas decreased (Table 3).

Hydroelectricity, which accounted for 57% of the total electricity generation in 1970, contributed only 29% in 1984. Unlike all other Latin-American countries, hydroelectric generation in Mexico is not expected to grow considerably in the future, due to high capital costs and the limited number of unexploited sites for large dams.

Also declining was the share of natural gas. Despite the existence of dual-firing capability developed to guarantee the use of the natural gas associated with oil deposits, its share was reduced from 17 to 9 percent during the period 1970-1984. This sharp decline appears to be caused by the availability of fuel oil surpluses, and at a price much lower than that of gas. The increase in gas prices induced the CFE to cut its gas consumption by 27% between 1981 and 1984, down 40% from its all-time high of 1979.

In recent years, coal and geothermal sites have been developed as alternatives to hydro-carbons, although they have not resulted in major changes in the overall structure of electricity generation. While geothermal capacity is expected to reach 600 MW and coal 1200 MW by 1990, their present contribution remains minimal (5.3% for coal and 1.8% for geothermal in 1984). Construction of more than one of the many nuclear power plants planned in the late seventies now appears unlikely because of the increasing costs and the difficulties in procuring foreign exchange.

Between 1970 and 1982, the residential and industrial sectors, which account for 78% of electricity end use (excluding Services), experienced 10 and 9 percent annual growth rates respectively. While demand in both sectors has been temporarily depressed by the economic recession -- dropping to 3.3 and 5.8 %-yr between 1982 and 1984 -- growth patterns are likely to resume although at lower levels than in the 1970s, inducing an increasing need for more generation capacity.

Table 3. Electric Power Generation, 1970-1984

	Capacity (MW)	Hydro (%)	Oil (%)	Gas (%)	Geothermal (%)	Coal (%)
1970	6068	56.9	25.2	16.9	0	1.0
1975	9830	36.7	44.5	16.9	1.3	0.6
1976	11460	38.3	46.9	12.9	1.3	0.6
1977	12092	38.9	47.5	11.8	1.2	0.6
1978	13992	30.3	53.8	14.7	1.1	0
1979	14298	30.7	48.7	18.8	1.8	0
1980*	14625	27.1	54.9	16.6	1.5	0
1981	17396	36.0	48.9	13.7	1.4	0
1982	18390	31.0	50.7	14.2	1.8	2.3
1983	19004	27.5	54.5	11.6	1.8	4.6
1984	19378	29.4	54.8	8.7	1.8	5.3

Notes: (*) 1980 data reflect seasonal shortage.

Source: CFE, PEMEX.

The overall efficiency of the thermal generation has increased steadily since 1975, reaching 30 percent in 1982, despite the grid being not completely interconnected. However, important steps can be taken to manage electricity demand, particularly by encouraging cogeneration. We mentioned above the considerable potential in the oil industry, where such plants do not exist. A recent study indicates that 50% of electricity used in the paper and the chemicals industry could be generated internally if combined heat and electricity production techniques were implemented. Correspondingly, 30% of electricity used in the steel industry could potentially be produced through cogeneration.

Oil Use in the Industrial Sector

The industrial share of total oil consumption decreased slightly between 1970 and 1981 (from 16 to 14 percent). During the boom years 1977-81, oil demand increased at only half the rate of total energy growth in this sector (which measured 6%-yr), reversing the trend observed in the first part of the 1970's (Oil: 8%-yr; Energy: 5%-yr). Consequently, oil share of total industrial energy demand dropped steadily, to a low of 26% in 1983 (see Table 4, which includes wood and bagasse). Natural gas picked up the oil consumption share, growing at 9 percent per year between 1977 and 1981. More recent

substitution patterns are difficult to determine, since the recession has provoked major changes in the composition of industrial output.

Economic austerity has forced drastic cuts in domestic demand, curtailing growth in all industrial sectors (industrial output decreased by 2% in 1982 and 5% in 1983). With decreasing oil prices and no resolution of the debt crisis, the outlook is bleak. The temporary recovery that took place in 1984 (industrial output increased 4% helped by government policies that guaranteed industries against foreign exchange losses) is expected to give way to a severe and prolonged contraction. This, in turn, implies that oil consumption is likely to remain depressed in all industrial sectors.

According to a 1981 survey, industrial *energy* demand is dominated by Iron & Steel (27%), Chemicals (11%), and Cement(9%), while the largest *oil product* users are Cement (32% of total industrial sector's oil), Chemicals (24%), and Paper and Pulp (14%). These are also the most oil intensive sectors, with oil shares of 46%, 28%, and 38% respectively.

The growth in value added -- and physical output -- of the most energy intensive industries (Table 5) followed the pattern of the entire sector throughout the different phases of expansion and recession of the country's economy (the only exception was the Chemical industry which noted an extraordinary growth throughout this period). If no major fuel substitution is achieved during the present recession, we expect this pattern of growth to resume following the recession period.

Table 4. MEXICO - Delivered Energy by Sectors, 1983

	Industry	Non-Energy	Res.-Comm.	Agricult.	Transport.	TOTAL
OIL, 10 ¹² Kcal	61.15	48.84	68.47	1.62	262.67	442.75
-, % of sec.	25.6	42.3	41.3	29.8	99.8	56.2
-, % of fuel	(13.8)	(11.0)	(15.5)	(0.4)	(59.3)	(100)
NAT. GAS, 10 ¹² Kcal	93.51	66.53	6.25	-	-	166.29
-, % of sec.	39.2	57.7	3.8			21.1
-, % of fuel	(56.2)	(40.0)	(3.8)			(100)
COAL, 10 ¹² Kcal	38.19	-	-	-	-	38.19
-, % of sec.	16.0					4.8
-, % of fuel	(100)					(100)
WOOD,BAGASSE, 10 ¹² Kcal	15.47	-	72.16	-	-	87.63
-, % of sec.	6.5		43.6			11.1
-, % of fuel	(17.7)		(82.3)			(100)
ELECTRICITY, 10 ¹² Kcal	30.42	-	18.75	3.82	0.45	53.44
-, % of sec.	12.7		11.3	70.2	0.2	6.8
-, % of fuel	(56.9)		(35.1)	(7.2)	(0.8)	(100)
TOTAL, 10 ¹² Kcal	238.74	115.37	165.63	5.44	263.12	788.30
-, % of sec.	100	100	100	100	100	100
-, % of fuel	(30.3)	(14.6)	(21.0)	(0.7)	(33.4)	(100)

Source: C.F.E.

Table 5. Patterns of Industrial Growth

(%-yr, based on value added, physical output in parenthesis)

	1970-77	1977-81	1981-84
Industry	6.0	9.4	-1.9
- Iron&Steel	6.1(5.2*)	8.1(7.8*)	-1.1(-1.0*)
- Cement	8.7(8.7)	7.9(7.7)	0.7(0.8)
- Chemicals	11.6(11.1)	13.0(19.5)	11.9(5.9)

(*) Values based on Tons of steel.

Unlike the other Latin American countries we have studied, where major drops in the intensities occurred in the seventies, overall energy and oil intensity in Mexico's industrial sector varied only slightly between 1970 and 1981. Also, unlike Brazil or Venezuela, no substantial electrification of the industrial production took place, except for steel. This is partially explained by the fact that the most electric-intensive industrial process, aluminum production, has not been developed in Mexico.

The Cement Industry

Cement is Mexico's most petroleum-intensive industry. Oil accounted for 46% of its energy input in 1981, while natural gas provided 45%.

Cement production expanded at an annual rate of 8.2%-yr between 1970 and 1982, but the recession forced sharp contractions in 1983 (-12.2%) as the construction industry slowed down. As an indication of partial recovery, growth returned to almost 8% in 1984.

Unlike the pattern characterizing most Mexican industrial facilities, the overall level of energy efficiency in the cement sector is satisfactory, and comparable to OECD levels. This seems to be explained by the predominance of modern and high quality imported technologies in the industry.

Most of the cement industry has dual-fuel capability, but the price difference has consistently favored fuel oil. And with gas prices increasing considerably in 1982, there is a marked disincentive to switch to gas.

The Petrochemical Industry

In 1981, oil accounted for 29% of energy inputs in this industry. Spurred by the expansion of the oil sector, the number of petrochemical plants increased from 60 to 81 between 1977 and 1981. At the same time, annual growth rates fluctuated between 10 and 16 percent, making this one of the country's fastest growing industries. Further confirming the industry's growth potential is the fact that, unlike all other industries, petrochemicals has continued to grow during the present recession (4%-yr in the period 1981-84).

The sector's expansion in a period of recession is partially accounted for by the increasing export share. The export potential has already attracted government subsidies to the industry, and these may even increase as a result of the need for foreign currency.

Until recently, subsidized domestic energy prices contributed to lower production costs, thus providing the sector with a comparative advantage vis-a-vis its international competitors. With domestic energy prices approaching international levels, this advantage is gradually disappearing. Recently the government has launched a program for better management, but large investments are unlikely to materialize.

Energy Use in the Steel Industry

Iron and Steel is the most energy intensive industrial sub-sector, but only 6% of its energy input is accounted for by oil products. Natural gas and coal, on the other hand, represent 52% and 30% of inputs.

Energy intensity of steel production (measured as E/Ton of steel) has declined steadily as newer electric arc furnaces and direct oxygen reduction furnaces have displaced less efficient open hearth furnaces as the dominant modes of production. The share of open hearth furnaces in total steel production fell from 58% in 1970 to 39% in 1981.

Steel use in Mexico has traditionally followed economic growth patterns, and a resumption of growth can therefore be expected to increase steel demand. Government policy will determine whether this demand will be satisfied through domestic production or imports. In the past, Mexico has been among the less efficient steel producers of the world. Satisfying steel demand internally will, in the short run at least, incur important increases in industrial energy use and result in higher costs to the economy. However, the debt crisis and the need to minimize imports may leave little choice.

The Residential Sector

Residential energy use increased at more than 10% per year between 1970 and 1981. Oil accounts for 41% of energy use in this sector; this constitutes 15.5% of total oil end use.

Although the use of oil products continues to increase, the rate of growth is smaller than the rate of growth for total residential energy consumption. However, since electricity is the fastest growing energy source in the sector, and since oil accounts for 55% of its generation sources, increasing electrification of households and appliance saturation imply increasing oil demand.

During the past decade, population growth and accelerated urbanization have been the major factors driving the growth in energy demand. Between 1970 and 1984 the urbanized share of population increased from 49 to 68 percent (from 23 million to 50 million). This migration induced a rapid substitution of electricity and LPG for wood, charcoal, and kerosene.

LPG, which accounts for more than two thirds of oil consumption in the sector, is the most diffused cooking fuel in the cities. As a result, the government maintained subsidies on this fuel when all other fuel prices increased sharply in 1983. This encouraged the illegal substitution of LPG for gasoline, which the government recently (1985) decided to discourage by gradually increasing the price of LPG.

Electrification of households increased considerably between 1970 and 1984 (from 59 to 79 percent). On the other hand, saturation of electric appliances remains low compared to other heavily urbanized Latin American countries, with the exception of TVs (in 60% of homes in 1980). Less than 10 percent of Mexican households owned a refrigerator in 1982, compared to more than 50 percent in Argentina and more than 70 percent in Venezuela. Other appliances are found only in high income households.

The saturation of air conditioning varies noticeably according to different geographical areas. It is found in almost 50 percent of households in the northern regions where the price of electricity is subsidized during the summer.

Electricity price policies in Mexico could be accompanied by incentives to buy more efficient appliances. Although no measurement is available, estimates indicate that the stock of air conditioners, as well as the new models that presently dominate the market, is very inefficient. Similarly, the average unit consumption of Mexico's refrigerators is 700 KWh per year, almost twice the level observed in Germany, and more than three times in Italy. Since appliance saturation is likely to increase rapidly from its present low level, the diffusion of efficient models might represent the output equivalent of several power plants.

The Transportation Sector

During the past decade, transportation has consistently accounted for more than one third of total energy use. From 37% in 1970, its share increased to a peak of 41% in 1981. It then declined to 35% in 1983, although still increasing in absolute terms. Virtually all energy use in this sector is accounted for by oil products. The sector is thus the greatest consumer of oil, accounting for 60% of total end use.

Gasoline

In 1981, gasoline accounted for some 63% of total consumption in transportation, compared to 50% in Argentina and Brazil. Consumption increased at an annual rate of 4% between 1970 and 1978, and at 15% per year between 1978 and 1981. Gasoline is used in almost 100% of private cars (no diesel car is available in the market), and in 30% of the truck and bus fleet.

Cars per capita are at a level comparable to Brasil. Car ownership grew 9% per year from 1970 to 1981, but stagnated in the following years, as a consequence of declining personal income.

Annual gasoline consumption per car (- 3000 liters/car) is among the highest in Latin America. Although information about the last three years is still tentative, there is indication that as incomes declined and gasoline prices reached international levels, the use of private cars, and gasoline use per car, diminished.

Further evidence suggests that the gasoline price increase caused some substitution of diesel for gasoline in the late 1970s, especially in the fleet of light trucks. More noticeable was the unexpected growth in the illegal use of LPG in cars. LPG prices are kept artificially low, as that fuel is subsidized for cooking.

Diesel

Diesel accounted for 70% of the fuel used in Mexico's truck and bus fleet in 1981. Its share of total fuel consumption in the transportation sector increased from 24% in 1970 to 29.5% in 1981. Decreasing industrial activity has reduced in recent years the demand for cargo transportation, causing a stagnation in the diesel use. It is therefore too early to determine whether recent sharp increases in gasoline prices will stimulate further dieselization of the country's truck and bus fleet.

Conclusions

Conservation may be Mexico's only viable strategy for avoiding a conflict between internal oil demand and the need for oil export earnings. The importance of cutting domestic oil consumption is linked to the urgent need to cut waste from the energy system as part of the immediate economic recovery effort.

By conducting a sectoral analysis of the most oil intensive economic sectors, we have identified the oil sector and the electricity sector as having large savings potential. Significant savings can be achieved in both sectors through the adoption of co-generation methods in the transformation process. By reducing electricity consumption in the production of paper, chemicals, and steel, such measures could also generate substantial savings in oil consumption.

While the recession forced a 50% decrease in real wages, forcing marked reductions in the demand for cars, housing, and appliances, and thus reducing oil consumption in the transportation and residential sectors, demand growth is expected to resume in both sectors although at a lower pace. To prevent a re-emergence of the wasteful patterns that characterized the expansion period, it is important that efforts be made to channel demand in these sectors to energy efficient products.

The prolonged recession has prevented Mexico from investing in exploration and production activities, freezing production capacities at 1982 levels. At the same time, lack of investment in all industrial sectors prohibited the emergence of any new and vigorous industry capable of complementing the oil sector's export potential. With the current drop in international oil prices, the conservation actions identified here appear to be the only alternative to more severe measures limiting the recovery potential of the country.

APPENDIX: The Oil Industry and the Mexican Economy.

Oil Supply and Export

In the early 1970s, Mexico's oil production represented 1% of world production while proven reserves were less than 1% of world total. With the uncovering of vast reserves in Chiapas and Tabasco, Mexico's proven oil reserves were upgraded from 6 billion barrels in 1976, to 11 billion in 1977, and 72 billion in 1981.

Discoveries occurred very fast and coincided with unprecedented increases in world oil prices between 1978 and 1981. A massive effort was made to increase production quickly and reap the benefits of the high prices. Production levels doubled between 1973 and 1977 (from 0.5 million bpd in 1973 to 1 million bpd in 1977) to reach a high of 2.8 million bpd in 1982. Coincidentally, the export volume increased from 20 thousand bpd in 1977 to 1.5 million bpd in 1982 (see Table A-1). From being a net importer of oil (until 1977), Mexico assumed a role as one of the world's major oil producers, and the largest supplier to the U.S.

The development of the oil sector became the single largest government expenditure, consuming 20% of total outlays in 1978-79. Pemex alone spent an estimated \$27 billion on oil sector development between 1977 and 1982, accounting by the end of 1980 for 37% of Mexico's external debt.

Presently, the combination of drastic budget cuts and low international prices has forced to a halt all further exploitation activities. But while the international price of crude is turning downward, the cost of extraction of Mexican crude is increasing. Mexico's largest oil reserves are located in the Marine Zone (59% of proven reserves), and are much less accessible than, for example, the Reforma Field wells. Once the most economically attractive wells are exhausted, the demand for oil will have to be satisfied through increasingly more costly exploitation of inaccessible deposits. The marginal cost of oil exploitation can thus be expected to increase significantly above its present level of approximately \$8/bbl.

Table A-1. Mexico: Crude Oil Production, Exports, and Domestic Supply

Year	Production		Export		Dom. Supply	
	(10 ³ bbl/d)	Growth, %-yr	% of Prod.	Growth, %-yr	% of Prod.	Growth, %-yr
1970	487	na	0	0	100	na
1975	806	10	12	na	88	38
1977	1086	15	19	38	81	21
1978	1330	20	27	58	73	9
1979	1440	8	39	44	61	-9
1980	1968	31	43	41	57	25
1981	2344	18	47	28	53	9
1982	2785	17	54	31	46	3
1983	2703	-3	57	3	43	-10
1984	2685	-1	57	-2	43	1
1985	2631	-2	55	-6	45	3

Source: Pemex.

Expanding the Oil Sector.

While the oil sector induced significant economic expansion between 1977 and 1981, it contributed to greatly exacerbating a series of economic imbalances as well. The new found oil wealth spurred the government to increase spending, often implemented through the expansion and generation of programs that subsidized a wide range of consumer goods and activities.* This expansion of the public sector was not matched by productive investments in the non-oil sectors (Table A-2). So while the oil sector expanded ten-fold, growth rates in the non-oil sectors of the economy tended to decline.

* In 1980, it was estimated that subsidies accounted for 30% of government expenditures. (COC HBS - p. 9.)

Table A-2. Real Growth rates in Main Economic Sectors, 1975-84
(percent per year)

	1978	1979	1980	1981	1982	1983	1984
GNP	7.9	8.6	8.1	7.9	-0.5	-2.8	3.9
Oil Sector	28.2	26.2	30.9	15.0	9.0	2.1	na
Manufacturing	9.0	8.6	8.1	6.4	-3.0	-8.1	na
Agriculture	4.4	-0.7	5.3	5.9	-0.6	3.4	na

Similar changes happened in the composition of Mexico's main export products. While revenue generated by petroleum exports increased almost 80%/year between 1977 and 1980, almost all other exports stagnated or decreased (Table A-3).

Table A-3. Composition of Exports, 1973-1983
(as percentage of total exports)

	1973	1975	1977	1979	1981	1983
Oil Products	1.2	15.7	22.3	45.1	77.6	74.8
Non-Oil Products	98.8	84.3	77.7	54.9	22.4	25.2
- Agriculture	54.3	44.0	42.0	29.2	5.8	6.0
- Manufacturing	35.7	29.5	29.2	20.2	14.2	17.1
- Minerals	8.8	10.8	6.5	5.5	2.4	2.1

Sources: Banco de Mexico, Pemex.

Growth in public as well as private income also increased consumption, and since a large part of this increasing demand for goods and services could not be met by domestic products, imports grew annually in absolute terms as well as a percentage of GNP.

As government deficit increased, and the balance of trade deteriorated, Mexico resorted to foreign lending. From \$5 b. in 1971, the loan burden increased to \$20 b. in 1977, \$57 b. in 1981, to reach \$100 b. in 1986. In 1985, the debt service alone reached an amount equal to 75 percent of oil revenues.

Declining international oil prices further aggravated the country's economic conditions, as oil export revenues were eroded, and fell in 1985 an estimated \$2 b. below the expected \$14b. level.

However, no other sector can replace or complement significantly the oil sector as the vital generator of foreign exchange. This implies that an increase in the export quota might be necessary to counteract the drop in oil prices and maintain the export earnings.

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