RESTRICTED

Report No. PTR-88

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

THE TRANSPORT SECTOR

OF

MEXICO

(in four volumes)

VOLUME III

PART A - PORTS

PART B - PEMEX: PETROLEUM TRANSPORT

May 13, 1971

Transportation Projects Department

THE TRANSPORT SECTOR OF MEXICO

VOLUME III

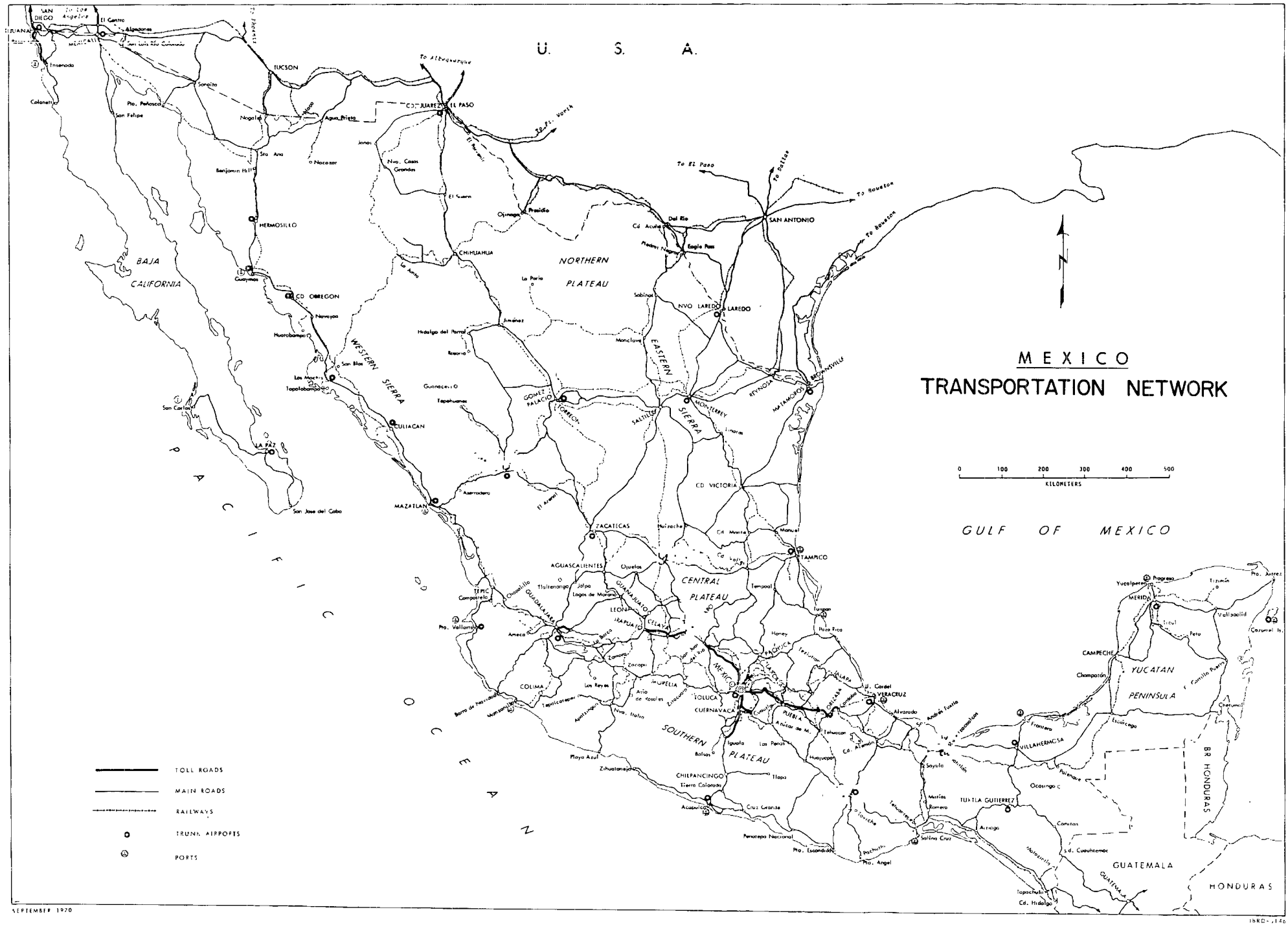
Table of Contents

(Table of Contents Continued)

PART B - PEMEX: PETROLEUM TRANSPORT

(Table of Contents Continued)

TABLES



MEXICO

TRANSPORTATION NETWORK

PART A -- PORTS

I. BACKGROUND

1.01 Along its 10,000 km of Gulf and Pacific Ocean coastlines Mexico now has 36 ports of varying size and importance. The country's economic development since the 1910 revolution, however, has not depended significantly on seaborne international trade. One effect of the revolution was that Mexico largely turned its back to the sea, looking inward to the resolution of its political, economic and social problems. Political power rested mainly with those from the dry central plateau and inland northern areas. Major efforts were made by land distribution and irrigation programs in these areas to raise agricultural output and thus feed the country's rapidly growing population. These, together with other projects of "high political visibility", left limited resources for agriculture and industrial development in and around the ports, many of which are located in physically and/or climatically difficult coastal plain areas where development costs are higher.

1.02 The bulk of Mexico's economic activity has become concentrated in the central plateau area, drawing migrants from elsewhere. The area, which includes Mexico City, geographically accounts for only 10% of the country but has over 50% of the total population. It is separated from the sea by mountain barriers that have made new or improved road and/or rail access to many seaports both difficult and costly. As a result, international trade developed strongly along existing rail and/or road routes to the U.S.A.

1.03 The Mexican economy is still not heavily dependent on ocean trade. Imports in recent years, for example, have been around 6.0 million tons p.a. Two-thirds of these, however, have come across the 3,000 km land border with the U.S.A. Of the one-third arriving by sea, about 75% have entered through the ports on the Gulf coast. This reflects Mexico's traditional trading relationships with Europe, the United States and the eastern seaboard countries of South America rather than with Japan and other countries in the Far East.

1.04 By contrast, of the 15 million tons or so of exports about 10.0 million tons went by sea -- divided roughly half and half between the Gulf and Pacific coast ports. Seaborne exports, however, account for less than 50% of the total value of all commodity exports because they consist mainly of low value to weight commodities such as sugar, molasses, sulphur, minerals (e.g. fluospar, zinc, and lead), cotton, corn and petroleum products (about 30% of all export tonnages). Most high value exports, such as fruit, tomatoes and vegetables, move by road or rail to the U.S.A.[1/]

1.05 In physical terms, Mexico's ports are more important for cabotage or sea-going domestic trade which, in recent years, has been about 14.0-15.0 million tons p.a., or about 55% of all tonnages moving through the ports. Over 95% of this domestic trade was in oil and petroleum products, with about two-thirds consisting of movements between Gulf coast ports and one-third between ports on the Pacific coast.

1/ Small, but potentially important, volumes of fruit are now being air-freighted to Canada and Europe.

1.06 A number of forces are leading the Mexican authorities to pay greater attention to the coastal areas generally and to the implications for ports in particular. Among these are:

a) continuing population pressure and the need to reduce concentration on the central plateau;

b) the employment potential of the "Free Port" areas;

c) the limited scope for further import substitution and the need to develop export outlets to absorb the surplus produce capacity that has been built up and to stimulate the industries involved to greater efficiency;

d) the ability of parts of the agricultural sector to produce exportable surpluses, though there is still likely to be a general problem of feeding the rapidly increasing population;

e) a growing recognition that fishing can not only provide more protein for home consumption but also offer export earning opportunities;

f) an awareness that Mexico, by its geographical position, could be a land-bridge for container traffic, specifically between Europe and the Far East or as part of a growing trade relationship between the Caribbean area generally and Japan;

g) the relative economics of moving petroleum products by tanker as opposed to other modes in parts of the internal trade; and,

h) the steady growth in tourists seeking sun, sand and sailing.

1.07 The Government recognizes the need to increase exports.[1/] In addition to a variety of export promotion incentives, it has supported major trade missions of Mexican businessmen abroad -- particularly to South America. There is also a growing awareness that Mexico could be an important supplier of raw cotton, feed grains and soy beans, among other things, to Japan. In return, Japan could supply capital goods and other equipment needed in Mexico's development -- provided policy and administrative changes were made by both countries to facilitate trade between themselves.[2/]

1/ " ... it is indispensable to augment simultaneously the supply of goods and services for export /and/ more unity and direction will have to be given to the general promotional policies for export". A. Ortiz Mena, "Stabilizing Development", a paper presented to the IBRD Annual Meeting, September 1969.

2/ "Mexico's Dilemma in Economic Development and the Japanese Solution", L. Hollerman, Inter-American Economic Affairs, Vol. 23, Autumn 1969, No. 2, pp. 75-88.

1.08 It is against this background that the present policies, administration, operations and capacity of the Mexican port system must be seen. History has played its role; the future is the challenge.

II. POLICY, PLANNING AND ADMINISTRATION

A. Policy

2.01 Mexico's ports are perhaps the most unorganized and technically least efficient part of the transport sector. That they have not inhibited past economic growth is accidental. In the future, however, they must be more efficient and have the capacity to meet the growing needs of international trade with a minimum use of resources. In addition, since the ports can generate substantial revenues (including foreign exchange) by effective planning and efficient operations their calls on the Federal budget and the nation's debt servicing ability can be minimized.

2.02 The mission recognizes that to bring about the changes which are needed and discussed below will not be easy. More specific policy indications than now exists, together with substantial improvements in port planning, administration and operations, will be necessary. These will require major political decisions and, perhaps, some steady monitoring by the Ministry of the Presidency to see they are effectively implemented.

2.03 Existing general policy statements such as "integration of the ports into the national transport system"; raising the level of efficiency in port operations"; "encouraging the development of the merchant marine", are insufficient guides to the Government or the Minister of the Navy, as the Cabinet Member responsible for most port matters, to assess whether progress is being made and whether it is acceptable. Desirable and legitimate as such statements may be as direction indicators, they necessarily involve a variety of policy matters which, in turn, have institutional/administrative, policy and organizational implications.

2.04 Whether the Ministry of the Navy, for example, with its divided interest in naval, naval aviation, merchant marine, shipyard and scientific exploration matters as well as the construction and maintenance of port works, is more effective than an authority concerned only with civilian port matters does not seem to have been the subject of much public discussion. Nor does the question appear to have been thoroughly examined as to whether the ports should be self-financing -- as, in theory, are the railways, airports, airlines and toll roads. Similarly, there seems to have been no questioning of the desirability or effectiveness of the Ministry of Communications and Transport as its prime involvement in port matters -- setting tariffs and charges for various port services, or whether it has consciously and successfully used these pricing powers to achieve objectives in the port sector. Nor do any clear instructions appear to exist as to the criteria or manner by which port investments are to be economically evaluated. Finally, there is no apparent evidence of a serious examination of the efficiency of the system whereby numerous workers' syndicates (unions) and cooperatives handle port cargo with whatever equipment they can finance themselves from their limited resources.

2.05 The above issues may, in fact, have been examined within the Government. Public discussion and the publication of authoritative government enquiries into such matters, however, is not in the tradition of Mexico. If they have been examined, no indication of serious investigations and measurement of the relative costs and benefits was made to the mission. Accordingly, the mission has had to interpret the current scene from largely its own brief observations and to make its comments and recommendations on this basis.

B. Port Organization

2.06 The Ministry of the Navy, in addition to its defense and associated functions, is the authority primarily responsible for the development of the "fiscal" sea ports (i.e. those where customs duties are collected). The five so-called "Free" ports come under the Ministry of Finance. This report mainly concentrates on the "fiscal" ports; hereafter, unless specified, as the ports.

2.07 Figure 1 indicates the present organizational structure of the Ministry. From this it will be seen that three of the nine Departments (Direccions - General) and a Planning Group (Junta de Planeacion) are most closely concerned with civil port works and administration.

2.08 The Planning Group is legally charged with a) studying and giving its opinion on projects; b) studying the programs of the Federal Government and other agencies which are related to maritime and port matters; and c) coordinating the Ministry's activities to ensure that they are consistent with approved programs. The Department of Maritime Works is responsible for the planning, design, execution and maintenance of port works as well as coastal and river protection works. In undertaking these tasks it is given responsibility for studying the needs of existing ports and of elaborating plans for complementary port installations, e.g. buildings, warehouses, etc. The Department of Dredging has broadly similar functions in relation to dredging requirements for lakes, lagoons, canals, navigable waterways and port entrance channels. Finally, the Department of Port Administration is expected to a) coordinate and control activities in the ports; b) "bring about the maximum improvement in port installations"; c) plan the establishment of port administrations; d) offer its views on the system and level of charges for port and maritime services; and e) study the standards and means whereby services at each port can be improved, including studies of the zones of influence of the ports.

2.09 In terms of organization and functional allocations, therefore, a machinery exists at the central government level for achieving objectives in the port sector. Whether it functions efficiently depends, however, not only on the quality of staff in the center but also on what actually happens in the ports. Coordinated planning and operations is particularly important in view of the numerous groups interested in various aspects of port activities (Table 1). In practice, as the following paragraphs suggest, coordination is weak and operational efficiency is not high. In the mission's view, this is primarily the consequence of:

a) the low political priority given to the ports up to now, and a hesitancy to face the political issues involved in a major improvement effort;

b) the limited experience and drive of officials in the center to undertake at a high professional level the planning and study functions which the law permits and expects. This, in part, has been conditioned by a) above; and,

c) the absence of a single authority (institutionally or individually) with overall power in the ports themselves.

C. Investment Planning

2.10 This is inadequately done and appears to have a high political element in it, with efforts being made to provide each of the 17 seaboard States with a port of some significance. Until recently the absence of good port traffic statistics was an inhibiting factor. Now excellent statistical data is available on a computer basis as to origins and destinations by commodities, etc. and should be fully used in future project evaluations. There is limited evidence of any serious economic evaluation, in terms of benefit identification and measurement, in the projects that have been submitted to the Ministry of the Presidency in recent years. As a result, with limited staff numbers and staff experience, the Presidency has had to evaluate requests largely on a qualitative basis and, through its control of investment allocations, it has become, in effect, the key port planner. However, it controls only one instrument directly and must work indirectly to improve port operations so as to avoid or limit capital investment needs. Its ability to influence the pricing of port services and thus improve the use of ports is limited.

2.11 Proposed port investments do not seem to receive adequate integration with the plans and timing for the improvement of other transport modes. For example, a project for the expansion and improvement of Acapulco port (including preliminary engineering) has been recently prepared. It does not, however, take full account of the costs, timing or possibilities of improving land transport to the hinterland, or of the possible environmental consequences on the large investments for tourism existing in Acapulco. The Planning Group in the Navy Ministry is understandably concerned primarily with naval matters and, as such, is staffed with people of limited experience in both the economic and operational aspects of commercial port planning. This is part of a general situation in the Navy Ministry where many of the Department Directors and other senior officials in the Ministry are naval officers. It is questionable whether this is conducive to a rigorous economic analytical approach to commercial port problems and projects.

2.12 There is some movement in the Ministry to get operational planning started. Here again, however, there is an internal coordination problem and a limited amount of experience which, to some extent, could be corrected by a properly conceived training program (including working spells in port administrations outside of Mexico).

III. PORT FACILITIES AND OPERATIONS

A. General

3.01 Within the ports -- many of which have excellent physical sites -- operations are often inefficient with facilities poorly utilized and inadequately maintained. One major reason for this is that there is no single controlling authority or individual in a port who can be held responsible, other than in San Carlos, B.C.[1/] In each port there is a representative of the Navy Ministry -- a Port Captain -- who is directly responsible to the Minister. His tasks are to police the port; control pilotage; direct ships to particular piers and so on. Apparently, he is not obliged to report whether there is any congestion in the port or to assess whether, when and in what form new works or equipment is required. The main initiative for such improvements often comes from local merchants and shipping agents who put pressure on the Departments' of Maritime Works and Dredging representatives in the ports.

3.02 There is also a Resident Engineer in the ports whose function is to coordinate all civil works building (including that of other Ministries and private agents). In practice, his authority appears limited and he can be by-passed.

3.03 The Port Captains and Resident Engineers are often either naval officers or "political" nominees. Since their period of tenure in any particular port is often limited because of the six-year political cycle, this has the disadvantage of leading to a partial understanding of local conditions and a limited identification with local needs.

B. Facilities

3.04 Marine installations such as wharves, breakwaters, oil terminal and other piers generally appear adequate for present traffic and for that which will reasonably develop through the forthcoming Presidential period (i.e. to 1976). Some capital investments, however, are needed in the ports if they are to improve efficiency and meet the changing technological scene in the shipping industry. Among these investments are the deepening of entrance channels in selected ports and the depths alongside some particular piers; changes in the layout of some ports;[2/] the provision of more warehouse space; the renewal and purchase of more cargo handling equipment; and the introduction of the facilities required to provide for the handling of some container and roll-on-roll-off traffic. The mission's task was not to identify such investments on a port by port, or item by item, basis nor to estimate in any detail the total costs (including the foreign exchange component) involved. Some indications, however, are given below.

1/ In this port, the Director of the Department of Administration in the Navy Ministry has full responsibility of all activities (e.g. hiring labor directly, pilotage, wharfage, tallying of cargo, policing, stevedoring, etc.) other than customs.

2/ Specific suggestions of the physical improvements for particular ports are given in Annex A.

C. Dredging

3.05 There is an evident lack of coordination between the two main Departments in some ports. For example, capital dredging may not be consistent with quay design, i.e. quays and sheds may be designed on the assumption of handling vessels of 30 ft. draft and capacity but the channel depths and depths alongside the berths may be only 20-25 ft.

3.06 Reportedly, the scheduling of maintenance dredging and the allocation of dredgers is not determined within the Ministry on an assessment of priority traffic needs. Perhaps for this reason, among others, PEMEX -- the national oil company -- contracts out for its own dredging needs. While this latter work seems to be done efficiently, it is carried out without adequate coordination and consideration of the needs of other agencies. The "Free Ports" also meet their own dredging needs by contract. The mission was unable to determine the amount of dredging recently undertaken (or required in the near future) or to assess the level of efficiency. It would seem, however, that with a staff of over 300 administrative employees and nearly 1,400 operating employees, the Department of Dredging could carry out substantially more work than was done in 1969,[1/] for example, even taking into account the wide dispersal of the ports.

D. Maintenance

3.07 The mission's limited observations of a few ports suggests that while in particular ports there are some competent and concerned officials general maintenance is unsystematically carried out, and is frequently below the standards Mexico attains in other parts of the transport sector. To a large extent this is probably due to limited budgetary funds -- reflecting the low priority of the ports -- and the diversion of port generated revenues to other budget uses as well as to a lack of planned maintenance programs being submitted with supporting data and justifications.

E. Cargo Handling

3.08 General cargo, and some bulk cargo, is usually handled by workers' syndicates (unions) which themselves may employ casual labor. The syndicates operate under concessions granted by the Navy Ministry, with the charges for the particular service rendered being determined by the Ministry of Communications and Transport. In some cases, the syndicates have modest amounts of simple equipment purchased out of a 10% surcharge allowed for this purpose on particular service charges. Local shipping agents may have small tractors and trailers and mobile cranes which they use for their own business within the port areas. Fortunately, the trend of conventional cargo ships to have improved handling gear on board the ship will minimize the need for smaller lifting capacity dockside cranes in some of Mexico's ports. There is no capability of handling container traffic on any scale in the ports and, reportedly, there is no very heavy lift crane in any Mexican port.

1/ In value terms, Pesos 44.7 million or US$3.6 million.

3.09 The present system of general cargo handling is labor intensive and fragmented among the syndicates. Since, for example, in Vera Cruz no direct loading or unloading into trucks takes place perhaps five or six syndicates may handle the cargo between the vehicle and the ship.-- other than authorized trucks are not allowed to enter to pick up or deliver cargo by law. This delays some cargo movements and adds to costs. Direct loading and unloading of rail-borne cargo is possible in some ports, but is likely to be charged the same rate as at other piers where multiple handling takes place. Bagged cargo is generally lifted by machinery on board the ship, with the bags then being opened and the contents poured into the ship's hold. Though not an uncommon practice in other ports, and having the advantage of employing labor, it can be inefficient and costly because of the delays involved. Comparative economic studies of this as compared with a more capital intensive system should be undertaken.

3.10 There seems to be little direct supervision of cargo handling by either the representatives of agents and shipping companies or by the syndicates. The work gang structure does not provide for an official foreman -- a "leader" may give instructions but he does not supervise or carry responsibility as would be practiced elsewhere. Under the system employed productivity varies widely by ports and the commodity composition handled. At Coatzacoalcos, for example, where a good deal of bagged cargo is handled, the average output is about 19 tons per hook hour and is good. By contrast, at Mazatlan, where much of the general cargo must be handled in small lot pieces, average output is only 7 tons per hook hour. For the six main ports shown in Table 2 the average figure is about 10 tons per hook hour, which is not particularly high.

3.11 Acceptable loading rates are attained for bulk mineral exports and for bulk liquid cargoes. Similarly, where the loading of grain takes place from silos productivity is very good. The use of rail hopper cars for the direct loading of grains, however, is not practiced -- though its possibility is being examined by the railway authorities. Grains are one among a number of outbound cargoes which arrive by rail that may be held in freight cars until needed for loading on board ship. It is believed that as many as 5,000 box-cars are in daily use as warehouses in this way. This is not only an inefficient use of rail equipment -- while at the same time the railway is renting cars from U.S. railroads at a per diem rate -- but also can cause line congestion outside some ports because of the limited yard holding capacity in port areas and thus add to the delays of inbound cargo moving from the ports by rail.

3.12 The warehousing system is inadequate both in terms of the total warehouse space available and operating practices inside them. In the case of outbound cargo often there is no transit shed space available because it is full of inbound cargo that has not been cleared expeditiously by the Customs. Until recently the "free time" allowed for inbound cargo, either on the dock or in a transit shed, was 30 days. Though this has been reduced to 15 days cargo still accumulates. The poor use of shed space is caused in part by backlogs of unclaimed cargo or of cargo that has been subject to legal dispute, sometimes for years. In part, it is also attributable to the time-consuming procedures employed by Customs and the general shortage of warehouse and open storage space.

3.13 The accumulation and cluttering up of port areas by cargo not only hampers the movement of equipment in the ports but also compounds itself by contributing to poor work attitudes. Because of inadequate stacking and record keeping procedures, it may be difficult to locate some merchandise quickly and thus involve the needlessly wasteful and costly shifting of cargo to find particular items.

3.14 In sum, therefore, the picture of general cargo handling -- which can be expected to grow if the exports of Mexican manufactured goods increases as expected -- is bleak. Fortunately, there are a few cases where dedicated men are trying to do a sound job. These exceptions offer hope for what can be and must be done in the future.

IV. TRAFFIC - PAST AND FUTURE

A. Past

4.01 The development of total port traffic between 1960-68 is given in Table 3 by foreign trade and cabotage or domestic traffic while Table 4 indicates the division by Gulf and Pacific Coast ports. They can be summarized as follows:

	1960	1968	% inc. p.a.
	(Million tons)		
1. Total all traffic all ports	13.4	28.1	9.5
2. Total foreign trade traffic	5.3	11.2	10.0
3. Total domestic trade traffic	8.1	16.9	9.5
4. Foreign Trade			
(i) Gulf Ports	3.43	5.77	6.7
(a) Exports	2.46	4.37	7.4
(b) Imports	0.97	1.40	4.6
(ii) Pacific Ports	1.88	5.43	14.1
(a) Exports	1.74	4.96	14.0
(b) Imports	0.14	0.47	16.3
5. Domestic Trade			
(i) Gulf Ports	5.31	12.02	10.5
(ii) Pacific Ports	2.78	4.90	7.3

4.02 The doubling in domestic traffic is accounted for mainly by increas oil movements at Coatzacoalcos and Tampico in the Gulf and at Salina Cruz and Mazatlan on the Pacific.

4.03 Comparison of the 1961 and 1968 statistics shows that about 70% of increase in foreign trade traffic is accounted for by greater volumes of sulphur, fluospar, molasses, salt, corn and fresh fruits exports and phosphates imports. Many of these are bulk cargo ideally suited to sea movement.

4.04 A summary picture of cargo composition at the 7 main ports in 1968 is as follows:

	General Dry Cargo	Bulk Dry Cargo	Total Dry Cargo	Oil Products	All Traffic
		(Million tons)			
Gulf					
Tampico	0.44	0.58	1.02	6.64	7.66
Coatzacoalcos	0.06	1.90	1.96	4.66	6.62
Vera Cruz	0.92	0.86	1.78	1.01	2.79
Sub-total	1.42	3.34	4.76	12.31	17.07
Pacific					
Salina Cruz	0.05	0.05	0.10	1.89	1.99
Manzanillo	0.25	0.50	0.75	0.16	0.91
Mazatlan	0.29	0.15	0.44	0.47	0.91
Guaymas	0.19	-	0.19	0.66	0.85
Sub-total	0.78	0.70	1.48	3.18	4.66
TOTAL	2.20	4.04	6.24	15.49	21.73
% of Total	10.1%	18.6%	28.7%	71.3%	100.0%

4.05 From the above figures it can be seen that the present proportion of general dry cargo is small (10%), while that of oil products is 71% and bulk dry cargo is 19%. Vera Cruz is the main general cargo port, with about two-thirds of its imports and one quarter of its exports being destined for or originating from the Mexico City area.[1/] When internal traffic is taken into account, the Vera Cruz-Mexico City route is one of the most important transport corridors in the country. Coatzacoalcos, by contrast, is primarily a port for the export of sulphur (1.4 million tons) and the movement of oil products in coastal trade (4.5 million tons). Tampico, also on the Gulf coast, is primarily an oil product port (2.4 million tons in exports and 4.2 million tons in coastal trade) because of a major Pemex refinery located there. Its other main purpose is for the use of mineral exports (fluospar, calcium, lead, zinc and sodium).[2/] It is, therefore, primarily a bulk port and its improvement to cater for the growing size of tankers and bulk carriers needs careful examination, especially because of the hydrological implications.

4.06 On the Pacific Coast, Manzanillo and Mazatlan are important for corn exports (350,000 tons and 100,000 tons) and for the unloading of oil products needed in their hinterlands (120,000 tons and 423,000 tons).

4.07 The general importance of oil and petroleum product movements raises important issues regarding the use of tankers and pipelines by Pemex. These are discussed separately in the section on this national oil company.

1/ Table 5 indicates total traffic growth at Vera Cruz.
2/ Table 6 indicates total traffic growth at Tampico.

4.08 Passenger traffic by sea is unimportant even though it has increased 10-fold between 1960-67 to about 110,000. It is mainly accounted for by ferry traffic between La Paz (Baja California) and Mazatlan and, more recently, between Puerto Juarez and the growing tourist center of Isla de Mujeres.

B. Future

4.09 No soundly based analysis as to the volumes of future traffic by ports or commodities has been done by the Navy Ministry. Projections to 1978 were made available to the mission. These, however, cannot be used for general planning or specific project planning purpose. They are merely extrapolations of past total trends. So far as the mission could ascertain, they are not based on a study of the potential developments (internally and externally) of the commodities now moving through the ports. In the case of coastal traffic they certainly do not take account of any changes in land transport which might divert traffic, particularly pipelines.

4.10 The result, therefore, is that those responsible for ports and their development cannot have a clear view on which to plan what is required, and where, in the near future. This deficiency must be remedied by serious studies of production trends and marketing possibilities. Experience elsewhere suggests there are dangers in this being done by a "Central Planning Office" which hands over the figures to the authorities responsible for ports. It also suggests that it is likely to be done best by those who are directly responsible, and particularly if they have a financial responsibility against which their performance can be tested. The results of their forecasting and the implications for port investments, however, must be assessed or scrutinized for reasonableness and acceptability by the investment approving authorities. A major effort, therefore, will be needed and it will require the injection of economists and other staff into whatever agency is ultimately made responsible for the ports. Some of these staff would have to be assigned to the ports to gather economic intelligence from shipping agents and others as to future trends. Fortunately, the recently improved statistical data on traffic flows, composition and origins and destinations is a good basis on which to begin.

4.11 While the task of improving forecasts is priority, it is fortunately not of the highest urgency. There is excess capacity in the ports and a scope exists for major improvements in operations which would also add to capacity. Accordingly, there is time while these operational and other improvements are being carried out for the work of forecasting to be properly planned, staffed and undertaken. One conclusion of this, the mission believes, is that Mexico should be extremely hesitant in approving any major fixed investments such as new ports or additional piers, wharves and breakwaters for a year or two until the economic studies and engineering implications have been fully worked out. As an immediate investment strategy, therefore, the best approach would seem to be to a) concentrate on handling and associated equipment which, if necessary, can be moved elsewhere; b) provide warehouse capacity where there is now an obvious shortage; and c) undertake selective dredging operations and remodelling works. In other words, the mission considers that about two years of hard preparation will be required to produce a meaningful, longer run port development program. Finally, since some of the skills needed are short or not available, the Government should consider specific technical assistance from outsiders for limited periods.

V. FINANCES

A. General

5.01 The Mexican ports are not financially autonomous,[1] with accounts kept on a commercial basis. Records of revenues and expenditures, however, are kept in Mexico City but not in the ports themselves. Port user charges are levied by the Federal Government but are regarded as federal taxes and as such are paid to the Ministry of Finance as general budgetary receipts. The charges are levied according to Federal Government decrees, with the current scale dating from 1966 which replaced that which had been in force since 1937. The Navy Ministry is not specifically charged with the initiative for proposing changes or for reviewing the levels set, though in practice some consultations take place between it and the Ministry of Finance.

5.02 Operating, general maintenance and maintenance dredging expenditures are determined and approved as part of the Ministry's allocation out of the national budget. Capital expenditures are approved as part of the normal governmental process by the Ministry of the Presidency and Ministry of Finance. Balance sheets are not maintained for any of the "fiscal" ports. A record of the value of fixed assets was not available to the mission and probably does not exist. A financial analysis comparable to that done in Vol. II for the railways is not, therefore, possible.

5.03 Navy Ministry figures indicate investments in the ports totalling Pesos 484 million (US$39 million) in the period 1965-69 (Table 7). This excludes investment in the Free Ports and in cargo handling equipment bought by the various labor concessionaires. The most important single investment was for improvements at the Pacific port of Manzanillo (US$10 million equivalent). Ministry of the Presidency figures for "investment" in port activities in the same period are Pesos 786 million (US$63 million).[2] The difference in figures is accounted for partly by debt servicing payments made by the Federal Government on internal and external loans used in the ports sector.

5.04 Information given by the Navy Ministry shows that if no new debt commitments are made there will be no debt servicing payments after 1973 when the following schedule of repayments is finished:

Debt	1970	1971	1972	1973
		(Pesos Millions)		
Internal Credits	112.7	5.3	-	-
External Credits	7.9	7.6	7.0	2.7
Total	120.6	12.9	7.0	2.7

This is probably inaccurate since information from other sources indicates that in 1969, for example, new commitments totalling US$6.52 equivalent were entered into for new dredgers from France.

1/ Excluding the Free Ports which are a separate operation with some autonomy.
2/ Inclusive of about Pesos 11 million by the Ministry of Communications and Transport.

B. Federal Revenues and Expenses

5.05 Statements of revenues and expenses for all and some of the main ports for 1968 and 1969 are given in Tables 8 and 9. The large increase in total revenues from Pesos 31 million in 1968 to Pesos 53 million in 1969 is almost entirely accounted for by more warehousing rents as a result of the reduction in "free time" for cargo from 30 to 15 days. It is, incidentally, indicative of the backlog in cargo which existed when the change was made and of slow clearance procedures.

5.06 In 1969 revenues exceeded expenses (excluding depreciation and dredging) in the ports but were marginally less for the total of all other ports. An accurate breakdown of dredging expenses by ports was not made available. It is unclear, therefore, whether particular main ports are in surplus or deficit. It looks, however, as if Vera Cruz is in surplus. For all ports together, when dredging is included, there is in 1969 a marginal excess of expenses over revenues -- Pesos 8 million (US$640,000).

5.07 These revenues consist of traffic or port dues (based on net registered tonnage of ships), dockage or mooring charges (based on the length of ship and the time it stays in port) and wharfage charges (based on merchandise loaded or discharged from vessels). The current scales are set out in Table 10. They indicate a) charges are low; e.g., wharfage on import/export cargo is Pesos 3 or US¢24 per ton and US¢3 per ton on coastal cargo; b) they are not cost reflecting; e.g., traffic dues on ships vary not only with their net registered tonnage (nrt) but also whether the ship is foreign or Mexican; is coming from or going to a foreign or Mexican port; is in or not in ballast; is carrying imports or exports -- on exports the current rate of 1 Pesos (US¢8) per ton of cargo loaded is low; c) there are numerous and questionable exceptions; e.g., coastal cargo and mail are exempt from wharfage.

5.08 The revenues also consist of warehousing rents. After 15 days of free time, goods pay Pesos 6 per ton per day for the first 30 days, Pesos 9 per ton per day for the next 30 days and Pesos 12 per ton per day thereafter. These, too, are low as compared with many ports.

5.09 The case for an increase in the different charges discussed above could well be made to take into account rising costs and particularly labor costs which increase every two years as part of the present national practice and will increase still further because of the 1970 new Labor Law. It is not recommended, however, that this should take place arbitrarily now. Some increase in warehouse charges though would seem desirable, especially if done in the context of a program to provide more and better warehouse facilities. The mission recommends that present structure and level of charges should be thoroughly reviewed and adjustments made as part of major new policy change and reorganization of port responsibilities.

C. Cargo Handling and Other Charges

5.10 As indicated earlier a variety of port services -- pilotage, tag service, stevedoring, wharf handling, etc. -- are provided by the workers' syndicates under concessions granted by the Navy Ministry. Pilotage is com-

pulsory for foreign vessels of over 2,500 nrt, with the fees being paid directly to the pilots who are self-employed. Stevedoring charges for ocean traffic are negotiated privately between the syndicate and shipping companies. Coastal stevedoring, however, and other shore handling charges, etc. are fixed by the Tariff Department of the Ministry of Communications and Transport to whom the syndicates make representations when they believe an increase is justified. This, in practice, is every two years as the National Commission for Minimum Incomes reports on this basis to the Federal Government. Based on its findings general wage increases take place in governmental services. This procedure does not mean that the wages of port workers are kept to the national minimum, but that their wages (i.e. cargo handling charges) rise in step with increase in the minimum wage and do not reflect any changes in productivity. There is some incentive effect, however, with the charges being based on tonnage.

5.11 A selection of minimum, maximum and average cargo handling charges at six selected main ports is given in Table 2. To illustrate the impact of all port and other charges, the costs incurred by three ships calling at Vera Cruz in late 1969 are set out in Table 11 and summarized as follows:

Cost per ton Handled (Pesos)

	Ship No. 1	Ship No. 2	Ship No. 3
Port Charges	2.80	2.37	32.34
Cargo Charges	57.14	68.15	63.21
Miscellaneous	1.44	1.30	3.71
Total	61.38	71.82	99.26
(US$)	(4.90)	(5.75)	(7.95)
Ship Size (nrt)	1,144	1,142	4,134
Tons Handled	1,314	1,778	413

5.12 The above figures it should be noted are not the "net additional costs" over and above ocean shipping charges borne by each ton of cargo, since some of the items making up the total are normally included in shipping freight rates.1/ They are given solely to indicate the difficulty of easy generalization about the effect of port pricing or user charges on the final delivered prices of goods and the elasticity of demand both for goods and port use. Much depends on the particular port services required, the type of cargo handled, the size of ships, whether overtime is required to clear cargo through Customs, etc. For example, ship No. 3 was three times the size of ship No. 1 and incurred pilotage and tug service charges 6.5 times greater but it only handled 413 tons as compared with 1,314 tons and required much less overtime working. The effect was that the average costs met per ton of cargo for ship No. 3 was US$7.95 equivalent as compared with US$4.90 equivalent for ship No. 1.

1/ Also costs of subsequent handling after discharge from the ship are not included in these figures.

5.13 To ensure that Mexico's potential exports are price competitive, close analysis is required of the impact of internal transport costs and port handling and other charges on the c.i.f. price of Mexican exports in foreign ports. Against this need to keep the costs of port services in total export prices low is the budgetary necessity to minimize the use of public funds by generating more income/revenues from the ports. In the mission's view a modest increase in the total revenues from port dues, dockage and wharfage (Pesos 14.5 million in 1969) is unlikely to have any significant effect on export competitiveness, i.e. the problems associated with increasing Mexican exports lies elsewhere. Similarly, the mission believes that adjustments could well be made in a series of appropriately timed steps to increase revenues from warehousing and demurrage. In other words, the port sector could be made to generate additional funds to meet needed investments[1/] without hampering the desired export drive.

1/ A description of possible improvement works, together with a very rough estimate of their costs and equipment needed, is given in Annex A.

VI. RECOMMENDATIONS

6.01 Given that export expansion is an important element in national economic policy; that efficiency and economic criteria are to be increasingly dominant issues in the Government's attitude to ports; and that other than for liquid bulk cargo there is surplus capacity for the present pattern of traffic in each port, the following recommendations should be considered:

(i) A National Ports Council should be created. The President of this Council would be the Minister of the strengthened Ministry of Transport, as recommended elsewhere. The Council would be composed of senior representatives of the various Ministries involved in port matters (Finance, Agriculture, Commerce and Industry, Public Works, Patrimony, Fomento). Its broad tasks should be to determine port policy, subject to Presidential approval; to develop, coordinate, approve and supervise programs to achieve the policy objectives; to review budgets of the ports; to approve the selection of advisory committees both to the Council itself and to particular ports. The Council would also be responsible for reviewing and recommending port user charges to the Ministry of Transport. These are now low and could be increased and generate substantial revenues which would finance an investment program. A professional Director should be appointed as the Council's chief executive with the staff, authority and clear responsibility for generating investment programs, budgets and controlling all port operations.

(ii) In the first instance, the ports should be operated as a system on a commercial basis. Later, steps could be taken to consider whether particular ports should be financially viable in their own right, including the re-investment of financial surpluses and/or with borrowing powers, etc. An important step in this process would be to limit the Customs to their basic functions and to transfer control over the transit sheds and warehouses to the General Managers in the ports. These General Managers should be appointed by the Council and given the full authority to control and manage all the facilities and operations in the ports to which they are appointed. In the first instance, they could be appointed to the 10 or so most important ports with one of their tasks being to train others for eventual appointment as General Managers elsewhere. The General Managers could have the benefit of two advisory committees -- one consisting of the agencies with a direct physical interest in port facilities, and the other representing the local community, e.g. business, banking, industry, agriculture, labor and the shipping community's representatives as well as the local governments concerned (State and town). In the more important ports the General Managers could have Department Heads for the following functions -- operations, traffic, finance, engineering and planning.

(iii) A major staffing effort should be made to bring the best available talent -- engineers, economists, financial analysts, etc. into the staff of the Ports Council and into the ports as General Managers and Department Heads. This effort must include an assessment of the training programs needed for key staff, as well as for stevedores and longshoremen in the ports. It will also require a determination of the needs for foreign specialist staff (including consultants) to advise on port operating methods, to install accounting and management control systems, to carry out traffic studies and, if necessary, to value port assets.

(iv) The appropriate strategy for port development should be to put the following ports -- Vera Cruz, Salina Cruz, Coatzacoalcos, Guaymas, Mazatlan and Tampico -- into first class condition as a priority. The extent and timing of urgent dredging work required should be determined.

(v) Selective investments should be made at a number of ports including Vera Cruz and Tampico, as indicated in Annex A. Vera Cruz is and must continue to be regarded as the premier east coast point of entry to Mexico. It is strongly recommended, therefore, that neither money nor energy be invested in developing an alternative new general cargo port to it at Tampico. Other than for PEMEX's needs, the existing facilities at Tampico can be extended, altered and modernized to take care of general and dry bulk cargo needs at the present site for long into the future. Satisfaction of PEMEX's needs and the other improvements, however, will require careful studies of the hydrological and possible social cost implications involved.

(vi) The construction of new or expanded ports (e.g. at Topolobampo and Acapulco) should not be contemplated at this time, except if a major associated industrial or mining project requiring a special facility is firmly committed and justified, for example, at Las Truchas for a steel plant. In such cases, the port and other transport facilities must be included in the economic analysis of the particular investment project.

(vii) Consideration should be given to the establishment of a port equipment leasing authority. This authority would buy equipment with the object of leasing it to the cargo handling syndicates; such equipment is needed for efficient operations. In this way equipment could be standardized, purchased on a volume basis and moved from port to port if demand changed. Leases should provide for appropriate amortization and maintenance of the equipment.

(viii) Heavy duty fixed and mobile equipment should be an investment undertaken through the Ports Council and appropriate charges made for their use. This equipment would include items such as gantry cranes and heavy lift cranes.

(ix) A minor general equipment program should be formulated. That is, firefighting and safety equipment needs upgrading and lighting, telephone and radio services need improvement.

(x) Warehouses should be provided to relieve the present congestion in the transit sheds. Since, however, a full program of installation will take time, the present 15 days of free time for imports should be reduced only to 10 days, with penalty demurrage rates on a rising scale for the next 5 days and goods then transferred to warehouses or other storage space at the cargo owner's cost. For exports the same free time should be allowed - 15 days - at a different scale of demurrage rates. If after 25 days cargo has not been shipped, it should be moved back to warehouses and charged the full warehouse rent rate.

(xi) The present regulations prohibiting the entry of trucks into port areas should be removed.

(xii) Studies

a) The possibility of a joint international port/industrial area at Matamoros (Mexico) and Brownsville (USA) should be examined.

b) The potential economic growth and transport requirements (including port implications) are required for the following corridors -- Mexico City/Vera Cruz; Guadalajara/Manzanillo; Coatzacoalcos/Salina Cruz; Monterrey/Tampico.

c) The potential and feasibility of river transport needs preliminary investigation.

d) An examination of the "interface" problem -- i.e. the transfer point of one mode of transport to another. In some ports it is probable that the cost of moving cargo from the port gates to the ship's side exceeds that of moving it from inland to the port gate, and vice-versa.

e) A study of the feasibility of using barge systems to improve coastal transport since Mexican shipyards are capable of building good barges and tow boats.

ANNEX A

POSSIBLE INVESTMENT/IMPROVEMENT PROGRAM

The mission has attempted on the basis of its visits to the 7 more important ports to prepare a rough outline, with tentative cost estimates, of the investments that might be needed to accompany and make effective its more general recommendations. The total estimated cost of such a program is about Pesos 560 million (US$45 million), as in the following Table. It is stressed, however, that these are based on broad engineering judgements, without the benefits of the technical and economic studies which would be required for investment decision purposes and for foreign financing. Nevertheless, it is believed they provide an operational framework within which to tackle the needed improvements in the Mexican port scene.

Attachment

October 14, 1970

M E X I C O

Possible 5-7 Year Port Investment Program

	Tampico	V. Cruz	Contzocoalcos	S. Cruz	Munzanillo	Mazatlan	Guayman	Total
1. Quay (Lineal feet) at US$2,000 per ft - $ million	(2000) 4.00	(1200) 3.40	(600) 1.20	(4000) 8.00	-	(600) 1.20	(600) 1.20	19.00
2. Warehouses ('000 sq ft) at US 5.00 per sq ft - $ million	(100) 0.50	(100) 0.50	(50) 0.25	- -	(50) 0.25	(50) 0.25	(50) 0.25	2.00
3. Dredging (m^2 million) at US$ per m^2 - $ million	(1.0) 0.40	(1.0) 0.40	(1.0) 0.40	(1.0) 0.40	(1.0) 0.40	(1.0) 0.40	(1.0) 0.40	2.80
4. Rail-Highway relocation "	0.25	0.25	0.25	0.50	-	0.50	0.25	2.00
5. Equipment "	0.75	1.50	1.50	1.50	0.75	0.50	0.50	
6. Container Facilities "	0.50	0.50	0.50	0.50	0.50	-	-	2.50
7. Silos/Elevators "	-	1.50	-	-	1.50	-	-	3.00
8. New Sheds "	-	0.50	-	-	-	-	-	0.50
9. Demolition "	0.25	0.50	-	0.50	-	-	-	1.25
Total "	6.65	9.05	4.10	11.40	3.40	2.85	2.60	40.05
Contingency "								4.95
Total "								45.00

October 14, 1970

ANNEX A
Attachment

TABLE 1

MEXICO

Parties Principally Interested in Port Matters

1. Ministries

Navy	- engineering, operations, dredging, administration, etc.
Transport	- road and rail access and pricing of port services
Public Works	- some construction (mainly buildings)
Finance	- customs and budgetary control
Agriculture	- inspection services
Health	- quarantine services
Patrimony	- ownership of federal property
"Fomento"	- general economic development
Commerce	- documentation and interests of port users
Labor	- wages and working conditions
Interior	- immigration/emigration
Tourism	- cruise ship requirements

2. Decentralized Organizations

Free Port Authority	- free ports
Railways	- access and cargo movements
Toll Road and Bridge Authority	- bridges over waterways and ferries
Pemex	- oil tanker and associated activities

3. Other Parties

State Governors	- development planning, etc.
Municipalities	- development planning, etc.
Chambers of Commerce	- user interests
Shipping Lines	- user interests

October 13, 1970

TABLE 2

MEXICO

Port Charges and Productivity Rates at Selected Ports - 1968

Port	Cargo Handling Charges per ton (Pesos)				Tons Per Hook Hour
	Stevedoring	Wharfhandling	Total	US $ Equivalent	
Veracruz:					
Imports					
Maximum	24.2	31.5	55.7	4.46	14.4
Average	24.2	21.0	45.2	3.62	10.0
Minimum	24.2	13.4	37.6	3.01	5.7
Exports					
Maximum	24.2	18.2	42.4	3.39	14.6
Average	24.2	15.1	39.3	3.14	10.0
Minimum	24.2	11.9	36.1	2.89	5.7
Tampico					
Maximum	9.1	27.8	36.9	2.95	13.0
Average	9.1	22.5	31.6	2.53	9.8
Minimum	9.1	12.8	21.9	1.75	6.6
Coatzacoalcos					
Maximum	5.2	27.0	32.2	2.58	23.7
Average	5.2	16.5	21.7	1.74	19.1
Minimum	5.2	9.5	14.7	1.18	14.4
Mazatlan					
Maximum	7.5	11.5	19.0	1.52	13.8
Average	7.5	10.3	17.8	1.42	6.9
Minimum	7.5	9.1	16.6	1.33	3.2
Manzanillo					
Maximum	5.4	14.1	19.5	1.56	15.8
Average	5.4	10.1	15.5	1.24	12.8
Minimum	5.4	8.3	13.7	1.10	9.7
Acapulco					
Maximum	6.4	23.7	30.1	2.41	15.2
Average	6.4	16.7	23.1	1.85	10.8
Minimum	6.4	9.7	16.1	12.9	6.4

October 13, 1970

TABLE 3

MEXICO

Seaborne Cargoes in Foreign and Cabotage Trades

(1960 - 69)

(metric tons - millions)

	Foreign Trade		Cabotage	Total Port
	Loaded	Unloaded	(Domestic)	Traffic
1960	4.2	1.1	8.1	13.4
1961	5.8	1.0	9.6	16.4
1962	6.6	0.9	12.1	19.6
1963	8.2	1.2	12.6	22.0
1964	8.3	1.7	12.1	22.1
1965	9.2	1.4	14.0	24.6
1966	9.1	1.5	14.4	25.0
1967	9.4	1.5	14.9	25.8
1968	9.3	1.9	16.9	28.1

Source: Secretaria de Marina

October 13, 1970

TABLE 4

MEXICO

Seaborne Cargoes-Gulf and Pacific Ports (1960-68)

(metric tons-millions)

	Gulf Ports		Pacific Ports	
	Loaded	Unloaded	Loaded	Unloaded
A. Foreign Trade				
1960	2.46	0.97	1.74	0.14
1961	3.67	0.83	2.17	0.14
1962	3.92	0.76	2.66	0.14
1963	4.51	0.92	2.76	0.33
1964	4.45	1.16	3.84	0.56
1965	4.80	1.14	4.42	0.29
1966	4.67	1.29	4.44	0.21
1967	4.71	1.25	4.65	0.29
1968	4.37	1.40	4.96	0.47
B. Cabotage (Domestic Trade)1/				
1960	2.64	2.69	1.38	1.40
1961	3.15	3.18	1.62	1.60
1962	4.50	4.52	1.55	1.53
1963	4.65	4.64	1.64	1.64
1964	4.19	4.24	1.87	1.83
1965	5.26	5.24	1.75	1.76
1966	5.37	5.34	1.83	1.87
1967	5.19	5.15	1.24	2.28
1968	6.09	5.93	2.37	2.53

1/ The difference between total loading and total unloading is accounted for by sailings at one year end that arrive at the beginning of the following year.

Source: Secretaria de Marina

TABLE 5

MEXICO

Port Traffic - Vera Cruz
(1961 - 68)

(metric tons - millions)

Cargo Type	1961	1962	1963	1964	1965	1966	1967	1968
1. Dry Cargo								
Foreign	0.67	0.57	0.65	0.69	0.68	0.75	0.66	0.87
Coastal	0.08	0.07	0.06	0.06	0.06	0.08	0.05	0.06
Total	0.75	0.64	0.71	0.75	0.74	0.83	0.71	0.93
2. Bulk Cargo								
Foreign	0.54	0.41	0.47	0.65	1.02	0.88	1.05	0.84
Coastal	0.01	-	0.01	0.03	0.03	0.04	0.01	0.02
Total	0.55	0.41	0.48	0.68	1.05	0.92	1.06	0.86
3. Oil Products								
Foreign	0.16	0.11	0.29	0.27	0.31	0.28	0.36	0.31
Coastal	1.09	0.97	0.88	0.77	0.75	0.63	0.50	0.71
Total	1.25	1.08	1.17	1.04	1.06	0.91	0.86	1.02
4. All Cargo								
Foreign	1.36	1.09	1.41	1.60	2.00	1.91	2.07	2.01
Coastal	1.17	1.03	0.95	0.86	0.84	0.75	0.56	0.78
Total	2.53	2.12	2.36	2.46	2.84	2.66	2.63	2.79
% of all cargo at all ports								10.0%

October 13, 1970

TABLE 6

MEXICO

Port Traffic - Tampico
(1961 - 68)

(metric tons - millions)

Cargo Type	1961	1962	1963	1964	1965	1966	1967	1968
1. Dry Cargo								
Foreign	0.33	0.35	0.35	0.34	0.48	0.46	0.40	0.39
Coastal	0.09	0.03	0.03	0.03	0.03	0.04	0.03	0.06
Total	0.42	0.38	0.38	0.37	0.51	0.50	0.43	0.45
2. Bulk Cargo								
Foreign	0.25	0.29	0.56	0.72	0.64	0.57	0.49	0.57
Coastal	0.02	-	0.01	-	0.05	0.02	-	0.01
Total	0.27	0.29	0.57	0.72	0.69	0.59	0.49	0.58
3. Oil Products								
Foreign	2.34	2.86	2.89	2.68	3.03	2.74	2.63	2.50
Coastal	2.01	2.88	3.25	3.00	3.40	3.45	3.80	4.14
Total	4.35	4.74	6.14	5.68	6.43	6.39	6.43	6.64
4. All Cargo								
Foreign	2.92	3.49	3.79	3.75	4.15	3.77	3.52	3.46
Coastal	2.21	2.91	3.28	3.03	3.48	3.51	3.83	4.20
Total	5.13	6.40	7.07	6.78	7.63	7.28	7.35	7.66

% of all cargo at all ports 27.2%

October 13, 1970

TABLE 7

MEXICO

Port Investments

1965 - 1969

(Pesos Millions)

Port	1965	1966	1967	1968	1969	Total
Ensenada	13.3	11.8	6.7	0.1	0.8	32.7
San Carlos	-	32.3	18.9	8.9	-	60.1
La Paz	0.3	0.2	0.1	0.6	2.1	3.3
Guaymas	4.9	0.6	6.0	1.5	2.8	15.8
Mazatlan	6.1	10.9	4.8	1.9	8.8	32.6
Puerto Vallarta	-	0.5	-	0.4	24.9	25.7
Manzanillo	7.1	8.0	7.5	53.9	50.5	127.1
Acapulco	0.6	00.2	9.5	3.1	1.7	15.1
Salina Cruz	0.1	-	-	2.4	2.6	5.0
Tampico	4.4	11.8	8.7	5.1	7.5	37.5
Veracruz	4.0	3.0	2.2	4.1	11.2	24.5
Coatzacoalcos	3.2	3.9	2.5	0.7	2.2	12.6
C. D. del Carmen	1.2	2.2	0.2	0.4	0.4	4.4
Yukalpeten	-	1.0	10.0	25.2	27.3	63.5
Other	3.2	1.1	3.5	2.6	13.3	23.7
	48.4	87.5	80.6	110.9	156.1	483.6
Free Ports	5.5	5.4	7.4	16.6	17.0	51.9
Grand Total	53.9	92.9	88.0	127.5	173.1	535.5

Source: Secretaria de Marina

October 13, 1970

MEXICO

Port Revenues and Expenses (1968)

(Pesos million)

Revenues	Acapulco	Guaymas	Manzanillo	Mazatlan	Tampico	Vera Cruz	Other Ports	Total[1/]
Port Dues	0.07	0.06	0.71	0.10	0.19	0.29	0.26	1.05
Dockage	0.08	0.17	0.40	0.24	0.53	1.23	0.32	2.99
Wharfage	0.17	0.47	2.28	0.98	1.83	3.51	1.27	10.51
Warehousing[2/]	0.80	0.05	0.45	0.60	1.73	6.67	0.35	10.63
On Fishing Vessels	0.16	0.19	0.01	0.07	0.05	0.01	4.74	5.23
Other	0.07	0.03	0.00	0.06	0.02	0.01	0.26	0.47
Total[1/]	1.34	0.97	3.21	2.04	4.36	11.73	7.22	30.88
Expenses								
Personnel	0.75	0.41	0.49	0.76	0.74	1.33	8.11	12.58
Operating	0.05	0.08	0.11	0.10	0.06	0.17	1.12	1.69
Dredging[3/]	-	-	-	-	-	-	-	40.38
Maintenance	0.09	0.07	0.22	0.14	0.30	0.80	0.58	2.20
Total[1/]	0.89	0.55	0.83	1.00	1.10	2.30	9.80	56.85
Net Revenues - Total[1/]	0.46	0.42	2.39	1.05	3.26	9.42	(1.58)	(25.98)

1/ Totals do not add because of rounding
2/ Collected by Customs
3/ Breakdown not available by ports

Source: Secretaria de Marina

October 13, 1970

TABLE 9

MEXICO

Port Revenues and Expenses (1969)

(Pesos million)

Revenues	Acapulco	Guaymas	Manzanillo	Mazatlan	Tampico	Vera Cruz	Other Ports	Total[1]
Port Dues	0.08	0.06	0.15	0.08	0.08	0.30	0.20	0.96
Dockage	0.12	0.34	0.25	0.25	0.72	1.35	0.35	3.37
Wharfage	0.26	0.81	1.84	0.73	1.63	3.96	1.14	10.36
Warehousing[2]	3.34	0.07	2.78	0.57	5.19	19.96	0.82	32.72
On Fishing Vessels	0.13	0.18	0.01	0.08	0.05	0.03	4.88	5.37
Other	0.07	0.06	0.00	0.04	0.02	0.01	0.43	0.64
Total[1]	4.00	1.52	5.02	1.75	7.69	25.60	7.82	53.41
Expenses								
Personnel	0.75	0.36	0.49	0.69	0.76	1.33	8.69	13.06
Operating	0.06	0.03	0.04	0.15	0.05	0.10	1.18	1.61
Dredging[3]	-	-	-	-	-	-	-	44.66
Maintenance	0.18	0.07	0.23	0.08	0.35	1.18	0.40	2.50
Total[1]	1.00	0.47	0.76	0.92	1.16	2.60	10.27	61.83
Net Revenues - Total[1]	3.00	1.06	4.27	0.84	6.53	23.00	(2.45)	(8.41)

1/ Totals will not add because of rounding
2/ Collected by Customs
3/ Breakdown by ports not available

Source: Secretaria de Marina

October 13, 1970

TABLE 2

MEXICO

Port User Charges

(Decree-Law of April 28, 1966)

A. Traffic Dues.

(i) Foreign going vessels with cargo for a Mexican port pay at the port of discharge:

			Mexican Pesos	U.S. Cents
up to 500	N.R.T.	per 10 tons	1.20	9.6
501-1,000	N.R.T.	per 10 tons	1.00	8.0
5,000	N.R.T.	per 10 tons	0.60	4.8
10,000	N.R.T.	per 10 tons	0.40	3.2
over 10,000	N.R.T.	per 10 tons	0.20	1.6

(ii) Foreign going vessels with cargo for a Mexican port, coming from another National Port, pay at the port of discharge:

			Mexican Pesos	U.S. Cents
up to 500	N.R.T.	per 10 tons	1.00	8.0
501-1,000	N.R.T.	per 10 tons	0.80	6.4
1,001-5,000	N.R.T.	per 10 tons	0.40	3.2
5,001-10,000	N.R.T.	per 10 tons	0.20	1.6
over 10,000	N.R.T.	per 10 tons	0.10	0.8

(iii) Vessels coming from another National Port with cargo originating abroad pay according to (i) above.

(iv) Vessels from abroad entering in ballast pay 50 per cent of the scale in (i) above.

(v) Foreign going vessels from another National Port entering in ballast, pay 50 per cent of scale (ii) above.

(vi) Foreign going vessels leaving with cargo for another National Port pay at the port of loading:

up to 500	N.R.T.	per 10 tons	2.00	16
501-1,000	N.R.T.	per 10 tons	1.50	12
1,001-5,000	N.R.T.	per 10 tons	1.00	8
5,001-10,000	N.R.T.	per 10 tons	0.50	4
over 10,000	N.R.T.	per 10 tons	0.40	3.2

(vii) Foreign going vessels leaving in ballast for another National Port, pay scale (vi).

(viii) Vessels leaving with export cargo, loaded for export or transhipment, pay: Per ton of export cargo loaded Mexican $ 1.00, U.S. $ 0.08.

Exemptions:

a) Warships, Mexican or foreign.
b) Vessels exclusively on Mexican or foreign government service.
c) Vessels calling out of necessity.
d) Submarine cable vessels.
e) Vessels docking for repairs or registration.
f) Fishing vessels serving Mexico.
g) Pleasure yachts.
h) Vessels on scientific or humanitarian service.

B. Mooring Charges.

Vessels moored alongside federal quays pay per 24 hours (or fraction over 15 minutes): Per 1 metric length Mexican $ 3.00, U.S. $ 0.24.

Exemptions:

a) Warships, Mexican or foreign.
b) Vessels on Mexican Federal Government service.
c) Submarine cable ships.
d) Scientific and humanitarian vessels.

C. Wharfage.

a) At wharves built or repaired out of federal funds the charge on each ton of import or export cargo moved is Mexican $ 3.00, U.S. $ 0.24.

b) Cargo from or to another national port, moved at coastal wharves is charged at Mexican $ 0.50 per ton, U.S. $ 0.04.

Exemptions:

a) Passengers' baggage.
b) Commercial samples paying no import dues.
c) Postal packets.
d) Packages discharged in error.
e) Fish products from fishing vessels.
f) Ships' stores for use by ships calling at the port.
g) Federal or state government effects.
h) Coastal cargo.
i) Salvage from wrecks or accidents.
j) Mail.

October 13, 1970

TABLE 11

MEXICO

Representative Charges on Vessels and Cargo

Port of Veracruz (late '69/early 1970)

	Ship No. 1	Ship No. 2	Ship No.3
Port Charges			
Pilotage	1,973	2,626	5,081
Tug service	-	-	5,250
Lines: mooring-unmooring	344	438	556
Launch and auto line	80	80	90
Tonnage dues	132	131	866
Migration, Port Doctor	310	150	1,056
Overtime to Customs and Port Authorities	300	300	300
Meals to Customs and Guard	560	480	160
Total Port Charges	3,700	4,205	13,358
Cargo Expenses			
Stevedoring - Discharge - Straight Time	27,230	28,522	2,354
Stevedoring - Discharge - Overtime	293	1,938	500
Stevedoring - Loading - Straight Time	9,825	22,878	9,408
Stevedoring - Loading - Overtime	-	2,863	355
Clerking & Tally, Discharging	4,581	3,471	999
Clerking & Tally, Discharging - Overtime	273	1,866	273
Clerking & Tally, Loading	960	1,805	538
Clerking & Tally, Loading - Overtime	45	1,222	391
Cargo Repairs	2,492	3,754	342
Dock Labor	5,511	21,331	4,211
Overtime to Customs	14,770	19,631	3,510
Labor Insurance	4,301	5,551	1,350
Watching Cargo	2,149	4,115	791
Wharfage, Dockage	2,402	1,782	983
Sundries	207	470	100
Total Cargo Expense	75,040	121,199	26,105
Miscellaneous	1,883	2,313	1,531
Total Costs	80,663	127,717	40,994
Tonnage Discharged	966	984	82
Tonnage Loaded	348	794	331
Total Tonnage Handled	1,314	1,778	413
Tonnage of Vessel GRT	2316	2312	7146
NRT	1144	1142	4134
Total Costs per Ton of Cargo Handled - Pesos	61	72	99
- US$	4.90	5.75	7.94

Note: Totals will not add because of rounding.

October 13, 1970

M E X I C O

MINISTRY OF MARINE

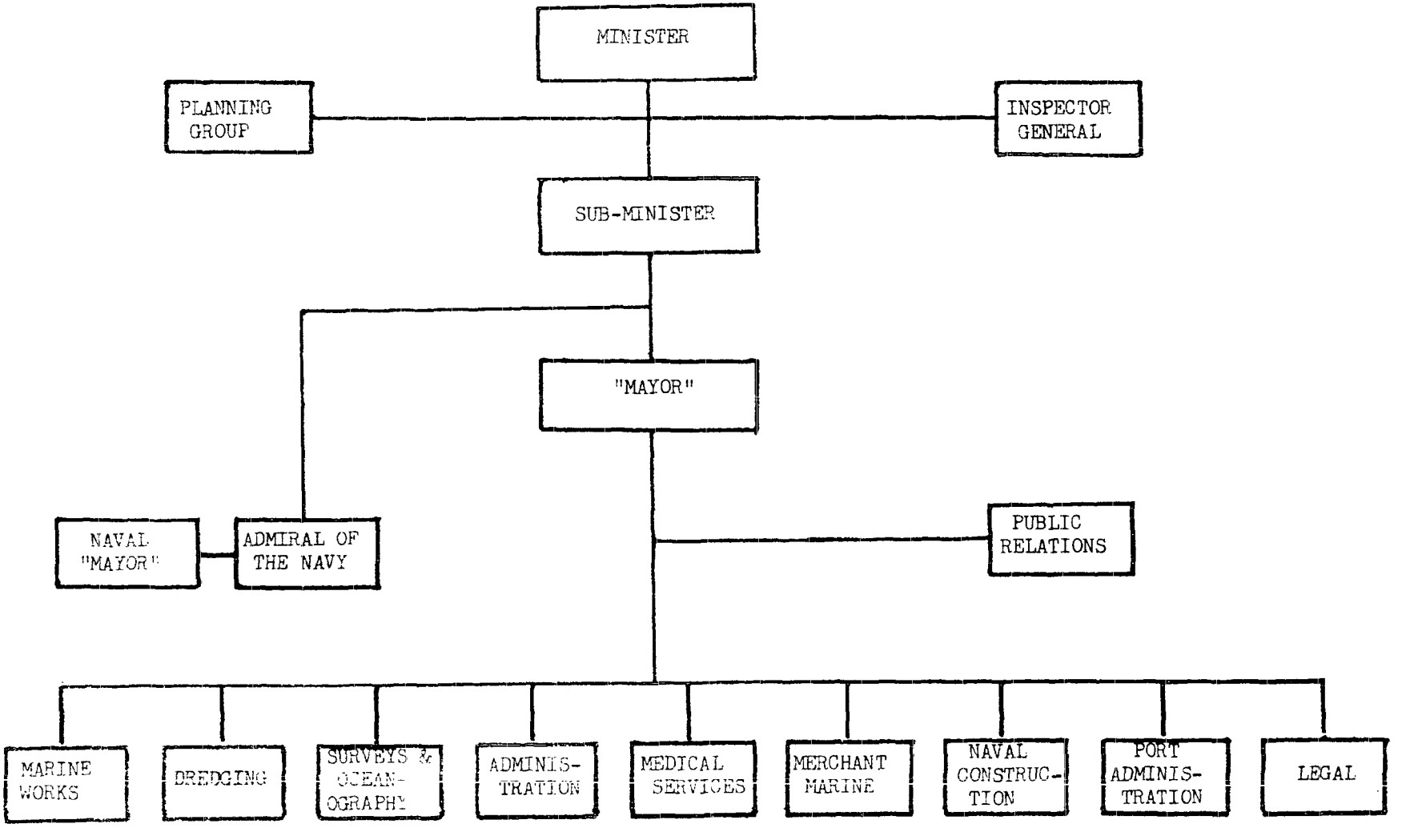


FIGURE 1

PART B - PEMEX: PETROLEUM TRANSPORT

I. SUPPLY FACTORS AFFECTING THE PLANNING OF TRANSPORT FACILITIES

A. Introduction

1.01 The importance of the petroleum industry in the Mexican transport sector can be appreciated from two facts: first, in 1969, the movement of crude petroleum and refined products in Mexico was almost 19 billion ton-km,[1/] as compared to a total of 21.5 billion ton-km of railway freight traffic; second, investments in transport, storage and distribution facilities by the state oil company, Petroleos Mexicanos (Pemex), averaged Pesos 616 million (nearly US$50 million) annually in the 1965-69 period or about two-thirds of the railways' average investments in both freight and passenger facilities in the same period. Pemex is the largest single company in Latin America and ranked about number 70 in the world.

1.02 Pemex, a fully integrated oil company, has more than tripled its gross sales in the past eleven years to achieve a billion dollar annual rate in early 1970. In effect, Pemex explores, produces, refines, transports and sells refined petroleum and natural gas; more recently it has diversified into basic petrochemicals which now account for 10% of its gross revenue. Pemex's policy is not to generate exports, but to supply the domestic market with refined products and gradually to substitute imports of petrochemicals. It will consider exporting only those joint products or crudes, which by their special nature cannot be consumed domestically. Temporary surpluses of intermediate petrochemicals such as aromatics are also exported. In this sense the company's approach is conservationist; it believes that scarce physical resources must be conserved to cover, over the longer run, the requirements of the domestic market. In view of the present reserves position, this approach appears to be logical with respect to petroleum products, but in the case of petrochemicals, it should be reviewed from time to time in the context of the changing world market demand and prices.

1.03 Pemex is responsible inter alia for transporting and distributing petroleum and natural gas products, so as to meet the growing energy requirements of the Mexican economy, to supply raw material inputs to the petrochemical industry and to cover its own needs for fuel. The company's transport policy is to seek a rational transportation system that will move oil by the most economic mode or combination of modes of transport. For some products, the choice among modes is limited. For example, natural gas in the gaseous form can only be transported by pipeline, while residual fuel oil cannot be moved by pipeline unless the pipe is heated or the product is made less viscous by the addition of a diluent such as kerosene.

1/ Excluding about 830 million cubic feet of gas daily.

1.04 With these limitations in mind, the company gives first priority to the movement of oil products by pipeline and then by tanker, once certain volume conditions have been fulfilled. These modes of transport are owned and controlled by Pemex itself and represent a decision to invest funds whether internally generated or externally financed. For the balance of its transport needs, approximately 36% in terms of tons originating and 24% on the basis of ton kilometers, the company must depend on railways and roads although in some cases it may own or lease the vehicle fleet. If a policy can be distinguished between these two modes, it is one which aims at encouraging the use of road transport for the movement of distillate products. These products, mainly gasoline, kerosene and diesel, are shipped over hauls of up to 400 kilometers. On a ton kilometer basis, railway costs are lower, but this consideration is outweighed in the view of Pemex on total distribution cost grounds by the flexibility, speed, and dependability of road transport services. The railways, however, are used preferably for residual fuel oil and for long-distance hauls of butane and propane gases (LPG): (also see Table 1)

Volumes Transported by Mode - 1969

	Tons (000)	%	Ton-km (million)	%	Average Distance (km)
Tankers 1/	9,200	38.7	7,360	54.2	800
Pipelines 2/	6,038	25.4	3,019	22.2	500
Railway	4,911	20.7	2,160	15.9	440
Road	3,621	15.2	1,050	7.7	290
Total	23,770	100.0	13,589	100.0	

1/ Including crude petroleum
2/ Excluding crude petroleum

B. Location of Production

1.05 One of the major uncertainties affecting the planning of transport facilities for oil and gas is related to the location of new producing fields. Broadly speaking, the production of both oil and gas is concentrated along the Gulf Coast of Mexico, the principal producing zones being Reynosa in the northeast, the Poza Rica area, including the continental platform in the mid-east region, and the fields extending from Agua Dulce to Comalcalco in the southeast.

1.06 Total production of crude petroleum and natural gas liquids in the past five years has increased by an average annual rate of 5.5% to

reach over 461,000 barrels daily (b/d). Concurrently, the shift in production toward the southeast has become marked with the Tabasco and Isthmus fields now producing over 44% of total crude output:

Crude Petroleum Production

	1964	1969	1964	1969
	(thousand barrels/daily)		(Percentage)	
Northeast	10.2	14.3	2.9	3.1
Central	204.1	241.0	57.6	52.2
Southeast	140.1	206.0	39.5	44.7
Total	354.4	461.3	100.0	100.0

1.07 The above trend has implications for the transport sector; production in the southeast cannot all be processed locally, but must be shipped in growing volumes to Madero. In 1969, about 35,000 b/d of crude were being transported by tanker from Nanchital, the port serving Minatitlan. Nevertheless, one of the brightest spots in the production outlook which could reduce the pressure to move crude out of Minatitlan, is the prospect for offshore development. The Atun field was producing 30,000 b/d by year-end and is expected to reach 70,000 b/d during 1970. The Arenque field offshore opposite Tampico is currently being drilled and there are other discoveries in the continental platform which have not yet been fully evaluated. Gulf coast offshore areas, with the present state of knowledge, are estimated to add some 800 million barrels of oil to reserves. Moreover, drilling has just commenced offshore on the Pacific coast some 50 miles from Salina Cruz. No oil has been found on the west coast of Mexico to date, but a discovery in the Salina Cruz area would have an impact on investment decisions in transport facilities crossing the Isthmus of Tehuantepec and, indeed, would alter the pattern of distribution of petroleum products.

C. Reserves of Oil and Gas

1.08 During the past decade, 1.86 billion barrels of oil have been discovered in Mexico. In this connection, two facts stand out which if they become permanent trends will affect the long term future energy supply position of the country and modify the transport problem. These are (a) the discovery rate per exploratory well has declined from about 2 million barrels to 1.5 million barrels in the period 1964-69 as compared to the previous 10 years, and (b) the theoretical duration of liquid

hydrocarbons reserves has fallen steadily from 25.7 years in 1959 to 19.2 years by the end of 1969. The first case indicates that discovery costs are becoming higher in view of lower success ratios and probably deeper wells. Nevertheless, improved seismic methods, breakthroughs in drilling technology or the discovery of new large fields could help to offset this trend. In the second case, the decline in the reserves ratio shows that net additions to new reserves are lower than total oil produced. Over the past 10 years, a total of 1.34 billion barrels of oil were extracted, while only 0.52 billion barrels were added to the stock of reserves on a net basis. At the end of 1969, total remaining proved reserves amounted to 3.24 billion barrels (Table 2). The concept of the reserves ratio or theoretical duration of reserves must be qualified; it throws no light on the rate at which oil can actually be withdrawn from the ground or on the volume of probable reserves which could be extracted by the employment of secondary recovery techniques.

1.09 Natural gas is located in the same general area as oil, being produced either as dry gas or in association with liquids. At the end of 1969, total reserves amounted to 11.6 billion cubic feet of which over 40% were situated in the south and about 35% in the Reynosa area. During the same year production rose to 1.67 billion cubic feet per day, roughly equivalent to 330,000 b/d of oil on a calory basis. As with liquid hydrocarbons, the reserves ratio has also declined.

D. Location of Refineries

1.10 At the end of 1969, Pemex was operating six refineries with a total distillation capacity of 552,000 b/d and cracking installations to process 152,000 b/d. Two of the refineries, those at Poza Rica and Reynosa, are small and their zone of influence is negligible. Of the four major refineries, Minatitlan (175,000 b/d) and Madero (169,000 b/d) are located near the source of production on the Gulf Coast. The two remaining refineries, Atzcapotzalco (90,000 b/d) and Salamanca (75,000 b/d) find their location inland near centers of consumption. The dominant characteristic of the petroleum transport sector, which is the very long haulage distances for refined products, arises as a consequence of the location of the two coastal refineries. For example, the zone of influence of the Minatitlan refinery covers the entire Pacific Coast of Mexico. The inland refineries must receive their crude inputs by pipeline and a new refinery to go on stream in the mid 1970's in the vicinity of Mexico City will also be supplied by this mode.

1.11 In response to market-demand, crude runs to stills rose to 463,000 b/d in 1969, representing an 83% utilization of installed refinery capacity. Refinery policy is directed toward the more intensive processing of the barrels of crude in order to obtain a greater percentage yield of higher value products and a lower proportion of residual fuel oil. This aim is in line with overall petroleum policy of conserving hydrocarbons resources for domestic use; in the future less fuel oil will be available

for export. The trends in refining can be appreciated from the following table:

	Total Capacity (thousand b/d)	Cracking Capacity (% of Total)	Crude Processed (thousand b/d)	Residual Fuel Oil Yield %
1969	311.2	21.5	287.0	42.0
1964	456.0	25.2	346.6	31.5
1969	552.0	27.5	462.8	25.5
1976 1/	1,022.0	37.7	698.6	15.1

1/ Estimated by Pemex.

1.12 One of the problems facing Pemex is the high sulfur content of the crude produced in the country. Desulfurization of diesel and kerosene fractions forms part of the refinery process at Minatitlan, Salamanca and Madero. The new refinery planned for Mexico City includes hydrodesulfurization processes for distillate products. The present facilities in operation at the above-mentioned refineries can produce an 0.05% sulfur diesel in limited quantities. According to Pemex the cost of desulfurization is on the order of two centavos per liter for the low sulfur fraction produced. This premium fuel can be blended with high sulfur material to give a product with acceptable sulfur specifications. In order to avoid excessive cylinder wear and other corrosion problems, consumers with heavy mobile equipment such as the railways should burn a diesel fuel with a sulfur content of between 0.5 and 1.0%. Railway diesel fuels now produced by Pemex can meet these requirements.

1.13 The reduction of the sulfur content of fuels in general is also important for the community in terms of air pollution. In particular, Mexico City is conscious of the problem of air pollution, not all of which is caused by sulfur dioxide emissions from the burning of fuels. In the US, Japan, Sweden, and other countries, clean air legislation has placed severe limits on the sulfur content of industrial fuels. The permissible sulfur levels along the US East Coast, for example, vary from 0.37 to 1.00%. In Mexico City, no legislation has been introduced as yet, but a commission is studying the causes of contamination, its measurement and regulation. The enactment of regulations to limit the sulfur content of fuels and reduce the lead content of gasolines would have investment implications for Pemex and price repercussions for the consumer of these products.

II. PETROLEUM TRANSPORT FACILITIES AND COSTS

A. Pipelines

2.01 The location of both production and of the four major refineries has determined to a great extent the present pattern of transportation and distribution. With the exception of crude shipments by tanker out of Minatitlan to Madero, all crude moves to the refineries by pipeline. Natural gas is transported exclusively by pipelines from the major producing fields which are the originating points for the northern and southern gas systems. These two gas systems are not yet interconnected.

2.02 Refined products move from the four refineries by pipeline, tanker, tank truck and rail tank car to the 60 or so sales agencies throughout the country, either directly or via transshipment points such as the ports on the West coast or pipeline terminals. Typical ports for the transshipment of oil products are Salina Cruz for outward cargoes and Mazatlan, Guaymas and Rosarito for inward cargoes.

2.03 The basic transport problems facing Pemex are those of distance and widely scattered points of consumption. The producing zones in Mexico are distant from the area of greatest demand for final products. This feature together with the geographical distribution of economic activity has given rise to the existing network of pipelines in the country. Given volume - at least five to ten thousand barrels daily according to the terrain - a pipeline outperforms all other modes of inland transport in the bulk movement of liquid products. In Mexico, pipelines are being employed to transport, in addition to the typical petroleum products, such specialized products as liquid ammonia, ethylene and propane. At the end of 1969, there were over 9,200 kilometers of trunk pipelines[1] of all types in service in Mexico.

2.04 Refined products pipelines: By the end of 1969, a total of 2,946 kilometers[2] of products lines were in operation excluding the Minatitlan-Salina Cruz liquid ammonia pipeline (Table 3). Total capacity was rated at 151,500 b/d of which 88% was being utilized. Some lines such as the Salamanca-Guadalajara pipeline and the line to Salina Cruz have been running at 100% capacity. Consequently, as a result of bottlenecks, new traffic has been shifting to other modes of transport in recent months. The areas of demand which are facing supply problems comprise Mexico City and the Pacific Coast. The existing facilities comprise 6 to 12-inch diameter pipe as shown in the following table:

---

[1] 15,937 kilometers if all loops, parallel lines and lateral lines are included as of December 31, 1968.

[2] Excludes lateral lines or feeder lines.

Major Products Pipelines in Mexico

	Diameter (inches)	Length (kilometers)	Capacity (barrels daily)
Madero-Chihuahua	12, 10, 8	1,276	36,000
Minatitlan-Mexico	12	578	55,000
Minatitlan-Salina Cruz	10	245	40,000
Salamanca-Guadalajara	6	315	10,000

2.05 Products lines in Mexico carry gasoline, kerosene and diesel with gasoline representing about 50% of the total volume. Products are sent in batches, with very little mixing. Residual fuel oil, because of its viscosity cannot be transported by pipeline except under certain conditions and can be considered normally as "captive" to the railroads. In technical terms, the transmission of heavy fuel oil by pipeline is feasible if the pipeline is heated or the product is diluted with a lighter hydrocarbon. Pemex plans to reduce the vicosity of fuel oil by adding kerosene for the proposed pipeline project between Minatitlan and Salina Cruz.

2.06 Crude Petroleum Pipelines: The principal crude trunk pipelines move oil from the central gathering facilities in the fields to the refineries (Table 4). The two major inland refineries, Atzcapotzalco and Salamanca are supplied by crude lines from Poza Rica which is also connected to the Madero refinery. The total length of the major crude pipelines network aggregates 2,448 kilometers including loops and parallel lines[1/]. It has a capacity of 575,000 b/d, but the average haulage distance is only approximately 150 kilometers. The principal crude lines to refineries are:

Major Crude Pipelines

	Diameter (inches)	Length (kilometers)	Capacity (barrels daily)
Poza-Rica-Atzcapotzalco	18	245	105,000
Poza Rica-Salamanca	12	455	50,000
Poza Rica-Salamanca	18 ,14	453	100-50,000
La Venta-Minatitlan	12, 12, 18	61, 49, 49	50-100,000
Naranjos-Madero	16, 20	120	60-100,000

2.07 Natural Gas Pipelines: There are no economical alternatives to pipelines for inland transportation of natural gas. Very little difference exists between the transmission of gas by pipeline and that of oil. Investments and operating costs for compressor stations and the same diameter pipe

---

[1/] If lines from the fields, with a diameter greater than six inches are included, the total length would be 5,660 kilometers.

are similar to liquid lines. The speed at which gas moves along a line is superior but because of the greater volume occupied by gas on a calory basis more oil can be moved through a similar line. Unlike liquid products, gas must be delivered to the final consumer by pipe. This implies splitting the trunk line into feeder and spur lines with consequent sharp increases in operating costs as the volume drops.

2.08 The natural gas line network in Mexico comprises two separate systems: The Reynosa-Chihuahua line in the north and the Cd. Pemex-Mexico-City-Guadalajara line in the south (Table 5). The total length of the network amounts to over 3,825 kilometers with an operating capacity of over 1.1 billion cubic feet per day. The characteristics of the tyo systems are:

	Diameter (inches)	Length (kilometers)	Capacity (million cubic feet)	Input 1969
Reynosa-Chihuahua	24,22, 16, 12	987	320	304
Cd. Pemex-Mexico City-Guadalajara	24, 14	1,283	615	524

2.09 The northern transmission system runs from Reynosa to Monterrey, Chavex and Chihuahua, a total distance of 987 kilometers, and has the following principal spur lines: Escobedo-Monclava (Altos Hornos); Monterrey-Hildalgo (Cement); Chavez-Torreon-Gomex Palacio and Escalon-Laguna del Rey. Gas is also exported from Reynosa via pipeline to the US. The export contract with Texas Eastern expires in 1978 and as of now no decision has been taken concerning its renewal. The major inputs for the southern system are from the absorption plants at Cd. Pemex and La Venta. The line which runs to Mexico City (Venta de Caspio), Salamanca and Guadalajara has a number of important outlets including Villahermosa, Minatitlan, Verzcruz and Queretero. Both systems are now operating at over 80% capacity. In view of the growing demand for natural gas, the construction of a parallel line to Mexico City has commenced and is scheduled for completion by 1972. In addition, the northern system is being strengthened in capacity by the addition of new compressor stations.

2.10 The total volume of gas moved by pipeline has been rising at an annual average rate of 9.6% reflecting the growth of energy demand and the substitution of residual fuel oil in the areas served by natural gas lines. The impact of gas on other modes of transport has been indirect; it has slowed the growth of fuel oil and shifted demand to regions not supplied by gas.

2.11 Pipeline Costs: Pipelines represent a specialized means of transport which is both secure and dependable. They operate continuously and do not require the return of empties. Pipelines can shorten distance between two points by cutting across terrain not accessible to roads or railways. Given minimum volume conditions, they are more economical for inland transport than other modes of transport and in Mexico can compete with cabotage operations. Pipelines are characterized by high initial investment costs, low operating costs and economies scale. Consequently, unit costs increase

rapidly as volume drops. Pipelines also have some disadvantages: they are not as flexible as road or rail transportation and they require minimum storage facilities at terminal points.

2.12 Pipeline construction and operating costs in Mexico appear to be in line with similar costs in other countries. Typical construction costs were made available to the mission which take into account the price of locally manufactured pipe and Mexican labor costs. Pemex uses its own construction division for pipe-laying. The costs presented below do not include terminals or pumps:

Pipeline Construction Costs in Mexico
(thousand Pesos per kilometer)

	10"	12"	14"
Pipe	168	203	218
Other materials	33	39	43
Labor	72	92	102
Total	273	334	363
US$/km (000)	21.8	26.7	29.0

2.13 Estimated operating costs were also made available for four diameter of pipe, under optimum and less than optimum volume conditions and two types of terrain: essentially flat ground and terrain with a gradient rising to 2,240 meters which is the altitude of Mexico City. The annual provision for depreciation is in all cases higher than all other operating costs combined, which is normal for pipelines of the diameters employed in Mexico. Table 6 shows total unit costs as calculated by Pemex for new investment purposes on the basis of a 350-day operating year. For purposes of comparative illustration only, the Mission has utilized the cost figure (including depreciation) of US cents of 0.1760 per ton kilometer as being representative of products lines operating under optimum operating conditions in Mexico. The ratio of railway to pipeline costs is at least 5:1. Even an eight-inch line operating at 50% of capacity over rough terrain gives a 3.5:1 ratio.

B. Tanker Fleet and Operating Costs

2.14 At the end of 1969, the Pemex tanker fleet aggregated a total of 350,000 deadweight tons and averaged 6.03 years in age (Table 7). Total tonnage owned by Pemex now represents over 50% of the ships under Mexican flag. The period 1965-69 saw almost the complete renewal of the fleet, with the purchase of 17 new tankers including specialized ships for ammonia, aromatics and ethylene. Prior to the acquisitions, the fleet had been allowed to deteriorate and become obsolescent:

Characteristics of Pemex's Tanker Fleet

	Number of Tankers	Average Age	DWT	Barrels
January 1, 1965	21	24.24	262,377	2,009,282
January 1, 1970	21	6.03	349,979	2,720,245

2.15 The renewal of the tanker fleet had several important effects. Repairs and maintenance costs were reduced drastically from Pesos 76 million in 1966 to Pesos 19 million in 1968. Moreover, the fleet commenced to earn foreign exchange on export freights, which amounted to Pesos 25 million in 1967 and Pesos 12 million last year. The utilization of Pemex tankers for export shipments represents the utilization of temporary excess capacity.

2.16 The total carrying capacity of the tanker fleet increased from 41 million barrels in 1965 to 110 million barrels per year by the end of 1969. Accounting for this increase was the rise in tonnage, higher speeds, faster turnaround times and reduced repair time. Loading, unloading and demurrage has been shortened from 23% to 18% of total time in operation and time for inspection and repairs to 17 days per year. Once new inspection and maintenance methods are introduced the stoppage for repairs will further be reduced to an average of 10 days per year and thereby increase carrying capacity.

2.17 Port conditions do not allow the use of tankers over 20,000 dwt and indeed place a severe limitation on the full utilization of the carrying capacity of the present tanker fleet. Because of draft limitations, Pemex's fleet could only move a maximum of 83 million barrels per year if required instead of 110 million barrels. In effect, because of draft limitations, tankers loading at Gulf ports cannot carry more than 110 to 120,000 barrels as compared to their maximum capacity of approximately 150,000 barrels. Tankers cannot operate with full cargoes out of Nanchital (27 feet), Veracruz (28 feet), Minatitlan (22 feet), Lerma (12 feet) and Acapulco (29 feet). This means that on the Gulf Coast 20,000 ton tankers operate at 75 to 80% of their maximum loads.

2.18 On the Pacific Coast there are limitationsoof a different type on the optimum use of the fleet. The limiting factor is not port facilities but storage capacity available at the different loading and unloading points. Tanker runs would be optimized and operating costs reduced if products tankers could discharge their full load at a single port instead of calling at a number of ports. Only Guaymas and Rosarito on the Pacific can accommodate fully loaded tankers. Other ports, in particular Mazatlan, in terms of their areas of influence, could take full cargo shipments if storage was made available. Another restraint on the optimization of fleet movements can be attributed to the lack of facilities for night operations at some ports on both the Gulf and Pacific Coasts.

2.19 On the Gulf Coast of Mexico, the average distance of tanker routes for crude and residual fuel oil is approximately 495 kilometers. The mission was informed that Pemex tankers average 60 to 65 trips per year. On the Pacific Coast the average voyage for a distallates and black products tankers is 1,930 kilometers.

2.20 The difference in distance is reflected in unit tanker operating costs. In sharp contract to pipelines, tanker costs drop significantly as distance increases, as terminal expenses and demurrage are averaged over a greater number of ton miles. Unit cost of voyages between ports on the east coast are higher than on the west coast of Mexico. The unit operating cost of the voyage between Salina Cruz and Rosarito has been calculated by Pemex at 0.072 US cents per ton-km. A typical cost estimated for an ocean-going tanker of 20,000 dwt is 0.0372 US cents, per ton-km[1/]. The following voyage costs were supplied to the mission by Pemex and are meant to be representative costs for full cargo lot shipments between the ports indicated. A tanker which partially offloads at several ports, as is still the practice for many shipments in Mexico will suffer rapidly rising unit costs.

Tanker Transport Costs Under Optimum Conditions

	Distance (km)	Centavos (per ton kilometer)	US Cents (per ton kilometer)
Nanchital-Madero	514	1.621	0.130
Salina Cruz-Acapulco	475	1.523	0.122
Salina Cruz-Rosarito	2,737	0.896	0.072
Tampico-Mazatlan	5,686	1.020	0.082

2.21 Actual average operating costs are somewhat higher because of port and storage deficiencies, undue delays and scheduling difficulties as well as excess capacity. In 1969, the fleet operated at 65% of total carrying capacity. The figures for actual operating costs discussed with Pemex cover a range from Pesos 0.0035 to 0.0056 per barrel-km. The mission has used the former figure equivalent to US0.225 cents per ton-km as representative of average costs under present operating conditions.

1/ Michael Hubbard "The Comparative Cost of Oil Transport to and within Europe".

C. Rail and Road Facilities and Operating Costs

2.22 In transporting products from refineries to markets, Pemex makes use of both rail and road facilities. The transport function of Pemex does not end at sales agencies. In towns, it distributes in owned tank trucks to the points of final consumption such as service stations. For example, in Mexico City over 170 tank trucks, the majority with a 15,000 liter capacity, are utilized. Outside cities the company moves products from its own sales agencies to points from which private distributors operate.

2.23 For intercity traffic, Pemex makes extensive use of the existing railway network and road system. Pemex moves about 29.2 million barrels (3.6 million tons) of products by road and 36.3 million barrels (4.9 million tons) by rail. During 1969, the company operated a total of 2,862 rail tank cars with an average capacity of about 9,700 gallons. It runs tank cars in the 8-10 and 12,000 gallon class. Of the total number of tank cars operated by the company, 42.4% are owned and the balance leased from Mexican and US railroads. Pemex had budgeted for 300 new tank cars per year to replace older equipment, but for a number of reasons the budget has not been executed. A basic problem facing Pemex is whether to tie up its resources in railway tank card or whether to lease them. Once it has bought new tank cars, Pemex has limited its flexibility in the use of alternative transport modes. The national interest and prudent business strategy requires that some tank cars be owned in Mexico. In other words, the issue is not all leasing or all ownership. The railways, however, are understandably reluctant to invest heavily in tank cars without any guarantee of traffic from Pemex. The mission cannot recommend a unique solution to this problem. It can only arrive out of discussions between the railways and Pemex as to what traffic guarantees and for what period can be given by Pemex and the assurances of service and contractual freight rates than can be given by the railways. The mission would recommend, however, that as some of the older tank cars now owned in Mexico reach retirement age, they should be replaced by 20,000 gallon cars which would offer unit savings to both the railways and Pemex.

2.24 As can be observed from the statistical data made available, Pemex has already started to increase the proportion of leased to owned cars. In practice, tank cars can be obtained from specialized leasing companies, a number of which operate in Mexico. It is usual to lease rolling stock for a ten-year period, although the time span may vary from company to company according to the circumstances:

Railway Tank Cars Operated by Pemex

Year	Owned	Leased	Total	% Owned
1966	1,264	1,495	2,759	45.8
1967	1,238	1,486	2,724	45.4
1968	1,224	1,550	2,774	44.1
1969	1,213	1,649	2,862	42.4

2.25 Railway transportation is used by Pemex for LPG and heavy fuel oil and to a lesser extent for distillate products. Tank trucks, however, carry the greater part of distillate traffic not moved by pipelines and tankers. Pemex does not own any intercity tank trucks, but enters into contractual arrangements with private truckers.

2.26 An analysis of oil products traffic by rail and road in Mexico suggests that the road fleet is more efficient, that is, it has greater flexibility, higher speed and more capacity per unit per year. A railway tank car will make a journey every 6.6 days averaging 135 kilometers daily, while a road tank truck covers an estimated 429 kilometers per day. In terms of cubic meters originating, a tank truck will carry 3.4 times as much as the rail unit, but based on ton-kilometers the advantage shrinks to 1.7 times. Average hauling distances for the transport of refined petroleum products were estimated at 445 kilometers for the railways and 290 kilometers for road traffic.

Comparative Operating Statistics

	Tank Car	Tank Truck
Average haul (kms)	445	290
Average journey (days)	6.6	1.35
Kilometers/day	135	429
Journeys/year	55	271
Cubic meters/year	2,019	6,786
Ton-km/year	887	1,535

2.27 The operational data reflect the many problems adversely affecting the proper scheduling of oil traffic by rail. The railways experience, among other, serious seasonal problems, in some areas, when they must give priority to agricultural goods. In addition there is a lack of adequate rolling stock. Moreover, at many points, either demand or storage is inadequate to sustain efficient railway operations. Under these conditions, the choice of placing more emphasis on road traffic for those products which are not captive to the railroads appears to be reasonable as a short term solution in terms of real costs to Pemex vis-a-vis disbursements for railway services.

2.28 The mission did not attempt to estimate the economic costs of road and rail transport of oil products. It did obtain, however, data on the cost of these transport services to Pemex. The figures selected for the railways, based on current tariffs including an element of taxation averaged US cents 1.126 per ton-kilometer, but varied between US¢0.64 for long haul movements of residual fuel oil to US¢1.36 for shorter hauls of distillate products. Road tariff schedules are arrived at by a process of bargaining and do not correspond to the fixed tariff levels set officially. Pemex informed the mission that the average unit per ton kilometer cost for the movement of distillate products by road excluding LPG was approximately 1.487 US cents.

III. TRAFFIC TRENDS AND PROBLEMS

A. Domestic Consumption of Refined Products

3.01 The domestic demand for refined products has grown at an average annual rate of 4.7% in the past decade and by 6.7% from 1964 to 1968. Overall energy consumption including natural gas has been growing at the higher rates of 7.6 to 7.9%. During the entire period under review, there has been a marked shift away from fuel oil in favor of the lighter products. Residual fuel oil represented 34% of domestic demand in 1959, but by 1968 it had decreased to 21%. This trend reflects the introduction of natural gas which has displaced residual fuel oil as the prime fuel for industrial purposes and coincides with the policy of upgrading refinery yields (Tables 8 and 9):

Distribution of Demand by Major Products
(in percentages)

	1959	1964	1968
LPG	7.0	11.3	12.5
Distillates	51.3	57.9	58.1
Fuel Oil	34.2	22.9	21.2
Others	7.5	8.2	8.2
Total	100.0	100.0	100.0

3.02 The absence of growth of fuel oil consumption and the continued strong demand for distillates has affected the various modes of transport of oil products. In fact, the slow rate of increase in the rail movement of oil - only 1.3% annually in the past decade - can be attributed in good measure to the shift of distillate products to the highways, to the changing structure of the domestic energy market and, in particular, to the fluctuations in the domestic demand for fuel oil. The rail tank car is the predominant mode of transport for this product.

3.03 In the past few years, total energy demand has been growing at a somewhat higher rate than the Gross National Product (GNP). Rates of growth in the GNP - and in industrial production - are often accompanied by sharper upturns in the consumption of energy. In Mexico GNP increased by 6.8% yearly in the past five years and energy demand by 7.9%. It is estimated that GNP will grow at 6.0% yearly during the period 1970-75. In view of this the mission believes that future demand will increase at a somewhat higher rate, perhaps 6.7% with liquid products growing slower and natural gas faster.

3.04 Much of the outlook depends on distillate products and LPG. The distillates market responds to the demand for fuel to be consumed by all forms of transport. The requirements of the transport sector averaged 220,000 b/d in 1969, or the equivalent of an average growth rate of 9% p.a. since 1965. In geographic terms, distillate demand on the Pacific may increase to 78,000 b/d by 1976, far in excess of the present pipeline capacity to the

West Coast. Mexico City requirements are estimated at 116,000 b/d by 1976, which could not by supplied with existing refinery or pipeline facilities.

Distillate Domestic Demand by Region[1/]
(barrels daily)

	1965	1969	1976[2/]	Average Growth Rates 1965-69	1969-76
Pacific Northwest	28,080	36,112	55,847	6.5	6.4
Pacific Southwest	8,264	11,844	21,726	9.4	9.1
Sub-total	36,344	47,956	77,573	7.2	7.1
Mexico City	55,108	71,381	115,745	6.7	7.2
Other	92,414	128,661	233,151	8.6	8.9
Total	183,866	247,998	426,469	7.8	8.1

B. Traffic Flows by Mode

3.05 Pipelines: In 1969, a total volume of 133,400 b/d (6.04 million tons) was carried by the products pipeline system as compared with 91,600 b/d (4.15 million tons) in 1965 (Table 10). Thus, in the 1965-69 period, total pipeline traffic increased by over 41,000 b/d representing an average annual rate of 10.1%. Pipeline traffic grew faster than the output of gasoline, kerosene and diesel fuel from the refineries. Of the total volume of these products leaving refineries, 54.8% was moved by pipeline in the first stage of distribution during 1969 as compared with 46.7% five years previously. Natural gas movements by pipeline increased by 9.6% p.a. in the 1965-69 period (Table 11).

3.06 Traffic flows by pipeline can be easily identified; the principal movements are shown as follows:

Products Pipeline Traffic
(thousand barrels/daily)

	1965	1969
Madero-Chihuahua	23.6	32.4
Minatitlan-Mexico	19.2	47.1
Minatitlan-Salina Cruz	35.5	33.4
Others	13.3	18.5
Total	91.6	133.4

1/Gasoline, kerosene, diesel (excludes LPG and jet fuel).
2/Pemex estimate.

Pipelines affect all other modes of transport. During 1969, most products lines were operated, as has already been stated, at between 90 and 100% of capacity. It can be affirmed that the products line system is becoming the source of bottlenecks because of the absence of spare capacity and delays in the construction of new lines. These lags in pipeline capacity are now showing up as sharper than average increases in other modes, notably road and rail. Petroleum traffic on the highways and railways reflected this situation in 1969. The railways alone registered an increase of 7% in oil movements over 1968. The investment strategy, as developed by Pemex, to cope with rising energy requirements and changing geographical patterns, envisages that pipeline traffic should increase by over 12% annually to average 296,000 b/d by 1976.

3.07 Tankers: Excluding specialized petrochemical products, 9.2 million tons of crude and petroleum products were loaded on Pemex tankers, mostly for cabotage, during 1969 (Tables 12 and 13). In the last two or three years, Pemex has on occasion utilized its tankers to carry fuel oil to the US East Coast to reduce idle tanker capacity. Tanker traffic has been rising at 4.5%. Traffic comprises crude petroleum and residual fuel oil movements between refineries and movements of distillate products and fuel oil to consuming points:

Tanker Traffic
(thousand metric tons)

	1965	1967	1969
Gulf Coast	5,691	5,768	6,789
Distillates	1,053	695	957
Heavy Products	4,638	5,073	5,832
Pacific Coast	2,033	2,178	2,411
Distillates	1,456	1,600	1,871
Heavy Products	577	578	540
Total	7,724	7,946	9,200

3.08 The principal traffic flows are, on the Gulf Coast, from Minatitlan-Nanchital to Tampico-Tuxpan for black products and from the two coastal refineries to several ports, including Veracruz to Lerma for refined products. On the Pacific Coast traffic originates out of Salina Cruz to the principal oil ports, notably Mazatlan, Guaymas and Rosarito. Present refined product requirements on the Pacific Coast exceed the capacity of the Isthmus pipeline and railway. Pemex estimates that during 1970 it will need to transport 48,000 b/d of distillates and 12,000 b/d of fuel oil to the Pacific. The Minatitlan-Salina Cruz pipeline has a maximum capacity of 40,000 b/d and the

railway, as operated today, cannot carry more than 8,000 b/d of fuel oil according to Pemex authorities. The mission was informed that two to three tankers a month are being dispatched from Tampico to the Pacific Coast via the Panama Canal to cover the deficit of refined products. These tankers (distillates and fuel oil) usually discharge at Mazatlan and Guaymas.

3.09 The future rate of growth of maritime traffic depends on a number of factors, among them (a) completion of a products pipeline from Salamanca via Guadalajara to a point on the Pacific, probably Mazatlan, (b) an additional line across the Isthmus of Tehuantepec, (c) a system of products lines in the Pacific Northwest either by extending the proposed line to Mazatlan to Culiacan and Los Mochis or by constructing a number of small pipelines from Guaymas, Topolobampo and Rosarito, (d) possibility of a new oilfield on the Pacific, (e) increased production from the offshore fields opposite Poza Rica. The demand for transport services in the Gulf will increase on account of the projected supply of refined products into Tuxpan for Mexico City, but exports to Brownsville and other US points may diminish. In the judgment of the mission, an estimate of 105 million barrels seems more realistic than the Pemex projection of 115 million barrels as the volume of cabotage trade by 1976.

3.10 Railways: The traffic of bulk petroleum products on the railways has not varied significantly with the exception of 1969 as the following table illustrates:

	(millions metric tons)
1969	4.29
1964	4.28
1968	4.59
1969	4.91

3.11 The principal causes of the absence of strong growth in freight traffic were, as has already been mentioned, the slow demand for fuel oil, the competition from the highways for distillate products and the uneven service provided by the railways. Fuel oil traffic, in fact, declined between 1959 and 1965, but expanded slightly after that date, while distillate products have increased slightly. The movement of fuel oil by rail reflects the rate of consumption of the product. Demand for fuel oil decreased following the completion of the Southern National Gas System, but since 1966 it has again shown an upward trend.

3.12 The principal flows of traffic originate at the four major refineries, from the pipeline terminals in the North and from ports on the Gulf Coast. The traffic moving from ports of unloading on the Pacific Coast is mostly by road. Over 20% of all rail traffic originates in Salamanca. Broadly speaking, fuel oil moves north from Tampico, north and west from Salamanca and west to Salina Cruz from Minatitlan. The points of origin of diesel and gasoline freight are far more widespread, generally pipeline terminals.

3.13 The mission believes that total rail traffic of petroleum products, including fuel oil and LPG, will increase but at a slower rate than demand, bearing mind the proposed pipeline program. How much will be transported by the railways will depend in part on the rates and the type of service the railways are prepared to provide. The alternative modes of transport for residual fuel oil are limited but no such problem exists with respect to gasoline, kerosene or diesel. The question that needs answering is what measures can the railways take to offset competition from the highways. The railways and Pemex should explore jointly ways to improve service, utilize black trains wherever possible and encourage the use of 20,000 gallon tank cars. Pemex could indicate its railway transport needs more accurately to the railways.

3.14 Road: The increase in the volume of distillate products moving by road has been remarkable. Traffic was up by 14.6% per year in the period 1966-69 to reach 3.6 million tons. Traffic flows are less identifiable. However, approximately 40% of road traffic originates at refineries and the balance at pipeline terminals and import points on the Pacific coast. The outlook for the future is for continued strong growth with rates of increase below the recent historical trend in the light of the projected pipeline construction program.

C. Intermodal Distribution

3.16 From 1966 to 1969, the distribution of oil products traffic (excluding crude petroleum for all modes except tankers) evolved as follows:

	Tankers	Pipeline	Railways	Roads
		(thousands of tons originating)		
1966	7,813	4,523	4,405	2,409
1969	9,200	6,038	4,911	3,620
		(all modes per cent)		
1966	40.8	23.6	23.0	12.6
1969	38.7	25.4	20.7	15.2
		(inland per cent)		
1966	-	39.9	39.9	21.2
1969	-	41.4	33.7	24.9

3.17 In inland transportation the trend has been away from the railways. Rail rates are approximately 25% below the tariffs Pemex must pay for intercity road haulage. However, due to the generally poor quality of the railway services, the greater efficiency and flexibility of road transport and the lower investment in storage facilities needed to handle road traffic,

tank trucks increased their share of total traffic. In the light of strongly increasing distillate consumption, the performance of the products pipeline sector, which increased its share of traffic has nevertheless been disappointing. Pipeline costs are highly competitive, the average cost figure used by the mission of 0.176 US cents per ton kilometer is about one-fifth of the railway tariff rate. Taking this factor into consideration, it appears reasonable to conclude that the expansion of pipeline traffic was hindered by the existing capacities of the lines themselves and by lags in new investment. Total pipeline capacity increases in discontinuous steps as pumping stations are added or new pipes are laid down.

3.18 The decrease of the share of the railways and marine division in the traffic pattern suggests that Pemex's unit average costs per ton kilometer are increasing. With the rather incomplete statistical information available to the mission only a partial review was possible. It was assumed that ton kilometer costs did not vary from year to year and that the haulage distance remained the same:

	Haulage Distance (km)	Average Cost to Pemex (US¢ per ton-km)
Tankers	800	0.225
Pipelines	500	0.176
Tank Cars	440	1.126
Tank trucks	290	1.487

3.19 On this basis, total ton kilometer costs for moving oil products in Mexico were US cents 0.450 in 1966 and US cents 0.475 in 1969 but if tanker transport is separated out, the inland figures are 0.738 and 0.749. In the light of the above, if Pemex is to hold down its average costs for refined products traffic, the expansion of the pipeline system, volume conditions permitting, appears desirable in order to reverse the trend of the present modal split.

IV. INVESTMENT AND MAJOR PROJECTS

A. Past Investment

4.01 Petroleum transport sector investment in Mexico during the past five years amounted to Pesos 3.1 billion or approximately 15% of total Pemex investments in all activities, including new wells. Transport investments in the 1965-69 period were distributed as follows: pipelines 39.3%, tankers 25.1%, storage and distribution facilities including ports 33.6% and road tank trucks 2.2%.

4.02 During the period three quarters of the tanker fleet was replaced with ensuing benefits to Pemex of lower operating costs and the elimination of inward charters. The heaviest investments in pipelines were directed toward the completion of the southern gasoline system as far as Guadalajara and increases in capacity through the addition of compressor stations and spur lines to the northern system allowing for an annual average increase in pipeline volumes of 9.6%. Investments in crude pipelines reflected the distribution of production and the increased capacity of refineries. In the same period, remarkably few products lines were completed reflecting the spare capacity existing at the beginning of the planning period. The heavy emphasis on storage and distribution plants has also had cost-saving effects. The added storage has enabled Pemex to make better use of its owned transport facilities - pipelines and tankers - improve its distribution system and avoid temporary local shortages. The 1965-69 investments are summarized below (also see Table 14):

Transport Sector Investment, 1965-69
(Pesos million)

	Total	Annual Average
Pipelines		
Crude	254	50.8
Gas	799	159.8
Products	157	31.8
Sub-total	1,211	242.2
Tankers	772	154.4
Storage & Distribution	1,035	207.0
Tank Cars	62	12.4
Total	3,080	616.0

B. Future Investment

4.03 During its next planning period, 1971-75, Pemex proposes to almost double capital investments in pipelines to reach Pesos 2.17 million. It is faced with the growing problem of supplying refined products to the Mexico City area and the Pacific Coast to meet anticipated demand. Pemex now recognizes that some products pipeline projects have been unduly delayed because of the investment priorities assigned to other activities such as petrochemicals. Less attention, however, seems to have been attached, in the allocation of available funds between the several modes of transport, for example, to pipeline projects in the northwest which would help to minimize transportation costs to the region. The following is the proposed investment program for 1971-75 (also see Table 15):

Transport Sector Proposed Investment, 1971-75

	Total	Annual Average
Pipelines	2,169	433.8
Tankers	846	169.2
Storage & Distribution	343	72.6
Ports	125	25.0
Tank Trucks	64	12.8
Total	3,557	711.4

4.04 Part of the pipeline investment, not considered in detail in this report is directed to crude and natural gas pipelines. A crude pipeline system is continuously undergoing change as new producing fields are connected and old fields exhausted. The location of new fields always constitutes an element of uncertainty. Planning can only be as good as the knowledge of new production facilities. Over the 1971-76 planning period, the principal investments in crude pipelines will be concerned with increasing the capacity of supply to La Venta, Minatitlan and Pajeritas in the south, and in the mid-east to the Mexico City refineries and to Madero and Salamanca. Natural gas pipelines are in a somewhat different situation; they connect the producing field to the final consumer. As such they are subject to the uncertainties and risks of future location of production on the one hand and on the other to the growth of the market. The program under consideration will produce significant increases in capacity of both the northern and southern natural gas systems.

4.05 The transport sector investments represent from 20 to 25% on the average of the total investment program of Pemex. Investments in the transport sector, as in other petroleum activities, are financed by the internal generation of funds, and by medium and long-term suppliers and bank credits. As an objective Pemex lays down that a substantial part of its investment program should be financed out of its own resources, approximately 70%. The present financial position of Pemex is reasonably sound although difficulties in the net cash flow may be expected in the next year or two owing to start up problems and lags in industrial installations. This is particularly attributable to the phasing in of some petrochemical plants which have not yet reached full production.

4.06 Variables which affect the net cash flow available for investment are the object of revision and review. Costs for example have increased. In particular one can point to the cost of producing low sulfur products which reflects the capital investment in new processes, but which has not been offset by higher prices. Natural gas prices in some parts of the country are very much lower than production and transport costs.

C. Major Products Pipelines

4.07 Three major products pipelines have been approved for construction or are under active consideration as follows:

Tuxpan - Poza Rica - Mexico City

Salamanca - Guadalajara - Pacific Coast

Minatitlan - Salina Cruz

4.08 Tuxpan-Poza Rica-Mexico City. The proposed products pipeline would relieve the supply problem in Mexico City by permitting the shipment of gasoline, kerosene and diesel from Madero and Minatitlan by sea to Tuxpan and then by pipeline to Mexico City. The measure is admittedly a temporary one, designed to cover increases in local consumption, until the new 150,000 b/d refinery for Mexico City is placed on stream in late 1975 or 1976.

4.09 Total distillate demand within the zone of influence of the Atzcapotzalco refinery has reached 90,000 b/d. The present situation is one whereby the pipeline from Minatitlan and the refinery at Atzcapotzalco are operating at capacity, but cannot meet demand. As a result of the supply-demand position an additional strain has been placed on other modes of transport, particularly the railways and highways. For example, Puebla, which is within the zone of influence of Mexico City, instead of receiving its supplies from the pipeline or Atzcapotzalco, will now depend on Madero.

Distillate Demand in Mexico City and Adjacent Areas

	1965	1969	1976
Mexico City	55,108	71,381	115,745
Others	12,130	16,632	27,570
Total	67,238	88,013	143,315

4.10 The pipeline has a high priority and represents a strategic investment for Pemex. Completion of 12 to 14 inches line with an ultimate capacity of 50,000 b/d is planned for 1971. Once the new refinery goes on stream, the pipeline would be utilized for imported LPG (butane and propane). Under conditions of uncertainty, the solution to the Mexico City supply problem is suitable because of its flexibility. It combines two modes of transport and alternative sources of supply in both the refined products and crude petroleum case.

4.11 Salamanca-Guadalajara-Pacific Coast. Pemex is giving high priority to a pipeline from Salamanca to Guadalajara and then to the Pacific via Tepic to a point probably near Mazatlan. The pipeline can be justified both on economic criteria and because of security reasons. The entire Pacific Coast of Mexico is dependent on the trans-isthmic pipeline and the Minititlan refinery for its supplies of light products. An alternative route is felt to be desirable on security grounds to supplement supplies from Salina Cruz and to reduce tanker delivery costs by eliminating Mazatlan as port of call for light products. Within this context, the decision represents a minimum cost approach for moving additional quantities of products to the Pacific coast.

4.12 Consumption in Guadalajara already exceeds existing pipeline capacity. The following demand figures have been projected for the area, one of the fastest growing in the country:

1969	12,332 barrels daily
1973	17,912 " "
1976	23,566 " "

4.13 Extension of the line to Mazatlan of some other point on the Pacific would provide a port for outward cargoes of refined products for Topolabampo, La Paz and the smaller ports. The 12 inch, approximately 500 kilometer line is dependent on the expansion of the Salamanca refinery,

(110,000 b/d) scheduled for completion in early 1972. During 1973 and beyond it could supply some 25,000 barrels daily to the Pacific Coast. The impact of the new pipeline would be mainly on shipping. Mazatlan requires three to four full tankers per month. Once completed, the pipeline would reduce voyages out of Salina Cruz and permit a more efficient scheduling of tanker operations along the Pacific Coast.

4.14 Minatitlan-Salina Cruz. The Minatitlan-Salina Cruz corridor (250 km) is of particular importance to the movement of light, heavy and specialized products from the refinery center at Minatitlan and petrochemical plants to the Pacific Coast. The corridor is a communications lifeline as far as the oil industry is concerned. By means of different modes of transport across the Isthmus, the Minatitlan refinery on the east coast extends its zone of influence along the entire west coast of Mexico. It is Pemex's largest and most complex refinery. Trans-isthmic transport facilities are varied but inadequate in the light of present and future requirements. The pipeline to Salina Cruz is limited to about 40,000 b/d but demand already exceeds capacity which can be pushed up only under increasing cost conditions. The railway as operated does not appear to be able to handle more than 8,000 b/d (1,080 tons/day). To assure the flow of oil products to the west coast, Pemex employs its tanker fleet. Approximately two tankers per month are being utilized for the 5,660 kilometer voyage from Madero to Guaymas via the Panama Canal. The present deficit moved by sea is on the order of 4,000 barrels daily of fuel oil and 8,000 barrels daily of refined products.

4.15 It may not be disadvantageous for Pemex to move small quantities of products to the west coast by tanker while it has idle capacity in its fleet. Costs, as will be observed below, are not substantially greater than by the railways. However, one of the major justifications for sending tankers via the Panama Canal is related to the dry dock facilities at Salina Cruz. Under present operating procedures tankers must go into dry dock for inspection once a year, but the company has already indicated that it is putting into effect new procedures whereby dry dock inspection will be required every other year.

4.16 Demand projections for the west coast indicate that fuel oil requirements, now at a level of 12,000 b/d will increase to 20,000 b/d by 1974. Distillate demand, which includes gasoline, kerosene and diesel but not jet fuel has been projected to increase at a rate of 7.1%: consumption of these products will reach an estimated 64,000 barrels daily in 1973 and 77,000 barrels daily by 1976. The extent of the supply problem can be appreciated by assuming that pipeline and rail capacity to the west coast remained at the 1970 level. Under these theoretical conditions, a total of some 7,000 tons per day (approximately 52,000 b/d) of fuel oil and distillate products would have to be carried by Pemex tankers in 1976. It would involve the employment of 10 tankers per month from the east to the west coast. Alternative non-pipeline inland modes of transport would signify substantially higher average costs to Pemex.

4.17 It is pertinent to examine briefly the alternatives in terms of costs confronting Pemex when planning its transport investments to the Pacific Coast. The mission has chosen three alternative modes or combination of modes from the point of embarkation, which is taken to be Minatitlan to the port of unloading assumed to be Guaymas. The alternative modes are pipeline and tanker, railway and tanker and tanker via the Panama Canal. The alternative routes and costs calculated, which are meant to be representative of optimum operating conditions, are applicable to distillates only. Fuel oil is a special case and will be reviewed below. Within this frame of reference, the mission has estimated the following approximate unit costs:

Movement of Distillates from Minatitlan to Guaymas: Cost per Ton

Alternative A: Pipeline and Tanker	US$ 1.56/ton
Alternative B: Railway and Tanker	US$ 3.84/ton
Alternative C: Tanker via Panama	US$ 3.98/ton

4.18 The above includes the cost of transshipment and handling under alternatives A and B. Two salient facts stand out: tanker and the combination railway and tanker modes represent costs approximately 2.5 times above the pipeline solution and the Panama Canal route shows only very slightly higher average unit costs, but includes an outflow of foreign exchange to cover Panama Canal dues. The above example also illustrates that the railway combination (Alternative B) is preferable to the longer tanker haul in that it is competitive on a costs basis, shortens the distance of the haul, eliminates the return of empty capacity over long distances and reduces the time factor.

4.19 To solve the trans-isthmus transport situation over the medium term and barring any major discovery of oil on the west coast, Pemex proposes an imaginative alternative. It would switch the actual 10 inch line to fuel oil and construct a new 14 inch pipeline for refined products. Briefly the project comprises the blending of fuel oil with kerosene on a 65 to 35% basis which reduces the viscosity and permits its transmittal by pipeline. Separation would take place at the pipeline terminal by means of simple distillation but a small part of the kerosene fraction would remain to give a more acceptable fuel oil in terms of pour point. The project is in the nature of an innovation, since, to the best of the mission's knowledge, there are no trunk pipelines for fuel oil operating elsewhere.

4.20 The 10 inch pipeline would operate intially at a capacity of 20,000 b/d with a fuel oil yield of 15,000 b/d. The capital cost of the separation or distillation facility, essentially a topping unit, would be approximately Pesos 30 million. The mission did not review the economics of the project with Pemex officials. However, a preliminary

estimate suggests that inland transport costs including the separation of kerosene from the blend at Salina Cruz would be considerably lower than present railway charges to the company; probably on the order of US cents 50 to 80 per ton below current railway rates.

4.21 The above conclusions have been reached on the basis of the financial costs to Pemex of the transport services provided by the railways. These financial costs are not to be confused with the true economic costs of moving additional quantities of fuel oil from Minatitlan to Salina Cruz. Elsewhere, the mission has estimated the long run marginal cost of freight service by specific commodity. For fuel oil, the economic cost to the railways on the Salina Cruz haul amounts to 6.36 centavos per ton kilometer as compared with an average tariff of 10.54 centavos. For the 280 kilometer trip, the difference between the two cost concepts reaches Pesos 15.31 per ton.

4.22 Concurrently with the above plans, a new 14 inch distillates pipeline would be built parallel to the existing right of way with an initial capacity of 60,000 barrels daily. Pemex plans to have these facilities in operation by late 1976. Some comments are in order.

4.23 The Guadalajara-Pacific pipeline will lessen pressure on the Minatitlan-Salina Cruz corridor for some years, but probably by 1975/77 availability of distillate out of the Salamanca refinery would not be sufficient to supplement west coast requirements. Irrespective of plans for a fuel oil line, the 14 inch distillates pipeline across the Isthmus would become necessary at this time. The critical short run problem then becomes that of making sufficient fuel oil available for west coast consumption without expanding the tanker fleet. This solution would involve the allocation of resources for significant investments at an early date.

4.24 The mission believes that the railways and Pemex should make a concerted effort to increase the capacity of railway traffic in the corridor from 8,000 b/d to 12,000 b/d and eventually to 16,000 barrels daily equivalent to 2,160 tons/day. The measures that should be taken involve the leasing of 20,000 gallow tank cars on the part of Pemex and the organization of block trains by the railways. Such an arrangement would not only give higher capacity, but also lower unit transport costs. Concurrently the problem of the rate structure taking into account the long run marginal costs should be studied by both managements. Additional storage and other terminal facilities would be required involving both Pemex and the railways in some new investments. The mission was also informed that some supplementary supplies of fuel oil would also be available at the Salamanca refinery, once the expansion has been completed. These supplies could be moved by railway to Manzanillo where there already exists facilities for handling fuel oil.

4.25 In summary, the trans-isthmic fuel oil pipeline project would be feasible on the basis of present tariffs by 1972 or 1973, but can be postponed at least to 1976 without affecting significantly the transport cost structure of the company provided railway traffic capacity is increased and a solution is worked out on the tariff rate to be applied to the additional tonnage moved. It should be pointed out that once the fuel oil line is in operation there will be a significant dip in railway transport across the Isthmus followed by a gradual rise as pipeline capacity becomes insufficient.

D. Port to Market Pipeline

4.26 In addition to the above, there are a number of smaller pipeline projects, some of which in the judgment of the mission might also be carried out in Pemex's next planning period. The projects refer to pipelines, not tied to refineries but to shipping ports on the west coast, notably Rosarito, Guaymas and Topolobampo. They could represent a significant cost-saving for Pemex in view of the growing requirements for distillates in the area. In terms of costs by alternative modes of transport, they would have a payback period of 18 months to three years. For financial reasons, however, they were not included in Pemex's investment budget for the period 1971-75 made available to mission.

4.27 Among others, the following products pipelines are being considered by Pemex:

Ports to Markets Product Pipeline Projects

Pipeline	Diameter	Length	Capacity (barrels daily)
Rosarito-Tijuana-Mexicali	8"	220	
Guaymas-Hermosillo-Magdalena	10"	300	10,000
Guaymas-Cd Ogregon-Navajoa-	10"	195	10,000
Topolobampo-Los Mochis	10"	24	10,000
Progreso-Merida	8"	34	40,000

Other pipelines of this nature have been considered such as one from Mazatlan to Culiacan and Los Mochis if it is decided to extend the Guadalajara line to Mazatlan instead of a point further south.

4.28 The main point to be made is that distillate traffic through these ports is projected to show a strong upward trend. At present over 13,000 b/d of distillate are moving through the port of Guaymas, excluding jet fuel, and by 1976 this will have increased to over 20,000 b/d. Similarly, the Rosarito-Mexicali area will consume around 20,000 b/d by 1976.

The construction of the above pipelines would extend the zones of influence of the ports, assure regular supplies and reduce transport costs. The mission is not in a position to indicate priorities as to the individual lines, but strongly recommends that the whole concept of port to market products line be reviewed within the company in order to shift forward the bulk of the investments for these projects. Consideration should be given to the integration of some of these projects with port projects, so that investments could go forward in a coordinated fashion.

E. Mexico City - Airport Pipeline

4.29 The efficiency of supply of jet fuel to the Mexico City airport has been called into question. Jet fuel is handled at airports through an intermediary NACOA in which the public sector holds more than 50% of the shares. Pemex delivers more than 900,000 liters per day (5,660 b/d) of jet fuel by tank truck from the Atzcapotzalco refinery into the NACOA tank farm at the airport. The price of jet fuel to the airlines was fixed recently at 47 centavos per liter (US¢14.23 per gallon) which is competitive with prices at the major U.S. airports for international aviation. NACOA pays 40 centavos per liter, the difference being attributed to a commission of 6 centavos and a throughput charge of one centavo per liter.

4.30 Pemex freely acknowledges that a jet fuel pipeline would reduce distribution costs and indeed, has already selected the right of way. Among the factors delaying the pipeline decision is an element of uncertainty with respect to the future role of the airport. It is understood by the mission that a study is being undertaken on the feasibility of relocating the airport to a new site.

4.31 The decision, nevertheless, to undertake the laying down of such a pipeline in the short run, will depend on negotiations between Pemex and NACOA as to the financing of the project. The project would reduce distribution costs and release tank trucks to handle other products: the investment decision merits prompt attention.

F. Tankers

4.32 During the past five years, emphasis has been placed on tankers within the transport sector of Pemex. The company has clearly defined its policy with respect to marine operations; this policy aims at the purchase of new tankers rather than at charters on a long-term basis. The reasoning behind this decision is that time charters tend to fluctuate widely during periods of crisis. For example, during the second Suez war of 1967 spot rates rose by more than 150 points. As a general comment the mission is of the opinion that for future incremental operations, the company should consider chartering a small percentage of the tonnage required on a long-term basis. The practice has been particularly attractive to oil companies when freight rates are low.

4.33 In the case of the tanker program some of the recent investments may have been premature, although in many ways, the lumping of investments in new tankers during 1965-69 was forced upon the management by the high cost

of operating an obsolescent fleet comprising tankers built in the 1930's and earlier. The acquisition of new tankers, on the other hand, has brought the company some very evident benefits in lower operating costs, reduced repair and maintenance expenses and foreign exchange earnings on export shipments.

4.34 The mission estimates that the present fleet could adequately cover needs through to 1975 if the pipeline and port improvement programs go ahead. The latter are not entirely under the control and direction of Pemex. Tentative plans have been put together for the purchase of six new 20,000 ton tankers over the period 1970-75 to replace an equivalent number of older ships. In Mexico, 15 years is considered as the useful life of a tanker in domestic trade. Replacement of the older vessels would add about 5 million tons per year in effective carrying capacity. It is recommended that the replacement of old tankers could be stretched out and not accelerated as proposed in the investment program. The reasons for this is that demand is likely to rise more slowly; the pipelines projects will reduce some of the urgency; improvements in the scheduling and maintenance procedures of the fleet may prove easier than anticipated; and a dredging and port betterment program will take a shorter time to be executed than forecast.

4.35 Port facilities in particular are limiting factors for efficient tanker operations. Insufficient storage capacity is another factor. Pemex uses fixed buoys at Tuxpan and Rosarito and has plans for a revolving buoy at Coatzacoalcos. It also tentatively plans to build permanent facilities to accommodate tankers up to 30,000 tons at Pajaritos. Tankers have commenced loading at Pajaritos using provisional facilities. Once the new works are completed, Nanchital will be eliminated. Present operations at Nanchital are hazardous and inefficient. In addition, the company is interested in developing the port of Topolobampo. Present conditions at this port preclude the entry of large vessels because of draft limitations. With dredging, however, a depth of 31 feet could be reached. In its review of port conditions and traffic, the mission believes that the development of Topolobampo as a deep water port would involve significant new investments and at the same time would have negative effects on Guaymas and Mazatlan, both of which are operating below capacity.

G. Pacific Coast Distribution of Jet Fuel

4.36 A problem that requires urgent solution concerns the supply of jet fuel to Pacific Coast airports. At present jet fuel is moved by road from the Atzcapotzalco and Salamanca refineries to the Pacific. Distances are long and transport costs high, and in the case of La Paz where the jet fuel arrives by ferry in drums, the supply is irregular, costly and limited. One solution under active consideration which appears to the mission to be the most viable would involve the freighting of the product by road or rail, capacity permitting, from Minatitlan to Salina Cruz. Its distribution to West Coast airports would be undertaken through the employment of a small tanker, probably in the 6,000 ton class.

V. TRANSPORT POLICY AND COORDINATION

A. Policy Objectives

5.01 The problem of the transport of oil products inevitably has occupied a great deal of attention within Pemex. It has allocated a significant proportion of its scarce resources -- approximately 15% of the investment budget in the past five years ---towards renewing and expanding its transport facilities. Marked progress has been made in the planning and administration of operations. More importance is being attached to future long-term planning, with a planning period of 10 years being thought more suited for the development of petroleum resources than the six-year Presidential span currently being used.

5.02 Pemex seeks the least cost alternative in transporting oil to the consumer. Its aim is to be able to operate a well-balanced system which will permit oil to move by the most economic mode or combined modes of transport -- according to the product. It is within this context that it has set certain guidelines and priorities. Within Pemex, priority is given in order of importance to pipelines, tankers, roads vehicles and railroad tank cars. Certain volume conditions must be fulfilled before either pipelines or tankers may be used economically. Both these modes require the allocation of investment funds and must, therefore, compete with the alternative needs of the company. The use of road transportation has gained ground. In using the railroads and highways to transport distillates Pemex is now guided by a policy of equal distribution between the two modes of inland transportation. Prior to this policy objective, instituted five years ago, the railways were given first choice and tank trucks were used for those movements where no rail existed or where the length of the haul was such as to make tank car movements impractical. Railroads have been relegated to last place for distillates, although they still carry the bulk of the fuel oil consumed in Mexico.

B. Organization and Administration

5.03 Transport operations and planning in Pemex are widely scattered through different departments. The major group intervening in decisions and operations affecting the transport and distribution of petroleum and natural gas comprise the following:

Crude Pipelines and Natural Gaslines	Primary Production Directorate
Products Pipelines	Industrial Production Directorate
Tankers, Road and Rail	Commercial Directorate

Under this system of responsibility, Primary Production deals with modes of transport connected directly to producing fields and Industrial Production with pipelines connected to the output from refineries. All other modes of transport -- tankers, tank trucks and tank cars, are handled by the Commercial Directorate which is also responsible for the final stages of distribution.

5.04 The Commercial Directorate was recently reorganized. It comprises three departments, namely Domestic Sales, Export Sales and Marine. The senior positions have been filled by staff with a technical background and a high level of experience and competence, drawn primarily from other areas within Pemex. The result has been reflected in more rapid decisions, better coordination and in an improved distribution system of petroleum products. The supporting staff has also been strengthened.

C. Coordination

5.05 Notwithstanding these changes, matters affecting the entire transportation sector continue to be informally discussed by the Production and Sales Committee. Decisions taken by one group are referred to other groups for informal comment. No one group in the institutional sense is charged with the formulation of plans and the coordination of transport decisions. The possibility of transferring the management of products pipelines and natural gaslines to the Commercial Directorate has been discussed within the Company. but in this respect no changes have been decided upon during the present Administration. The mission found during its visit that there was no group at the working level familiar with all aspects of the transport function. Pemex collects a wealth of statistics on transportation, but the information is dispersed throughout the agency and is often not utilized in decision making. For example, the agency receives all the basic ingredients for origin and destination statistics for rail and road shipments, but does not process them. Transport cost accounting systems also need to be improved.

5.06 In the light of the above discussions, the mission recommends that a permanent transport policy planning committee should set up within Pemex with the object of:

a) forecasting medium and long-run energy demand and requirements for transport services, both on a national and regional basis;

b) centralizing and using the statistical information flowing into the company as a result of its transport activities;

c) recommending transport policies for the company; and,

d) coordinating transport decisions, including the planning of long-run investments.

TABLE 1

MEXICO

PEMEX: PETROLEUM TRANSPORT
Volumes Transported by Mode

	Products Pipelines 1/ (barrels)	Tankers 2/ (barrels)	Road 3/ m^3	Railways m^3	Total
		(In Thousands)			
1965	33,449	58,821			
1966	36,467	59,375	3,086	5,183	-
1967	42,882	60,323	3,054	5,173	-
1968	47,569	65,468	4,036	5,398	-
1969	48,687	69,953	4,642	5,777	-
Average Annual Growth Rates 1966-69	10.1%	4.5%	14.6%	3.7%	
		(in thousand tons)			
1965	4,148	7,726		4,400	
1966	4,523	7,813	2,407	4,405	19,148
1967	5,318	7,947	2,382	4,397	20,044
1968	5,899	8,603	3,148	4,588	22,238
1969	6,038	9,200	3,621	4,911	23,770
		(in million ton kilometers)			
1965	2,074	6,180		1,936	
1966	2,262	6,250	698	1,938	11,148
1967	2,658	6,358	691	1,934	11,641
1968	2,949	6,882	913	2,019	12,763
1969	3,019	7,360	1,050	2,160	13,589
Average distance (km)	500	800	290	440	

1/ Excludes crude petroleum and natural gas pipeline movements.
2/ Excludes petrochemicals, but covers crude petroleum, refined products, both distillates and residual fuel oil.
3/ Excludes the movement of petroleum products in drums amounting to over 350,000 tons per year at a cost of approximately Ps 55 millions.

Note: Conversion Factors
.85 Heavy products
.78 Dist. - Pipelines/Road

Source: Pemex

TABLE 2

MEXICO

PEMEX: PETROLEUM TRANSPORT

Theoretical Duration of Liquid Hydrocarbons

and Natural Gas Reserves

	New Reserves 1/ (1)	Production (2)	Reserves at Year-End (3)	Ratio Reserves/Prod. (4)=(3)/(2)
	Liquid Hydrocarbons (million barrels)			
1954	143.4	85.2	1,671.8	19.6
1959	316.5	105.8	2,722.9	25.7
1964	118.9	129.5	2,925.3	22.6
1965	34.6	132.1	2,827.8	21.4
1966	316.6	135.0	3,012.3	22.3
1967	253.3	149.9	3,115.7	20.8
1968	211.5	160.5	3,166.7	19.7
1969	243.8	168.4	3,242.1	19.2
	Natural Gas (million barrels equivalent of gas)			
1954	276.4	18.8	876.9	46.6
1959	132.7	65.8	1,625.0	24.7
1964	185.4	97.0	2,302.0	23.7
1965	46.7	98.6	2,250.1	22.8
1966	200.3	105.8	2,344.6	22.2
1967	140.1	114.6	2,370.1	20.7
1968	109.2	115.6	2,363.7	20.4
1969	86.1	121.8	2,328.0	19.1

1/ Includes discoveries, extensions and revisions.

Source: Pemex

MEXICO

PEMEX PETROLEUM TRANSPORT

Products Pipelines in Mexico

Line	Diameter (Inches)	Length (Kilometers)	Pump Stations Actual	Pump Stations Future	Year Installed	Capacity Actual	Capacity Future
Madero - Monterrey	12	495	2	6	1956	36,000	70/76,000
Monterrey - Gomez Palacio	10	346	3	4	1960	22,000	39,000
Gomez Palacio - Chihuahua	8	435	2	4	1962	14,000	24,000
Salamanca - Guadalajara	6	315	1	2	1952	10,000	17,000
Desperdicios - Aguascalientes	8	71	-	-	1954	10,000	17,000
Salamanca - Morelia	6	109	1	-	1966	6,000	-
Poza Rica - Mexico	4	235	4	5	1956	4,500	5,300
Minatitlan - Mexico	12	578			1962	55,000	-
T. Blanco - Veracruz	8	97			1967	17,000	-
Minatitlan - Nanchital	12	20	1		1964	30,000	-
Minatitlan - Salina Cruz	10	245	4		1952	40,000	-
Minatitlan - Salina Cruz (NH_3 line)	6	245	2		1968	800T	
Principal Projected Pipelines							
Salamanca - Guadalajara	12	238		2	1972	-	48/72,000
Guadalajara - Pacific Coast	12	315		1	1972	-	60,000
Tuxpan - Mexico	14/12	60/30		6-7	1971	-	50,000
Minatitlan - Salina Cruz (Distillates)	14	245		2	1976	-	90,000
Minatitlan - Salina Cruz (F.O.)1/	10	245		4	1976		15,800

1/ Existing distillates line will be converted to residual fuel oil.

Source: Pemex

TABLE 3

MEXICO

PEMEX: PETROLEUM TRANSPORT

Principal Crude Petroleum Pipelines

	Diameter (inches)	Length (kilometers)	Pump Stations	Year Constructed	Investment (Pesos million)	Capacity (b/d)
Comalcalco-La Venta	10/12	116	1	1961	30.2	30,000
La Venta Minatitlan	12/18	61/49	3	1958/67	63.3	150,000
Cd. Pemex-Minatitlan	10	250	2	1953	51.0	10,000
Poza Rica-Atzcapotzalco	18	245	6	1955	140.0	105,000
Poza Rica-Salamanca	12	455	9	1950	150.0	50,000
Poza Rica-Estac. 7	18	118	6	1967	140.0	110,000
Estac. 7-Salamanca	14	335	2	1964	101.0	50,000
Estac. 7-Rio Remedios	10/12	118	-	1925	3.0	20,000
Tuxpan-Poza Rica	16	63	-	1954	20.2	50,000
Poza Rica-Alamo	12	52	1	1941	10.4	25,000
Alamo-Naranjos	10	59	3	1925	2.0	15,000
Potrero-Naranjos	8	33	1	1926	1.4	7,500
Naranjos-Madero	16/20	120	2	1969	96.0	100,000
Naranjos-Madero	8	112	3	1926	8.5	32,000

Source: Based on data from the Primary Production Sub-directorate of Pemex.

TABLE 4

MEXICO

PEMEX: PETROLEUM TRANSPORT
Principal Natural Gas Pipelines in Mexico

	Diameter (inches)	Length (kilometers)	Compressor Stations	Year Installed	Total Investment (Pesos million)	Capacity (million cubic feet per day)
Northern Transmission System						
Reynosa - Monterrey	22/24	250/130	1	1958/69	100,000	380
Monterrey - Chavez	16	309	2	1952/59	105,000	100
Chavez - Chihuahua	12	428	2	1961	128,000	60
Chavez - Torreon	12	33	-	1960	9,000	40
Escalon - Lago del Rey	8	104	-	1968	20,000	-
Esobeda - Monclava	10	173	1	1959/68	109,900	90
Matamoros -Cd. Aleman	12	183	-	1950	31,000	-
Reynosa - Monterrey 1/	14	240	-	1948	n.a.	75
Cd. Aleman - Monterrey 1/	12	154	-	1930	n.a.	30
Southern Transmission System						
Cd. Pemex - Mexico	24	240/280	9	1961/68	200,000	615
Mexico - Salamanca	14	269	1	1961	88,000	100
Salamanca - Guadalajara	14	234	-	1967	97,000	40
Vta. Carpio - Tlalcheuol	6	180	-	1968	36,000	n.a.
Angosteira - Vera Cruz	20	75	-	1952	25,000	n.a.
La Venta - Pajaritos (Ethane)	8	43	-	1968	8,000	17

1/ Private

Source: Pemex

TABLE 5

TABLE 6

MEXICO

PEMEX: PETROLEUM TRANSPORT

Pipeline Operating Costs 1/

500 kilometer pipeline	Centavos bl-km	Centavos Ton-km	US Cents Ton-km
10 Inch Pipeline - Flat Terrain			
20,000 b/d	0.4697	3.7871	0.3030
42,000 b/d	0.3252	2.6220	0.2098
- 2,240 Meter gradient			
20,000 b/d	0.5596	4.5119	0.3610
42,000 b/d	0.3951	3.1856	0.2548
12 Inch Pipeline - Flat Terrain			
31,500 b/d	0.3685	2.9711	0.2377
60,000 b/d	0.2827	2.2794	0.1824
- 2,240 Meter gradient			
31,500 b/d	0.4451	3.5888	0.2871
60,000 b/d	0.3433	2.7680	0.2214
14 Inch Pipeline - Flat Terrain			
48,000 b/d	0.2689	2.1681	0.1734
75,000 b/d	0.2457	1.9810	0.1584
- 2,240 Meter gradient			
48,000 b/d	0.3376	2.7220	0.2178
75,000 b/d	0.3077	2.4809	0.1985

1/ Based on 350 day operating year.

Source: Based on data from Pemex (Industrial Production Sub-directorate).

TABLE 7

MEXICO

PEMEX: PETROLEUM TRANSPORT

Pemex Tanker Fleet
as of April 30, 1970

Name	Year Constructed	Years in Operation	DWT	Capacity (Barrels)
1. Salamanca	1948	22	4,180	31,188
2. Ignacio Allende	1954	16	17,752	143,920
3. Lazaro Cardenas.	1955	15	16,306	136,540
4. Guadalupe Victoria	1958	12	19,934	161,852
5. Abelardo L. Rodriguez	1956	14	17,450	145,827
6. Juan Alvarez	1955	15	19,100	154,192
7. Cuauhtemoc	1967	3	15,605	121,277
8. Jose Maria Morelos	1967	3	20,495	157,012
9. Miguel Hidalgo	1967	3	11,085	78,513
10. Plan de San Luis	1967	33	15,590	121,277
11. Plan de Ayutla	1967	33	20,488	157,012
12. Plan de Guadalupe	1967	3	20,460	157,012
13. Vicente Guerrero	1967	3	8,753	54,536
14. Mariano Escobedo	1967	3	9,400	72,473
15. Francisco I. Madero	1968	2	20,500	157,012
16. Venustiano Carranza	1968	2	15,577	121,277
17. Alvaro Obregon	1968	2	20,463	157,012
18. Plutarco E. Calles	1968	2	15,558	121,277
19. Benito Juarez	1968	2	20,484	157,012
20. Plan de Ayala	1968	2	20,397	157,012
21. Melchor Ocampo	1968	2	20,402	157,012
22. Emiliano Zapata	1970	1/12	2,910	20,834
			352,889	2,741,079

Source: Pemex

MEXICO

PEMEX: PETROLEUM TRANSPORT

Supply and Demand of Crude Petroleum and Refined Products

(thousand barrels daily)

	1959	1964	1965	1966	1967	1968	1969	Annual Average Percent Change 1959-64	1964-69	1959-69
Production										
Crude and Condensates	264.1	315.8	323.2	331.9	364.5	389.0	410.6	3.6	5.4	4.5
Natural Gas Liquids	25.6	38.0	38.8	38.0	46.2	49.5	50.7	8.2	5.9	7.1
Total	289.7	353.8	362.0	369.9	410.7	438.5	461.3	4.1	5.5	4.8
Refined Products Imports	22.9	25.3	24.8	34.3	31.9	32.0	n.a.	2.1	6.0 1/	4.1 1/
Domestic Demand										
LPG	19.1	35.7	41.9	46.3	49.7	51.7	--	13.3	9.7 1/	11.7 1/
Distillates 2/	139.8	183.3	191.4	205.9	263.9	240.4	--	5.6	7.0 1/	6.2 1/
Others	113.4	98.5	95.5	107.2	79.3	123.3	--	-2.9	5.8 1/	1.0 1/
Total	272.3	317.5	328.8	359.4	392.9	415.4	n.a.	3.1	6.9 1/	4.8 1/
Crude and Products Exports	36.4	46.9	47.9	46.7	49.4	44.0	44.6	5.2	-1.3	2.1

1/ To 1968 only
2/ Gasoline, jet fuel, kerosene, diesel

n.a. = not available

Source: Pemex

TABLE 8

TABLE 9

MEXICO

PEMEX: PETROLEUM TRANSPORT

Domestic Consumption of Refined Products 1959, 1964, 1968
(barrels daily)

	1959	1964	1968	Annual Average Changes 1964-68	1959-68
LPG	19,064	35,815	51,749	9.7	11.7
Casoline	79,093	95,985	126,450	7.1	5.3
Kerosene	31,087	31,557	33,527	1.5	0.8
Jet Fuel	-	3,012	6,463	21.0	-
Diesel	29,597	53,267	73,889	8.5	10.7
F.O.	93,078	73,076	87,504	4.6	-0.7
All Others	20,399	25,643	33,715	6.3	5.4
Subtotal	272,318	318,355	413,297	6.7	4.7
Natural Gas	54,605	147,460	217,176	10.2	16.6
Total	326,923	464,542	630,473	7.9	7.6

Note: Natural gas converted to barrels of oil equivalent on the basis of 5,000 cubic feet of gas for each barrel of crude petroleum.

Source: Compiled from Pemex figures.

TABLE 10

MEXICO

PEMEX: PETROLEUM TRANSPORT

Movement of Refined Products by Pipeline
(barrels daily)

	1965	1966	1967	1968	1969
Madero-Cd. Victoria-Monterrey-Gomez Palacio-Chihuahua	23,615	23,923	27,874	30,602	32,432
Salamanca-Guadalajara-Aguascalientes	8,155	8,623	9,428	9,319	10,058
Salamanca-Morelia	2,207	2,135	3,825	4,150	4,437
Minatitlán-Salina Cruz	35,492	34,214	37,116	38,571	33,379
Minatitlan-Mexico	19,213	29,411	36,231	44,162	49,148
Poza Rica-Atzcapotzalco (propane)	2,957	2,427	3,009	3,522	3,933
Total	91,641	99,911	117,484	130,326	133,388

Source: Pemex

TABLE 11

MEXICO

PEMEX: PETROLEUM TRANSPORT

Transmission of Natural Gas by Pipeline

(Million cubic feet/day)

	Northern System	Southern System	Total
1965	203.15	371.26	574.41
1966	225.82	419.77	645.59
1967	231.27	461.98	693.25
1968	269.75	468.96	738.71
1969	304.14	524.73	828.87
Average Annual Rate of Increase 1965-69	10.7%	9.0%	9.6%

Source: Pemex

TABLE 12

MEXICO

PEMEX: PETROLEUM TRANSPORT

Tanker Transportation in Tons and Ton/km

	Distillates	Heavy Products ('000 metric tons)	Total	Distance (miles)	Average Distance (km)	Ton Mile (million)	Ton km (million)
1965	2,510	5,215	7,725	391,428	800	3,838	6,180
1966	2,359	5,454	7,813	356,773	800	3,881	6,250
1967	2,295	5,652	7,947	400,033	800	3,948	6,358
1968	2,714	5,889	8,603	500,543	800	4,274	6,882
1969	2,829	6,371	9,200	587,446	800	4,571	7,360

Source: Pemex

TABLE 13

MEXICO

PEMEX: PETROLEUM TRANSPORT

Volumes Transported by Tanker[1]
(Thousands barrels)

	1965	1966	1967	1968	1969	1970[4]
Distillates[2]						
Total	20,238	19,016	18,506	21,892	22,810	27,729
Gulf Coast	8,494	6,958	5,605	7,732	7,722	8,705
Pacific Coast	11,744	12,058	12,901	14,160	15,088	19,024
Heavy Products[3]						
Total	38,582	40,359	41,817	43,576	47,143	52,271
Gulf Coast	34,319	36,940	37,540	40,593	43,150	47,771
Pacific Coast	4,273	12,419	4,277	2,983	3,993	4,500
All Petroleum Products						
Total	58,821	59,375	60,323	65,468	69,953	80,000
Gulf Coast	42,813	43,898	43,145	48,325	50,872	56,476
Pacific Coast	16,008	15,477	17,178	17,143	19,081	23,524

1/ Excludes movement of ammonia and other products which in 1969 amounted to approximately 2,000,000 barrels
2/ Includes gasoline, diesel, etc.
3/ Includes crude petroleum, residual fuel oil, etc.
4/ Programmed

Source: Pemex

TABLE 14

MEXICO

PEMEX: PETROLEUM TRANSPORT

Transport Sector Investments, 1965-69
(Pesos Millions)

	Pipelines	Tankers	Tank trucks	Storage & Distribution	Total
1965	177	134	11	215	537
1966	353	39	28	270	690
1967	389	280	5	322	996
1968	151	295	4	165	615
1969	141	24	14	63	242
Total	1,211	772	62	1,035	3,080
Annual Average	242.2	154.4	12.4	207.0	616.0

Source: Pemex

TABLE 15

MEXICO

PEMEX: PETROLEUM TRANSPORT

Transport Sector Investment Program
(Pesos Millions)

	Pipelines	Tankers	Tank Trucks	Storage & Distribution	Port Facilities	Total
1971	1,003.0	179.4	-	71.0	25.0	1,278.4
1972	428.0	237.5	-	70.0	25.0	760.0
1973	210.0	179.4	25.5	72.0	25.0	511.9
1974	297.0	-	13.5	70.0	25.0	405.5
1975	231.0	250.0	25.0	70.0	25.0	601.0
Total	2,169.0	846.3	64.0	353.0	125.0	3,557.3
Annual Average	433.8	169.2	12.8	70.6	25.0	711.4

Source: Pemex