Joint UNDP/World Bank
Energy Sector Management Assistance Programme

Instituto Nacional de Energía—ECUADOR

Ecuador's Energy Situation: Analysis of Current Problems, Short-term and Medium-term Policy Guidelines and Repercussions on the Economy

Washington, April 1991

ECUADOR'S ENERGY SITUATION: ANALYSIS OF CURRENT PROBLEMS, SHORT-TERM AND MEDIUM-TERM POLICY GUIDELINES AND REPERCUSSIONS ON THE ECONOMY

This is the English version of the report issued in Spanish in Quito in July 1988.

This study was financed by the World Bank, the United Nations Development Program and the Government of Italy.

FOREWORD

This study, requested by the Ministry of Energy and Mines and coordinated by the National Energy Institute, was prepared by a group of Ecuadorian and international consultants who were advised by several World Bank missions. During the time this document was prepared, Mr. Jaime Yumiseva was Executive Director of the National Energy Institute. Appreciation is extended to him, for the assistance provided by the Institute, and to Mr. Patricio Romero J., Director of Energy Planning of the Institute, who coordinated the study.

The members of the Ecuadorian consulting team were Messrs. Luis Bacigalupo, Mauro Davalos, Wilson Pastor (petroleum subsector), Marcelo Jaramillo (electricity subsector), Carlos Quevedo (alternate sources and energy conservation subsector) and Carlos Izurieta (macroeconomics). The Ecuadorian consultants were assisted by: Messrs. Luis Andrada (energy economist), Joao N. Baptista (electricity specialist), Franco Brunelli, Mario Rastelli (electricity tariffs), Hernan Campero (macroeconomics), Kenneth Hornby (petroleum specialist), Claus Rose (gas specialist), David Schodt (specialist in energy economics), and William Simmons (petroleum specialist).

Additional assistance was provided by officials of Ecadorian energy institutions, including: INE: Messrs. Byron Granda, Francisco Lopez, Julio Teran and Juan Zak; CEPE: Messrs. Julio Cardenas and Benigno Trujillo; National Hydrocarbons Directorate: Mr. Julio Aldaz; INECEL: Messrs. Edgar Almeida, Bolivar Lucio and Ruben Suarez. Mr. Michel Del Buono, Senior Economist, World Bank Industry and Energy Department, led the World Bank advisory missions that included staff members Messrs. Jaime Porto Carreiro and Jeffrey Mullaney.

Special thanks are given to the secretarial pool: Mmes. Maria Susana Aguirre, Maria Antonieta Flores and Irene Ricci. The English version of the study was typed by Ms. Olga Camacho and edited by Ms. Maria Cerritelli.

ABSTRACT

Despite the drastic decline in world oil prices, Ecuador's economy continues to be strongly dependent on oil production and exports. It is estimated that a 10% increase in oil exports--brought on either by increased production or reduction in domestic consumption--would result in an increase of approximately 1% in Gross Domestic Product in the short-term.

A number of problems face Ecuador's energy sector: limited reserve potential of hydrocarbons; heavy subsidy of energy prices; and financial and legal constraints within which CEPE and INECEL are forced to operate.

With a reserves-to-production ratio of less than ten years, Ecuador must intensify its own exploration efforts and maintain foreign investments in order that its hydrocarbons subsector might contribute to the national economy into the 21st century.

The domestic price of crude oil continues to lag behind replacement costs (-30%), and represents only 50% of economic costs. Translated into retail prices of refined products, this causes huge government subsidies and losses to the public sector, and to CEPE in particular.

CEPE's investment program, currently emphasizing transportation and refining activities which present no critical problems, should give priority to exploration and production. This step is necessary not only because of the general state of Ecuador's reserves, but also because of the high economic returns attainable through these upstream activities.

CEPE's present finances, which show a budget deficit estimated at 40% for the five-year period 1988-1992, are in difficulty as they neither permit recovery of operating costs nor provide incentives for expansion of activities. CEPE's financial deadlock can only be solved by a structural reform of current oil revenues distribution. CEPE, like any other company, should be able to cover its costs and obtain a reasonable profit to self-finance some share of its investments.

The legal status of both CEPE and INECEL, as entities dependent on the central organs of government, should be modified to allow for the financial and operational autonomy of private companies.

A critical problem affecting the electricity subsector is the financial difficulty currently experienced by INECEL and by electricity distribution companies. This difficulty is a consequence of low revenues caused by tariffs which are 40% below production costs, and of reductions in government capital contributions to the subsector. This situation has caused yearly losses since 1982 with accumulation of arrears and inability to meet debt service.

The following measures are recommended to solve these problems: rationalization of electricity tariffs, recapitalization of the subsector and drastic reduction in investments based on a rethinking of coverage expansion and reliability of service. In addition, solutions are needed for technical problems (energy losses in the distribution systems, sedimentation in the Amaluza reservoir); legal problems (structure of subsector agencies, lack of definition of EMELEC's situation, etc.); and administrative problems.

By way of illustration, the study provides an analysis of the impact which several of the recommended measures would have on the subsector. In particular, the study examines the economic repercussions of measures such as new tariffs--which would permit cost recovery in the short run and partially contribute to investment (20%-30%) in the medium term--and reduction of energy losses and of government capital contributions to subsector enterprises.

ACRONYMS

IDB	Interamerican Development Bank
IBRD	International Bank for Reconstruction and Development
CEPE	Ecuadorian State Petroleum Corporation
CONADE	National Council for Development
CSE	Superior Council of Energy
DNH	National Hydrocarbons Directorate
E. E.	Electricity Distribution Company
EMELEC	Electricity Company of Ecuador (a private firm)
INE	National Energy Institute
INECEL	Ecuadorian Electrification Institute
MEM	Ministry of Energy and Mines
OLADE	Latin American Energy Organization
GBG	General Budget of the Government
OPEC	Organization of Petroleum Exporting Countries
GDP	Gross Domestic Product
SNI	National Interconnected System

ABBREVIATIONS

API	American Petroleum Institute
b	Barrel
BPD	Barrels Per Day
LPG	Liquid Petroleum Gas
GW	Gigawatt
GWh	Gigawatt-hour
Kgoe	Kilogram of Oil Equivalent
Km	Kilometer
kV	Kilovolt
kWh	Kilowatt-hour
kW	Kilowatt (1000 watts)
MBCD	Thousand Barrels Per Calendar Day
MBPD	Thousand Barrels Per Day
MMB	Million Barrels
MMCF	Million Cubic Feet
MMCFD	Million Cubic Feet Day
MW	megawatt
S	sucres
toe	tons of oil equivalent
AGR	Annual Growth Rate
GAV	Gross Aggregate Value
W	Watt

CURRENCY EQUIVALENT

(1988)

Exchange rate used in this study:

US$1 = 300 Sucres

ENERGY CONVERSION FACTORS

Petroleum

Crude Oil	139 toe = 1,000 b
LPG	114 toe = 1,000 b
Gasoline	122 toe = 1,000 b
Kerosene and Jet Fuel	133 toe = 1,000 b
Diesel Fuel	139 toe = 1,000 b
Fuel Oil	153 toe = 1,000 b

Biomass

Firewood	300 toe = 1,000 b
Charcoal	650 toe = 1,000 b
Bagasse	209 toe = 1,000 b

Electricity 86 toe/GWh

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Economic Development and the Energy Sector

1. Since August 1972, when Ecuador first exported oil, revenue from oil marketing has emerged as the main source of financing of the economy. This resource has made possible countless investments which have radically changed Ecuador into a country quite different from what it was 16 years ago, particularly with regards to energy infrastructure, communications, transport, housing, health and education.

2. Over the past 25 years Ecuador's GDP has grown at the rate of approximately 6.7%. This growth, however, has been almost exclusively associated with oil sector productivity sector due to the stagnation of other economic activities resulting from exchange and monetary policies which have kept the sucre overvalued and the real interest rate negative for almost ten years. Since the drop in oil prices in 1985, Ecuador has ceased to grow. As a result, and due also to a change in foreign exchange policy, the agricultural, forestry and fishing sectors have increased their combined participation in GDP from 14.97% in 1982 to 17.7% in 1987.

3. Average annual growth rates of the petroleum (9.22%) and electricity (7.13%) subsectors over the period 1977-1986, which are higher than the growth rate of the entire GDP (3.37%), show the importance of the energy sector in the economy. The substantial growth of the petroleum and electricity subsectors is due to considerable increases in CEPE and INECEL investments, resulting in a significant expansion of oil and hydroelectric infrastructures in recent years. Thus, for example, in 1983 the Gross Value Added of oil increased by 27.2% and that of electricity by 14.9%. This coincided with the beginning of oil production in the Libertador field and of the Paute project, while global GDP fell by 2.8%. In 1984, growth rates were 9.2% and 28.8% for oil and electricity, as against 4.2% for GDP.

4. In examining Ecuador's domestic demand for energy, two factors should be noted: the global and the sectoral energy content per GDP. Records show higher consumption levels than elsewhere in Latin America, a logical result of price policies since 1972. Based on 1986 data, the energy content of GDP is calculated at approximately 400 Kgoe per thousand US dollars of GDP, while the average in Latin America for the same year was 290 Kgoe per thousand US dollars of GDP.

5. The influence of the energy sector on the economy, based on the current economic structure (1986 intersectoral relations), shows that an increase of 10% in oil exports would result in an increase of 1.1% in GDP, while a decrease of 10% in the domestic demand for refined products, due to domestic price hikes or other energy conservation measures, would cause a decrease of only 0.1% in GDP. For each 10% decrease in domestic fuel consumption, therefore, there is a net increase of 0.5% in GDP. According to the same analysis, a 10% decrease in electricity consumption would effect a decrease in GDP of only 0.01% and would result in savings of little over 0.02% in foreign exchange; however, it would channel significant additional resources to the electricity subsector.

Petroleum and Public Finances

6. Ecuador's public finances have, since the 1970s, depended heavily upon petroleum revenue and external financing. Efforts to diversify taxation outside the energy sector have proved ineffective. Public consumption and low-return investments have increased while private consumption has been encouraged by an irrational, widespread subsidy policy financed by a growing external debt. Public expenditure grew at a real annual rate of 10% between 1973 and 1982, because of foreign loans which multiplied the external debt 13 times.

7. If we consider that a reduction of US$1 per barrel in the price of crude means a decrease of approximately 1% in GDP--and that during the current year oil prices have fallen to US$13/barrel from the budgeted price of US$17--then we can expect that growth of GDP will be reduced by approximately 4% during the current year. Furthermore, as reduction in oil prices causes an almost equal decline in public revenue, we can assume that the government deficit will increase to almost 9% of GDP as against the 5% budgeted at the beginning of the year.

8. Oil exports accounted for 74% of total exports in 1983 and fell to 40% in 1987, as a result of the decline in world oil prices and the interruption of production caused by the earthquake of March 1987. On the other hand, non-petroleum exports, especially shrimp and seafood (which have expanded mostly as a result of changes in foreign exchange policies since 1981) have increased participation in total exports from 14% in 1981 to 27% in 1987.

Energy Resources

9. Ecuador abounds in energy resources. Hydroelectric resources represent a gross potential of about 93 GW, of which approximately 900 MW are utilized. Ecuador has proven oil reserves of approximately 1100 million barrels (151 million TOE), which at current rate of production would be sufficient for approximately 9.6 years of production. The approaching maturity of main fields and the growth of domestic consumption due to excessively subsidized prices have contributed to a declining trend in Ecuador's annual production. Ecuador looks set, therefore, to become a net importer by the year 2002--based on the moderately optimistic scenario of new reserve discoveries--or by the year 2007 using the optimistic scenario. Proven reserves of dry natural gas are estimated at 160,000 MMCF in the Gulf of Guayaquil and at 270,000 MMCF in associated form in the Oriente oil fields. Mineral coal reserves, which have not yet been developed, are estimated at 15 million TOE. Furthermore, there are substantial non-conventional resources such as biomass, geothermal and solar energy.

Evolution of the Structure of Energy Consumption

10. Final energy consumption in 1986 was 5.1 million TOE, with an average annual growth rate of 4% (1980-1986). This figure, which may be considered high, is due in part to the low domestic prices of refined products and electricity.

11. Energy demand in the period 1974-1986 has been met mainly by hydrocarbons (an average of 93% of final consumption). The most striking change in the structure of consumption of hydrocarbons is the increase in participation of LPG: this rose from 1% of total demand in 1984, to almost 6% in 1986. Ecuador's annual per capita consumption of 230 barrels ranks substantially higher than the average of Latin American countries at a similar level of development (150 barrels per inhabitant per annum). Electric energy production per inhabitant in 1987 was 540 kWh/year, lower than the mean of Latin America (700-800 kWh per inhabitant per year). However, electricity consumption per household user in 1987 was 1600 kWh per year, reaching levels comparable only to those of European countries such as Spain and Austria, despite a price disadvantage in relation to hydrocarbons. The cost of LPG and domestic kerosene expressed in terms of useful energy in the household sector for cooking is four times lower than that of electricity and six times lower than that of firewood. In the industrial sector, and as motive power, electricity expressed in useful terms costs twice as much as diesel used as fuel.

12. Transport leads all sectors in energy consumption, with growth at 19% per year, accounting for 41% of total consumption in 1986 as compared to 16% in 1974. Average consumption by the transport sector in Latin America was 25% of total energy consumption, with a declining tendency over the medium-term. This means that in Ecuador there is high, indiscriminate, and low-priority energy consumption. The commercial and public sectors absorbed 31% of the 1986 demand, followed by industry (18%). Agriculture, fishing and others accounted for the remaining 10%.

Institutional Aspects of Energy Policy Management

13. The Higher Council of Energy (CSE) coordinates energy policies with the development of the country's other sectors. Its main functions are: to establish national energy policies and submit them for approval to the President of the Republic; to approve and control development of the Master Energy Plan prepared by the National Energy Institute; and to regulate energy sector activities. The Executive Director of the National Energy Institute acts as advisor without vote. To this date the Council has not been operative.

14. The Ministry of Energy and Mines (MEM) is responsible for establishing and supervising energy policies. The National Energy Institute (INE) advises the MEM on energy policies and coordinates sector planning. Planning, implementation and control of operations in the main subsectors have been entrusted to the two main sector enterprises, namely CEPE for hydrocarbons and INECEL for electric power.

I.N.E.

15. The National Energy Institute (INE) was created in September 1978 as an agency under the MEM. It comprises a Technical Council, which resembles a Board of Directors, an Executive Directorate and a Technical-Administrative Office. INE is responsible for preparing the Master Energy

Plan as well as short-, medium- and long-term programs, and for considering energy efficiency and any environmental impacts that might arise in their execution. INE promotes, moreover, research on development, demonstration and transfer of technology of new, renewable and non-conventional sources of energy. As advisor in the management of the energy sector, INE coordinated the preparation of this study.

CEPE

16. The State Petroleum Corporation (CEPE) was created in June 1972 as an agency under the MEM. In addition to producing, refining, transporting and marketing oil, CEPE is a member of the CEPE-TEXACO Consortium, with 62.5% of shares, of the CEPE-CITY Association, and of the ANGLO and REPETROL Refineries. It is also a minority shareholder of Austrogas, an LPG distribution company, and of the steel firm ECUASIDER. CEPE is Ecuador's most important company, with estimated sales of $1,400 million in 1988 and a workforce numbering 4,200 employees, of which 12% are management and professional personnel.

INECEL

17. The Ecuadorian Electrification Institute (INECEL) was created in 1961 as the official organization in charge of the country's electrification. INECEL, responsible for the generation, transmission and distribution of electric energy, has established 17 electricity distribution companies, and is the major stockholder in each. The Empresa Electrica del Ecuador (EMELEC) does not belong to this group: it is a private company, owned by foreign capital and serving the city of Guayaquil. In 1986, INECEL employees numbered 2,500, of which 37.5% were executive and technical personnel. The electricity distribution companies, excluding EMELEC, numbered 6,700 employees.

Technical Aspects of the Hydrocarbons Subsector

Reserves

18. Petroleum reserves are estimated quantities of oil expected to be commercially recoverable under existing technical and economic conditions. These estimates should be revised as production proceeds and as more geological and/or engineering information becomes available, or as changes occur in the economic conditions of evaluation. The relative degree of uncertainty may be expressed by classifying reserves as proven or unproven. Certainty of recovering unproven reserves is lower, so they may be further classified as probable or possible, to denote the progressive degree of uncertainty.

19. Proven reserves remaining in the fields currently under production are estimated at 1083 million barrels, to which 71.4 million must be added, from fields as yet undeveloped. Probable reserves

(with a lesser degree of certainty than proven ones) are 647 MMB. With these resources, Ecuador could continue exporting oil until the end of the century. By then, it will have consumed approximately 1150 million additional barrels of its reserves.

20. The substantial increase in world oil prices and a temporary abundance of foreign currency in Ecuador in the 1970s led to diminished exploratory activity and a subsequent decrease in reserves.

21. Official reserve figures began to be increased noticeably in 1984. Two main factors affected this increase: changes in the recovery factor of deposits and, to a lesser degree, discovery or incorporation of new fields. Thus, from 882 MMB in 1983, reserves figures were shown as 1126 MMB in 1985, 1219 MMB in 1986 and 1557 MMB in 1987.

22. Accuracy of the reserves figure 1557 MMB is questionable: there is insufficient technical evidence to infer that the water injection process near the aquifer -- which maintains pressure in the Sacha and Shushufindi-Aguarico fields -- is generating additional secondary reserves. Discoveries over the past 15 years, with the exception of the Libertador field, have been rather small, (fields with reserves of approximately 10-50 MMB), and in recent years, discoveries have been mainly of medium density crudes (15-25 API).

23. Proven natural gas reserves are located in the Gulf of Guayaquil and in the Oriente region. In the former, proven reserves of dry natural gas in the Amistad field are estimated at 160,000 MMCF, a volume which at present does not guarantee the field's commercial value. The associated gas produced in the Oriente, with reserves estimated at 270,000 MMCF, will run out at the same time as petroleum. Geographic dispersion of the fields, together with the high cost of extraction, accounts for the failure to utilize all of the associated gas.

Production

24. Ecuador's petroleum activities date to 1911 with discovery of the Ancon No.1 well in the Santa Elena Peninsula on the Pacific Coast. A new oil era began with petroleum exports from Balao, Esmeraldas in 1972. In the following decade, production was maintained, with minor fluctuations, at approximately 175-210 MBPD. In the wake of the drop in international oil prices, an expansionist production policy was implemented as compensation for the decrease in export revenue. Thus, production reached 278 MBPD in 1985 and 291 MBPD in 1986.

25. Of Ecuador's total production, 99.68% comes from the Amazon region. In this region, the CEPE-TEXACO Consortium produces 78.31% of total production, CEPE produces 19.73% and CEPE-CITY 1.96%.

26. Of the 439 wells drilled to date in the Amazon region, 295 are under production. Of these wells, 67% use artificial lift: pneumatic, hydraulic and electric; the others use natural water pressure. The other 144 wells have been abandoned, closed down due to lack of pressure or mechanical problems, or transformed into water injector wells. In the Santa Elena Peninsula, only 560 of the more than 1800 wells drilled are operative, producing 1000 barrels of petroleum a day. Given the 1083 million barrels of remaining proven reserves still in the fields under production, and the average production for 1988 of 310 MBPD, the country's present reserves-to-production ratio is 9.6 years.

Refining

27. Ecuador has five refineries with a total operating capacity of 137 MBCD. The new Amazonas refinery and the one already in existence in Lago Agrio are "topping" units which operate at full capacity (joint production of 10 MBCD to supply their areas of influence). Recent modernization of the Esmeraldas refinery, which has conversion units, has increased its processing level to 85 MBCD. In the Santa Elena Peninsula there are two refineries with "topping" units (ANGLO and REPETROL) with capacities of 34 MBCD and 8 MBCD, respectively.

Distribution System

28. The Transecuadorian Pipeline transports the crude produced in the Oriente to the Pacific Coast Terminal in Balao, near the Esmeraldas refinery. The pipeline is 500 km long, with a nominal transport capacity of 320 MBPD. There is also a connection with the Colombian pipeline, Puerto Asis-Tumaco, which makes the transport of an additional 50 MBPD possible. This capacity could be expanded to 70 MBPD at little additional cost, if this should prove necessary. If the optimistic exploration/production scenario is considered, however, maximum expected level of production could reach 347 MBPD, which is lower than the pipelines' current transportation capacity.

29. LPG from the Shushufindi extraction plant and surplus gasoline from the Amazonas refinery are sent to Quito through a pipeline of 6.7 MBPD capacity. Refined products from the Esmeraldas refinery are transported to Quito through a clean product pipeline with a capacity of 56 MBPD, to Ambato through another pipeline of 14.4 MBPD capacity, to the Guayaquil area by sea, and to the northern part of the country by tank trucks. Refined products from the Anglo and Repetrol refineries are transported to the south of the country and to Guayaquil by tankers and tank trucks. A portion of the products for Guayaquil is unloaded in Tres Bocas and pumped to Pascuales through a 108 MBPD pipeline.

30. There are 16 tanker ships, with a total capacity of 300,000 tons, which are chartered for the export of crude and fuel oil and for coastwise shipping of oil and refined products.

31. Present storage capacity is 1.6 MMB, distributed among nine main terminals, plus an additional 2.8 MMB in the refineries. However, there is insufficient LPG storage, barely 8 days' supply at the El Salitral terminal and at the bottling plants (14 days' when the storage of the refineries is included).

Technical Aspects of the Electricity Sector

Generation

32. Nominal installed power at the beginning of 1988 was 1764 MW, of which 1100 correspond to the National Interconnected System (SNI) and the remainder to regional companies. Of the firm power of 1444 MW, 52% comes from hydroelectric power plants. Transmission losses reduce that power to 1320 MW, which was the amount available in 1987 in the main SNI substations to cover maximum peak demand of 1020 MW. It is feasible to rehabilitate a good part of the existing thermal capacity in the regional electric companies.

Transmission and Distribution

33. At the end of 1988, the transmission system in service will still have a radial configuration. The system has a total 1734 km of high tension transmission lines (615 km of 230 kV and 1119 km of 138 kV). The sub-transmission and distribution network has a total of 3300 km, the greater part at 69 kV. The 17 distribution companies and a cooperative operate the sub-transmission and distribution systems servicing a total of 1,181,000 users (as of December 1987). These companies, together with INECEL, are implementing a Rural Electrification Program to serve 38,000 new users. Because of current very low tariffs, the program, in the short/medium term, will result in an increase in financial losses, for both INECEL and the companies.

Losses and Consumption

34. Energy losses in the distribution systems are rather high, with an average of 18% in Quito and Guayaquil. Some companies have registered losses of up to 32%. This is evidence of technical problems in installations, illegal consumption, and inefficient mechanisms for metering and billing. Electricity consumption is mostly for household use (40%), followed by industrial use (33%). Distribution by company is asymmetric, with industrial consumption being greater in the Guayaquil area (EMELEC). EMELEC accounts for almost 40% of total sales and, in conjunction with the Quito Electric Company, for 65%. The remaining 35% is shared by the other 16 companies. Of total users, on December 1987, 85% were households and 1.4% were industries. EMELEC and the Quito Electric Company, together, have 42% of total customers. The volume of sales and the number of customers of

the remaining 16 companies are limited and do not justify the existence of so many different companies. Reduction in their number could improve efficiency, service quality, and, in addition, perhaps reduce costs.

Financial Aspects of the Hydrocarbons and Electricity Subsectors

35. CEPE and INECEL are totally financially dependent on the government. Oil revenue is administered by the government through an allocation system that leaves the Corporation with fewer funds than proper management requires. This situation leads to excessive dependence on government transfers, which are essentially unpredictable stopgaps. Pressure has reached such levels that it hinders development of CEPE and subsequently of the oil industry as a whole, since CEPE cannot honor its financial obligations to third parties, and in particular to operating companies (such as TEXACO and CITY) and service contractors.

36. The present situation stems from 1979, when legal measures curtailing revenues were established together with a fiscal policy drastically reducing CEPE's share of oil revenues. In 1983, with the advent of an exchange rate ceiling of 44 sucres to the dollar for oil exports, CEPE's share of revenue was frozen. Concurrently, purchase of foreign currency for CEPE's expenditures was made at the considerably higher official exchange rate (now 250-275 sucres to the dollar). In 1984, CEPE's revenues from sale of fuels in the domestic market were frozen, and in 1985 a new ceiling was set for the dollar exchange rate for oil exports from the Northeast (66.5 sucres per dollar). Finally, in 1986 any new revenues that CEPE might have obtained from new production or discoveries were blocked.

37. CEPE's financial situation grew critical in 1988 when, for the first time in the company's history, the operational deficit reached almost 43% of the approved budget (using an exchange rate of 300 sucres/dollar in 1988). CEPE's financial situation over the five-year period is expected to be unmanageable: if the investments programmed in CEPE's five-year plan and the current oil revenue allocation system are maintained, the accumulated deficit will be approximately $1800 million.

38. These legal measures have rendered unprofitable CEPE's four main activities: the export of oil from the CEPE-TEXACO Consortium, of petroleum from the Northeast, of fuel oil and the sale of refined products in the domestic market. Only two marginal activities-- sale of lubricants and transport through the Transecuadorian Pipeline-- remain free of currency restrictions and price freeze.

39. Increase in oil exports from the Northeast partially counteracted, until 1985, the impact of these measures. Increase in costs and depreciation of the sucre beginning in 1986, served, however, to exacerbate the situation.

40. Through the 1973 creation of the National Electrification Fund (FNE), which served as local counterpart in granting foreign loans for the large investments made in the last 15 years, INECEL's financial resources increased because of oil. In the past four years, however, FNE revenues have

diminished considerably due to the drop in international oil prices and the fixed sucre/dollar exchange rate at 66.5 for oil royalties of the subsector. In 1983 INECEL received US$171.2 million; in 1987 it received only US$20.8 million.

41. This decrease in revenue has been exacerbated by other government measures such as elimination of customs duty exemptions, increase in fuel costs, sucre devaluations and, since June 1988, freezing of the monthly electricity tariff increase. The government has failed to compensate for the reduction in oil transfers by a real increase in tariffs. Since 1982, tariffs in constant money have been eroded as a result of factors unrelated to the subsector, such as inflation, rate of exchange and political interference in fixed tariffs. This deterioration is much more noticeable if tariffs are stated in US$ equivalency. In these terms, tariffs dropped from US5.12 cents per kWh in 1980 to US3.83 cents in 1987. The highest tariff charged was US6.52 cents per kWh in 1981. It is evident that all this contributes significantly to the deficit of the electricity subsector.

Role of Conservation and Alternate Sources of Energy

Energy Conservation

42. There is ample potential for energy conservation in the various consumer sectors as well as in the energy supply system. The industrial sector, after transportation, emerges as the main consumer of commercial energy, with 17% (1986) of final consumption. Non-metallic mineral industries consume the greatest amount of energy: cement (44% of the commercial energy consumed by the industrial sector), followed by the food industry, including sugar and beverages (26% of total commercial energy). Energy audits made by INE in the main energy-consuming industries, extrapolated to the entire sector, show substantial energy saving potential.

43. The transport sector, the main consumer of final energy (41%), uses only oil products and has good potential for saving energy through:

(a) improvement of vehicle efficiency;

(b) increase in utilization factor;

(c) optimization of size of vehicle; and

(d) promotion of more economical vehicles.

44. The household sector, which consumes 33% of total energy, shows energy saving potential. In urban areas, the main steps to take could be: improvement in the efficiency of locally-made

equipment, taking into consideration the limitations of national industry, and the substitution of electricity by solar energy, when this becomes economically justifiable.

45. In rural areas, firewood is the main source of energy for cooking. Traditional stoves are inefficient and create a high demand for firewood, which supply is inadequate in the central provinces and in Loja. This situation contributes to problems of deforestation and soil erosion. Programs for dissemination of efficient stoves, reforestation and promotion of alternative fuels, such as biogas and domestic kerosene, could address the energy problem facing some of the country's rural areas, and could contribute to environmental protection.

Alternate Sources of Energy

46. Development and dissemination of alternate sources of energy and their technologies could affect an improvement in energy supply conditions. Since 1980, INE has instituted a broad program for development of alternate sources of energy and for research, adaptation and demonstration of new technologies.

47. Small hydroelectric power plants operating with Ecuadorian equipment may prove an economic alternative for providing electricity to those consumers who live at a distance from the main distribution system. Solar water heating is now a mature technology in the country and has already given rise to established commercial activity.

48. Passive solar energy offers great potential for savings in air conditioning systems. Photovoltaic systems for applications in remote areas which require little energy could be an alternative. Other sources, such as biomass, wind and geothermal energy could play an important role if the prices of conventional sources approached their economic costs.

49. The excessively subsidized prices of conventional energy make alternate sources of energy and energy conservation economically unattractive to consumers. Moreover, these subsidized prices do not encourage self-generation or co-generation by producers, which could result in significantly lower costs and, consequently, reduce investments required of the government.

Energy Scenarios

50. To analyze probable trends of future economic growth, it has been assumed that oil exports are the explanatory variable in the behavior of GDP, both in the short- and in the medium-term. Consequently, two basic scenarios have been designed which take into account the average production projections, a single refining structure and two estimates, by CEPE and by INE, of domestic demand for hydrocarbons. A high hypothesis and a low hypothesis of evolution have been used for international oil prices to establish the impact of oil exports on GDP growth.

51. Production projections and their behavior over time are estimated according to three scenarios: the pessimistic (in which maximum production of 295 MBPD would be reached in 1988 and later decline); the optimistic (in which the level of production would reach 347 MBPD in 1994); and the medium or expected scenario (in which a peak production of 312 MBPD would be reached in 1989). This last production profile, used to calculate the impact on GDP, reflects the most probable reserve estimate at December 31, 1987 of 1100 million barrels, to which 568 million barrels could be added as a result of exploration to be carried out between 1988 and 1993 by 13 international companies.

52. As to refining, it is assumed that installed refining capacity will remain the same as that of 1987. Prices of hydrocarbons determine domestic demand and volume of exports. Decreased consumption due to higher prices (with prices rising between 100% and 250%) of refined products on the domestic market is expected to increase the exportable surplus of hydrocarbons. This surplus is included in the exportable amounts under the INE hypothesis, whose estimate of demand is better than CEPE's.

53. There are two scenarios for international oil prices: the first is based on World Bank estimates forecasting an average annual growth rate of 8.6% for the 1988-1995 period and 7.6% (in current dollars) between 1988 and the year 2000. The second is a more optimistic scenario in which price increases are projected one year ahead. Real prices are relatively stable in both scenari, without any pronounced increase in the medium-term.

Alternate Measures and Proposals to Resolve Problems in the Energy Sector

54. This part of the Executive Summary describes alternate measures and proposals for the solution of energy sector problems. Chapter II offers an analysis of Ecuador's energy sector problems. Alternatives and proposals are presented in Chapter III, and a brief evaluation of the impact of the measures and proposals is discussed in Chapter IV. This section will introduce in the following order: Hydrocarbons, Electricity, Conservation and Alternate Sources, and Institutions.

Domestic Prices of Refined Products

55. Prices of refined products must be readjusted by considering the cost of replacement of crude oil instead of the historical cost; depreciation and amortization should be charged against revalued assets for the various stages of production (transporting, refining, and distributing the refined products) together with a real profit margin on investment at each stage of production. It is recommended that an immediate study be made of CEPE's accounting and financial systems in order to revalue the corporation's assets.

56. Refined products require a new price structure, wherein the price of diesel fuel approaches that of premium gasoline and the price of liquid petroleum gas (LPG) approaches the average price. The price of domestic kerosene should be lower than the price of LPG to encourage its consumption in rural areas (rather than the more costly LPG).

Average Price Level of Refined Products

57. Unless the Hydrocarbons Law is amended, its limitations cannot currently be avoided. On the other hand, domestic pricing policy should tend towards prices that reflect the (internal) cost of replacement, and eventually economic costs (world prices).

Hydrocarbons Law Option (Low Option)

58. This option assumes that, according to the Hydrocarbons Law, prices will be readjusted to historic costs and maintained in real terms. Under this assumption, during 1988 the average price should increase 115% by June 1988 (125 sucres a gallon).

Opportunity Cost Option (High Option)

59. This policy is based on international crude oil prices and on the loss constituted by selling crude oil at domestic historic cost. The average price of refined products, according to this option, would be 212 sucres a gallon, by June 1988 -- almost four times the present price (58 sucres a gallon). Gradual adjustment of prices to this level (or concept) would allow Ecuador to adapt to its future as oil importer, predicted for the end of the 1990s. Setting prices of refined products according to this option would require amendment of the Hydrocarbons Law.

Replacement Cost Option (Recommended Short-Term Option)

60. This option takes into consideration the cost of gradually renewing present reserves in accordance with the cost of exploration, development and production of newly discovered deposits. According to CEPE's exploration policy, the most representative replacement cost is expected to be that of the central eastern region. The average price of refined products with this replacement cost would be 170 sucres a gallon in 1988 -- almost 200% higher than current prices. To set prices of refined products according to this policy would not require an amendment of the present Hydrocarbons Law but rather a re-interpretation which would consider the need for replacing those reserves that are consumed. This study recommends this option. The following table shows the prices according to the three options.

Table 1: AVERAGE PRICES OF REFINED PRODUCTS IN THE RECOMMENDED, HIGH AND LOW ALTERNATIVES IN 1987 US$/B

	1988	1989	1990	1991	1992
Low Option	8.1	17.0	16.63	15.0	14.7
High Option	8.1	28.7	26.9	27.1	28.3
Recom.Option	8.1	23.0	22.5	21.5	21.3

Price Structure of Refined Products

61. As indicated in Chapter II, the price structure of refined products in Ecuador suffers from two significant distortions: the first concerns diesel fuel, and the second LPG. The structure proposed is not as wide as the current structure, particularly with regards to gasoline and distillates. This would reduce the subsidy for diesel fuel and, to a lesser degree, the subsidy for LPG as well. The relative price of super/extra gasoline would permit greater consumption of super gasoline. The relative decrease in the price of extra gasoline would be compensated by the price of diesel fuel. Domestic kerosene and LPG prices would remain competitive, and use of fuel oil instead of diesel No.1 would continue to be encouraged. This structure is merely indicative. If the prices were actually applied, it could be modulated and gradually adapted. The following table describes current and proposed price structures.

Table No. 2

STRUCTURE OF PRICES OF REFINED PRODUCTS

	CURRENT	PROPOSED
Super Gasoline	190	150
Extra Gasoline	155	130
Diesel 1	95	115
Diesel 2	95	115
Residual	60	60
Domestic Kerosene	52	80
LPG	56	100
Average Price	100	100

62. In order to actually fix the prices of refined products it is proposed that by mid 1988 the level of the Hydrocarbons Law be reached (125 current sucres a gallon), i.e., an increase of 115% over the current price--and that this price be kept stable in real terms. Beginning in 1989, the trend should be towards replacement cost in real terms, which would imply that increase for that year--in real terms--should be 30%. Prices would afterwards be adjusted to offset inflation. This means that in 1987 sucres, the average price of a gallon of refined product should go up from S/.39 (in April 1988) to S/.84, i.e., 115% in real terms. If this decision is postponed, increase in the last quarter of 1988 should be 140%, due to inflation.

Technical Aspects

63. To ensure reliable figures for proven reserves and production projections, it would be advisable to form an inter-institutional group of impartial specialists to carry out the simulation and follow-up of the behavior of deposits in the different oil fields. Computer facilities available in Ecuador would be used but, for the initial stage, computer programs and technical advice would be hired.

64. Special emphasis should be given to extraction of medium density oils of 15 to 25 API degrees, taking advantage of the presence of lighter crudes, since this is probably the only way of extracting and transporting these crudes. Study and evaluation of heavy crudes (8 to 15 API) should be continued in the fields of Pungarayacu, Oglan, etc., because of the importance of their reserves.

65. Production rates of the consortium's old fields require updating, as some of the official production rates have not been modified since 1978 and are not adjusted to current deposit conditions.

66. Exploration in the Amistad field and in other offshore areas should be left to foreign investors because of the high risk involved.

67. The rehabilitation project for the Santa Elena Peninsula fields should be re-evaluated in light of present economic conditions.

CEPE's Financial Aspects

68. The present oil revenues distribution system should undergo some changes, in order that CEPE may recover costs in each activity as well as a percentage of global oil revenue (between 5% and 10%). The latter would enable CEPE to generate reasonable self-financing of the minimum investments programmed. Since these reforms may take some time--possibly a year of analysis and legal change--it is proposed for the sale of refined products on the internal market that CEPE immediately recover its costs plus a percentage (20%) of profits, which at present end up in the Government budget. To this end, it would suffice to regulate Article 73 of the Hydrocarbons Law through an Executive Decree.

Recommendations for CEPE's Five-Year Investment Plan

(a) reinforcement of team responsible for coordinating the investment budget in the planning department, in order that it may determine which projects are economically feasible and establish investment priorities;

(b) expansion of geophysical investments: CEPE would thereby have sufficient exploratory objectives to implement drilling of at least five wells a year;

(c) modification of CEPE's exploratory program, increasing exploratory wells from 14 to 23 so as to gradually replace foreign companies' exploratory program beginning in 1990;

(d) modification of CEPE's production program, to include development of fields in the central eastern region, such as Capiron (N-E), Tivacuno, Curaray and Primavera;

(e) study of expansion of the Peninsula refineries towards the closing of the five-year period, in order to find the most economical option for meeting demand for refined products;

(f) preparation of comparative technical and economic studies on size, location and type of gas plant as well as determination of the best use for the Libertador field gas;

(g) limitation of CEPE's investments in other industrial companies, leaving this to the private sector.

(h) to date no studies are necessary for the expansion of the Transecuadorian Pipeline;

(i) all investments proposed by CEPE for pipelines should be economically evaluated and assigned priorities relative to all other CEPE projects;

(j) bottling projects for LPG and lubricating oils should be financed by private companies and removed from CEPE's Investment Program; and

(k) study of present storage capacity for refined products (especially LPG) in each one of the terminals and their zone of influence to determine capacity.

CEPE Investment Priorities

69. In brief, CEPE's investment program should be substantially reduced and reoriented toward upstream activities such as exploration and production. CEPE's investment program, according to the Five-Year Plan, updated to June 1988, contemplates an investment of US$1102 million for the 1988-1992 period, of which 64% is for processing and transport projects, which should have low priority. This study proposes a US$647 million program for the five-year period, of which 23% is for processing and transport. Exploration and development/production activities are emphasized. The proposed program is summarized in the following table.

Table No. 3

CEPE: INVESTMENT PROGRAMS FOR 1988-1992
(In million of 1987 dollars)

	1988	1989	1990	1991	1992	Total
Present	177	235	288	290	112	1102
Proposed	154	139	122	110	122	647
Difference	-23	-96	-166	-180	+10	-455

70. This reduction in the investment program is of crucial importance. CEPE will otherwise continue to show a substantial deficit which cannot be covered through the alternative financial solutions proposed for CEPE (see preceding paragraph and Chapter III, paras. 3.53-3.69).

Institutional Aspects

71. Congress should pass a new law granting CEPE financial and operational autonomy. It should also invest CEPE with the power to create affiliates and subsidiaries (some of which could involve private national and/or foreign capital) under the control of the National Directorate of Hydrocarbons, for technical aspects, and of the Superintendency of Companies, for financial aspects. The same law should incorporate the above-mentioned financial rationale.

72. The Hydrocarbons Law should also:

(a) introduce, explicitly, the concept of replacement cost of a barrel of petroleum as the cost of production and allow the gradual application, by the government, of the economic cost as the national economy evolves from a petroleum exporter to a petroleum importer;

(b) change the make-up of the Advisory Commission of Petroleum Policy in order that it becomes the Energy Policy Advisory Commission and includes INE;

(c) include new provisions in the Hydrocarbons Law regarding exploration and production of free natural gas, particularly with respect to its selling price on the domestic market and the relative price of natural gas and its substitutes such as fuel oil;

d) establish priorities in allocating oil revenues so that CEPE may first recover its costs in each phase and a percentage of the profit, to finance the expansion of its activities, before profit is distributed among other recipients; and

(e) invest CEPE with responsibility for operations of the CEPE-TEXACO Consortium, the Transecuadorian Pipeline, the field jointly managed with CITY and the ANGLO and REPETROL refineries. CEPE should prepare and set up appropriate organization and management systems.

Electricity

73. The problems facing the electric energy subsector resemble those facing the hydrocarbons subsector in that they are of a financial, planning, institutional and legal nature.

Expansion Plan

74. The following is a summary of the measures recommended for the Electricity Subsector.

Reduction of investments, as follows:

(a) deferment of the Paute Mazar Project--instead, a thermal steam plant of 125 MW for 1996 or 1997 should be considered;

(b) revision of the Demand Projection;

(c) rescheduling of works in progress;

(d) implementation of essential programmed works: Daule-Peripa, dredging, transmission, studies;

(e) reduction of investments in other activities;

(f) setting an adequate tariff level that will permit covering costs in the short-term and contribute to investment in the medium-term; and

(g) increasing the tariff for block sales by 100% and the tariff to the final user by 40%. These tariffs should be maintained at their real value by periodic increases in line with inflation.

75. Energy losses suffered by electricity companies should be reduced from 17% to 15% in 1989-1990 and subsequently to 12%-13% in 1992-1993.

76. Subsector Capitalization: It is essential that the government make annual contributions of capital to INECEL in accordance with investment needs. The exchange rate ceiling of S/.66.50/US$ for oil royalties should be eliminated under a legal reform of the distribution of oil revenues.

77. Structuring of the Subsector: EMELEC should be integrated into the subsector in accordance with the law and the specific contract to avoid bad debt problems and optimize energy generation.

78. The number of distributor companies should be reduced to a total of nine.

Institutional and Legal Aspects

79. INECSL's legal framework should be changed. INECEL should be converted into a public enterprise under the control of the Superintendency of Companies so as to:

(a) limit the influence of the Board of Directors on internal management;

(b) revise the make-up of the Board of Directors;

(c) re-establish control over electricity companies;

(d) establish uniform and more balanced labor relations;

(e) improve internal coordination inside INECEL and between INECEL and the other companies; and

(f) implement a public relations program.

Reduction of Investments

80. The Master Electrification Plan requires thorough updating, in line with present and future financial conditions, through the study of alternatives which would drastically reduce investments, especially in the short/medium term. Possible options could be the reduction of area serviced, establishment of service priorities and reasonable reduction in the degree of service reliability.

81. An alternate expansion program has been considered which would include the following measures.

Demand

(a) downward revision of demand projections;

(b) re-scheduling of generation projects in progress (Paute C) within the terms of the contracts;

(c) construction and start-up in 1993 of Daule Peripa (same as in the Master Plan);

(d) implementation of the first dredging phase (deep dredging) in the Amaluza reservoir (same as in the Master Plan) and a study of final alternate solutions for the sedimentation problem;

(e) deferment of implementation of the Mazar project;

(f) rehabilitation, between 1989 and 1993, of part of the thermal generation capacity of the distributing companies. This will allow deferment of the start-up of new important plants for at least a year;

(g) consideration of the construction of a steam plant (125 MW) for start-up in 1996, followed by a hydroelectric project (eventually San Francisco) in 1998;

(h) continuation of the Master Plan transmission projects, although it would seem advisable to make technical studies to postpone the Paute-Pascuales-Prosperina line (US$25 million at June 1987 prices);

(i) limitation of INECEL distribution investments to 60% of the Master Plan figure;

(j) assignment to distributing companies of a maximum of US$20 million per year (this includes the cost of rehabilitating thermal generation capacity);

(k) completion of rural electrification works for which there is financing; and

(l) continuation of feasibility studies that have financing. The most important ones are San Francisco, Sopladora, Coca-Codo Sinclair and Chespi (which does not have financing yet).

Other

(a) utilization of a 10% discount rate instead of the 8% used in the Master Plan; and

(b) utilization of more realistic fuel costs (present ones are too high and bias the least cost path towards hydroplants).

82. The following paragraphs describe in greater detail two of the main recommendations for the electric subsector, namely, the investment program and the tariff policy. A more extensive discussion of the other proposals is found in Chapter III.

Investment Program

83. INECEL's investment program is based on an optimistic view of future demand and on availability of a petroleum surplus. Without harming the electricity subsector, which is one of the country's best public services, programmed investments could be substantially reduced in the next five years, as shown in the following table.

Table No. 4

INECEL: INVESTMENT PROGRAMS (1988-1992)
(in millions of 1987 dollars)

	1988	1989	1990	1991	1992	TOTAL
Present	230	186	189	183	185	973
Proposed	157	179	92	54	75	557
Diff.	-73	-7	-97	-129	-110	-416

Note: The investment program was modified up to 1997. Further reductions are possible (see Chapter III, paras, 3.85-3.88).

84. Tariffs must be set at levels that will cover service costs in the short-term and contribute to investment in the medium-term. Measures should include mechanisms that prevent future deterioration of tariffs resulting from inflation. They should consider a structure that differentiates according to level of tension, hour of day and period of the year. Net positive internal generation of funds should be sought in the short-term. This could be achieved gradually, with annual increases, in real terms, over a period of years, or quickly, through substantial increases from time to time. An ad hoc tariff analysis determined overall average costs for block sales and sales to final users. In 1988 sucres, these were 7.5 S/kWh and 12.8 S/kWh, respectively. Estimates based on legal provisions in force until June 1988 show that this year distributing companies will pay an average of 3.8 S/kWh for block purchases, and final users will pay an average of 9.15 S/kWh.

85. It would prove convenient, moreover, to increase concomittently electricity tariffs and the prices for refined products. The first increase should aim to cover service costs, plus depreciation and financial charges. This means an increase of 100% for block sales and an increase of 40% for sales to the final user. Assuming that tariffs are increased in August/September 1988, the average new tariffs

should be approximately 7.5 S/kWh for block sales and 13 S/kWh for final users. These tariffs could be maintained in real terms for a year, after which there would be a new adjustment. After the second increase, tariffs should be moderately increased in real terms until they contribute 20-30% of the investments constrained in Expansion Plan.

86. The increases, which should be made simultaneously for block sales and final users, could serve to introduce the concept of a more adequate tariff structure, in line with the expected results of the World Bank financed study of Long Run Marginal Costs (LRMC):

(a) increases should differentiate by level of tension, and

(b) block tariffs should be the same for all distributing companies.

Conservation and Alternate Sources of Energy

87. Although reduction of subsidies for conventional energy and continuation of development activities by INE will help promote conservation and the use of alternate sources of energy, these steps must be complemented by the following measures:

(a) gradual improvement of energy sector efficiency to decrease demand for operation as well as investment resources;

(b) diversification of energy sources and technologies to achieve greater harmony between energy supply and demand requirements;

(c) inclusion of environmental protection as a factor in selecting energy projects and as an objective of sector management;

(d) updating of energy sector legislation and organization to permit, when warranted, utilization of decentralized energy sources and construction and operation of small energy systems (below 500 kW), including cogeneration, by the private sector; and

(e) establishment of expeditious financing mechanisms (through credit institutions) for investments in conservation and alternate sources of energy.

Specific Measures for the Promotion of Energy Conservation

88. Industrial Sector

(a) Continue program for promotion of energy conservation through energy audits, training, technical assistance to the industrial sector, etc., which INE has been carrying out since 1981.

(b) Promote optimum use of process heat in industry through cogeneration. Prepare pertinent legal reforms and ensure that they are enacted.

(c) Study feasibility of substituting non-commercial fuels (bagasse, industrial wastes, etc.) and geothermal fluid for oil products, taking into consideration environment protection.

89. Transport Sector

(a) Update legal provisions to improve efficiency and utilization of existing vehicles, reorganize urban traffic and make a detailed study of fuel consumption in maritime transportation, which has exceedingly high consumption levels.

90. Household Sector

(a) The urban household sector shows potential for reducing electricity consumption through efficient use of appliances, controlling time of use, and resorting to alternative energy sources.

(b) It is possible to improve the efficiency of locally produced lamps, ventilators, air conditioners, refrigerators, stoves and heaters.

Specific Measures for Promotion of Alternate Sources of Energy

91. Solar Energy

(a) Use of solar systems, whenever economical, for heating water in projects sponsored or implemented by the public sector.

(b) Consideration of photovoltaic systems for communications (IETEL) and health (IEOS) installations in remote areas.

(c) Preparation of design manuals for using passive solar energy (INE).

(d) Periodic training of construction professionals in the use of passive solar energy, and provision of advisory services to entities in charge of urban development for the use of passive solar energy.

92. Small Hydroelectric Plants

(a) Schedule implementation of small plants already identified as users of national technology (INECEL-INE) after their evaluation, and acquire a better understanding of the potential of small hydroelectric plants.

93. Geothermal Energy

(a) Complete feasibility studies already underway, i.e., the low-enthalpy project in Los Chillos Valley (INE), the binational high-enthalpy project (with Colombia), further study of geothermal potential.

94. Biomass

(a) Coordinate (INE-Ministry of Agriculture) a program of incentives for forestry plantations in Chimborazo, Cotopaxi, Tungurahua, Bolivar and Loja (Provinces with the greatest fuelwood deficits).

(b) Promote training in forestry administration.

(c) Identify projects which both produce energy and help the environment, such as treatment of sewerage water, processing of wastes from slaughterhouses and other industries, treatment of solid waste for heat generation, etc.

Impact of Proposed Measures on the Economy

95. This section analyzes the impact of proposed measures on the main economic indicators, such as GDP, Balance of Payments, Public Finances and the level of domestic prices. Effects of the proposed measures, especially of prices and institutional changes (such as distribution of oil revenues) on sector enterprises and on the Government Budget have been estimated and discussed in Chapter II.

96. The following is a summary of the main conclusions reached concerning the impact of proposed measures.

(i) Considering the optimistic hypothesis of an increase in non-petroleum exports, a reduction in non-productive consumption and a substantial growth in investment ratio, it has been determined that growth of GDP for the four scenarios will fluctuate between 3.8% and 2.1% over the period 1988-1995. Only the first two would prevent a slow impoverishment of the population, since Ecuador's annual population growth rate in coming years is estimated at more than 2.6%.

(ii) Readjustment of prices of refined products as well as changes in their structure would tend to increase exportable petroleum surpluses due to lower consumption, decreased smuggling and greater investments, made possible by additional revenues. In view of the importance of petroleum exports, reduced domestic consumption of oil products should be encouraged, and a fund should be created for investments in energy conservation.

(iii) Increase in fuel prices would have a lower inflationary impact than is generally believed. Econometrically, the impact should not be greater than 3.6% for a 100% increase. The real figure could be slightly higher because of psychological and speculative factors. This could be attenuated at the consumer level through monetary measures and proper controls. Because of its lower penetration of productive sectors and family budgets, the increase in electricity tariffs would have a lower inflationary effect. Incidence of electric energy as a production input, even in branches which use electricity intensively, such as the cement industry, does not exceed 3% of total production costs. Even though an increase in electricity tariffs does not have the same economic effects as an increase in the prices of refined products, it would slow future demand and would therefore reduce investment and foreign currency requirements as well as channel additional financial resources to the utilities.

(iv) Current inflation levels and trends require immediate price revisions at the suggested levels and maintainance of these in real terms. A later revision or at lower levels would be affected by inflation and would require subsequent drastic increases to offset this effect, at much higher economic and social costs.

(v) Volume of oil exports would diminish between 1988 and 1995 due to depletion of reserves, technical restrictions of production and increase in domestic demand. For the high scenario, the decrease would be at an annual average rate of 6.6%; for the low scenario, the decrease would be 9.8% a year.

(vi) This situation makes it essential to rationalize CEPE's investments, giving priority to exploration and field development which yield immediate returns. This would make it

possible to increase exportable petroleum surpluses in the short-term. High-risk investment should be undertaken by foreign companies.

(vii) Given the two hypotheses of international prices, projections of crude exports (and equivalent) at current dollar prices show rates which range from 2.6% for the high scenario to -2.0% for the low scenario. Using an average annual inflation of 3.5% for the dollar, it can be seen that in all scenarios there is a real decrease in the value of petroleum exports.

(viii) Revenue prospects from hydrocarbons exports, which are rather disheartening, require that non-petroleum exports be encouraged to compensate for future decrease of exportable crude balances, which will tend to disappear by the end of the nineties.

(ix) For the above-mentioned scenarios, the size of the Trade Balance will be similar to that of recent years, with a slight growth in current dollars but a decrease in real terms. Consequently, it is necessary to attract foreign capital.

(x) Deficit in the Public Sector Budget, as well as in CEPE and INECEL, can be diminished through raising prices of refined products and electricity tariffs, as well as revising investments and the priority attached to them.

(xi) The strong impact of the exchange rate on economic activity, on CEPE and INECEL finances, on Public Sector Budget, on Balance of Payments, etc., requires careful handling of the foreign exchange policy.

Impact of the Increase in Crude Exports

Under the present economic structure (1986 intersectoral relations), an increase of 10% in petroleum exports represents an increase of 1.1% in GDP and in the Value Added of the economy. On the other hand, a 10% decrease in domestic demand for refined products due to a price increase, or some other energy conservation measure, produces decreased economic activity which results in a reduction of 0.1% in GDP. Consequently, for each 10% increase in fuel exports (which could be achieved through eliminating contraband and lowering domestic consumption by 10%, which could result from 100% to 150% price increases) a net GDP increase of approximately 1% is obtained.

Impact of Reduction in Electricity Demand

98. Reduction in electricity consumption by 10% would cause a small decline (0.01%) and a slightly higher savings of foreign exchange (0.02%). However, it should be borne in mind that substantial indirect savings of foreign currency would result from a decrease in future demand for

electricity because of reduced construction programs, which have a large imported component. Additionally, this would help channel substantial financial resources into the electricity subsector, reducing INECEL's deficit considerably and, therefore, the need for government subsidies (and the growth of the monetary supply). The foregoing demonstrates the convenience of taking measures to conserve electricity, such as setting tariffs to discourage waste.

Impact on Inflation

99. Based on production and final consumption structures, estimates have been made of the impact of the increase in prices of refined products and electricity tariffs on inflation at gross production and final consumer levels. Approximate opportunity costs of refined products are 250% higher than present market prices. The following table shows the increase in production costs by sectors for increases of 100% and 250% in current prices. Greatest impact, as shown, apart from on the sector's own consumption (as in petroleum refining), is in the electricity (thermal generation) and transport (gasoline and diesel) sectors.

Table No. 5

IMPACT OF FUEL PRICE INCREASES ON PRODUCTION COSTS
(PERCENTAGES)

SECTORS	100% INCREASE	250% INCREASE
Agricultural-Livestock	0.8	2.0
Petroleum and Gas	0.1	0.2
Refining	24.56	61.2
Mining	1.8	4.6
Food Industry	0.5	1.2
Metalworking	0.7	1.7
Manufacturing Industry	0.5	1.3
Electricity	17.64	44.0
Construction	0.7	1.9
Transportation	10.72	26.8
Services	0.5	1.2
Production Inflation:	3.6	9.0
- Final Consumption Inflation:	3.1	7.8

Source: Work Group and INE.

100. Likewise, the rise in production costs and in final consumption prices in the electricity subsector is shown on Table No. 6. As indicated, the greatest impact is on the Mining and Services sectors. This impact, however, is minor in general.

Table No. 6

IMPACT OF ELECTRICITY TARIFF INCREASES ON PRODUCTION COSTS
(PERCENTAGES)

SECTORS	100% INCREASE	250% INCREASE
Agricultural-Livestock	0.10	0.20
Petroleum and Gas	0.10	0.21
Refining	0.04	0.08
Mining	1.17	2.33
Food Industry	0.49	0.99
Metalworking	0.52	1.03
Manufacturing Industry	0.37	0.74
Electricity	10.31	20.61
Construction	0.17	0.35
Transportation	0.03	0.06
Services	1.12	2.23
- Production Inflation	0.80	1.40
- Final Consumption Inflation	0.60	0.70

Source: Work Group and INE.

Effect of Reestimation of Reserves and of Price Changes on Petroleum Production, Domestic Consumption and Exports

101. While official estimates show a reserves-to-production ratio of almost 14 years, based on daily production of 310,000 barrels, estimations of this study show 9.5 years, i.e., the duration of reserves is shorter by 4.5 years.

102. To analyze the effect of this re-estimation, three scenarios for discovery of reserves have been studied: low, medium (the expected case) and optimistic. A description of the scenarios follows.

Table No. 7

SCENARIOS OF PRODUCTION AND REMAINING RESERVES

YEARS	LOW SCENARIO PROD. (MBPD)	LOW SCENARIO R.RES (MMB)	MEDIUM SCENARIO PROD. (MBPD)	MEDIUM SCENARIO R.RES. (MMB)	HIGH SCENARIO PROD. (MBPD)	HIGH SCENARIO R.RES. (MMB)
1988	294.7	946.2	310.2	1021.5	310.2	1033.6
1989	286.7	846.1	312.3	1034.1	319.9	1034.1
1990	277.8	823.7	304.2	974.9	318.9	1017.4
1991	258.0	738.8	289.3	903.7	309.2	961.8
1992	247.4	719.7	286.1	904.7	324.4	1007.9
1993	228.9	939.6	280.2	883.9	326.1	1122.9
1994	212.1	565.4	257.5	823.9	347.1	1247.7
1995	196.7	496.7	236.9	771.3	346.2	1170.8
2000	85.9	276.1	145.6	482.4	275.7	927.4
2005	17.5	195.4	87.2	275.5	164.4	585.5

Source: Work Group estimates.

Evaluation of the Three Scenarios

103. Comparison of the low scenario with the medium scenario shows that in the pessimistic scenario, daily production would be lower by almost 16,000 barrels in 1989; 40,000 in 1995; and by 60,000 in the year 2000. Production according to the optimistic scenario would be similar to production of the medium scenario in 1988, 109,000 barrels more in 1995 and 120,000 barrels more in the year 2000.

Refined Product Demand and Exportable Petroleum Surpluses

104. Based on estimated volumes of remaining petroleum reserves and on production projections according to the medium (expected) scenario, the following exportable balances of petroleum and refined products have been determined, using CEPE and INE figures for the estimated domestic demand. Domestic demand estimated by CEPE is larger (and the exportable surplus smaller) than that of INE. The Work Group believes that INE estimates of future consumption are more accurate. The following table shows export projections based on INE's projected demand.

Table No. 8

PETROLEUM PRODUCTION, CONSUMPTION AND EXPORT PROJECTIONS
MILLIONS OF BARRELS (INE DEMAND)

ITEM	1988	1989	1990	1991	1992	1995
Total Production	113	114	111	106	104	86
Refinery Throughputs	37	38	40	41	42	46
Crude Imports Equiv.	2	1	0	0	0	2
Crude Exports Equiv.	9	8	9	10	11	15
Total Domestic Consumption	38	39	40	41	43	47
Crude Exports	75	75	71	65	62	39
Total Crude Exports	84	83	80	75	73	55

Source: CEPE and Work Group Estimates.

105. Petroleum and refined product exports for 1995 are equivalent to 65% of estimated exports for 1988, which implies that between 1988 and 1992, exportable surpluses would be reduced by 29 million barrels. Average annual reduction in the exportable surpluses is 5.8%.

Petroleum Export Prices

106. The economic impact of higher world oil prices has been estimated on the basis of the intersectoral relationships and aggregate demand structure (Input-Output Matrix) of 1986. Two international price hypotheses have been used to estimate oil exports, as shown in the following table.

Table No. 9

SCENARIOS FOR EXPORTS AND INTERNATIONAL OIL PRICES

	EXPORTS (millions of barrels)		PRICE (current dollars per barrel)	
YEARS	HIGH	LOW	HIGH	LOW
1988	84	74	14	14
1989	83	73	15	14
1990	80	69	17	15
1991	75	63	19	17
1992	73	59	21	19
1993	92	58	24	21
1994	63	49	25	24
1995	55	41	27	25

Source: Work Group.

107. In order to measure the impact of oil export projections on GDP, it was necessary to make two assumptions: (1) Projections for non-petroleum exports (traditional and new) were made based on historical trends and on the need to compensate in part for volume and price declines in oil exports. (2) It was assumed that their value would increase at an average annual rate of 4.6% in current dollars.

108. Based on the input-output matrix of 1986 and the above-mentioned export and oil price scenarios, estimated growth rates for GDP over the 1988-1995 period are shown below. Probable export volume is the high estimate, and thus the most probable growth rates are 3.8% and 3.3%.

GDP GROWTH RATE
(1975 price)

EXPORT/PRICE		ANNUAL GROWTH RATE (%)
High	High	3.8
High	Low	3.3
Low	High	2.5
Low	Low	2.1

The Trade Balance

109. The Trade Balance will be similar to that of recent years, with a slight growth in current dollars but a decrease in real terms. Cumulative annual growth rate of the Trade Balance varies between 3.1% for the high-high and 1.87% for the low-low scenarios.

Impact of Institutional, Legal and Price Measures on Finances of
Sector Enterprises, Government Budget and Other Institutions

Hydrocarbons

110. Chapter II makes reference to the fact that CEPE's projected financial situation under the Five-Year Plan--assuming there will be no change in its revenue, expenditures or investments--will show an accumulated deficit of US$1900 million for the period 1988-1992. In view of this unmanageable situation, the following is an evaluation of the results of the different measures proposed in Chapter III to improve the Corporation's financial situation and to correct economic distortions caused by present price structure, distribution of petroleum revenue and investment program.

Price of Refined Products at Replacement Cost
(Recommended Option)

111. A change in prices of refined products to match replacement costs would result in additional revenues of US$6.3/Bl on average, compared to the Hydrocarbons Law price (Low option). This would mean additional government annual revenue of around US$250-296 million, based on INE and CEPE domestic consumption projections. The alternative based on international oil prices (high option) would generate approximately twice as much additional revenue as the recommended option.

Reform of the Oil Revenue Distribution System

112. With regard to the impact of different alternatives on oil revenue distribution, it can be noted that adjustment in the price of refined products (to match replacement costs) implies an increase of US$1974 million for the General Budget and US$104 million for CEPE, whereas the other recipients would continue to receive their same allotment. The immediate, short-term alternative implies variations only in General Budget and CEPE revenues, totaling US$1967 million. Contrary to general belief, in-depth restructuring of the oil revenue distribution system would imply redistributing revenue among only two recipients: the General Budget and CEPE. Different alternatives and their effect on revenue of the GDB, CEPE, the Armed Forces and other recipients are shown in the following table.

Table No. 10

IMPACT OF ALTERNATIVE PRICE POLICIES ON DISTRIBUTION OF OIL REVENUE
(Period 1988-1992)
(Millions of 1987 US$)

ALTERNATIVE	GBG	CEPE	ARMED FORCES	COM-PANIES	IMP	OTHER	INECEL	TOTAL
Base Case No Fuel Price Adjustment	3668	541	823	759	278	194	52	6315
Base Case Fuel Price Adjustment	5642	645	823	759	278	194	52	8395
Elimination of Exch. Rate Ceilings	3208	1931	969	759	278	857	343	8395
Recovery Costs + 5% Petroleum Rev.	4827	1725	802	759	278	251	52	8395
Recovery Costs, Sale Ref. Prods. +20% Prof.	4675	1613	823	759	278	194	52	8395

Source: Work Group.

Investment Rationalization

113. Rationalization of the investment program for the period 1988-1992, in accordance with the proposal made in this study, implies a reduction of US$455 million (1987 dollars) in investments. CEPE's financial deficit for that period would consequently be reduced from US$1790 million to 1340 million, which would be a positive complement to other proposed measures. As Table No. 11 shows, the proposed rationalization of investments would lead to greater exploratory and production activity.

Table No. 11

CEPE: INVESTMENT PROGRAM 1988-1991
(Million of 1987 US Dollars)

	CEPE PLAN	PROPOSAL	DIFFERENCE
Exploration	81	114.4	+ 30.4
Production	259	340.1	+ 81.1
Processing	411	45.3	-365.7
Transport & Storage	296	101.6	-194.4
Marketing & Other services	55	48.8	- 6.2
TOTAL	1102	647.2	-454.8

Source: CEPE and Work Group.

Impact of Recommended Measures on Electricity Subsector

114. As mentioned before, under the Master Electrification Plan, which calls for monthly tariff increases (2% for block sales and 3% for final users), the estimated deficit for 1988-1992 is US$734 million at June 1987 prices, with disbursements of US$414 million of external credit. Given these facts and the country's economic situation, an analysis of the economic impact of the measures suggested in this study follows.

Tariff Adjustments

115. Increases of 100% have been recommended for block sales and 40% increases for sales to final consumer. A real increase (that is, higher than the rate of inflation) of 1% per month could be an alternate option.

Reduction of Losses, Reduction of Investments, Renegotiation of Debt, and Elimination (or Revision) of Exchange Rate Ceilings

116. Financial rehabilitation proposed through these measures aims to make annual deficits disappear after 1991 and cover the accumulated deficit by the year 1993, when there would be a positive balance. It should be noted that these results are merely theoretical and that a more important reordering of the entire sector, such as the reorganization of the oil revenue distribution system, would render certain measures obsolete (for example, the elimination of exchange rate ceilings). It is also probable that in five years INECEL will no longer receive any petroleum funds. The only effect of these measures outside the electricity subsector would be that, to the extent that the subsector covers its costs, government subsidies would be reduced.

CHAPTER I

ENERGY IN THE ECUADORIAN ECONOMY

Energy and the Economic Structure of the Country

Economic Development and the Energy Sector

1.1 Ecuador began exporting oil in August 1972. Revenue from oil marketing has emerged as the main source of financing of the economy, making possible numerous investments that have radically altered the country. These investments have affected, in particular, energy infrastructure, communications, transport, housing, health, and education.

1.2 Over the past 25 years, the Gross Domestic Product of Ecuador has grown at a rate of 6.7%, comparable to the growth rate of the GDP of Brazil over the same period. This growth has been almost exclusively associated with productivity of the petroleum sector, however, because exchange and monetary policies have kept the sucre overvalued and the real interest rate negative for almost ten years. These two factors have prevented diversification in economic activities. With the drop in oil prices in late 1985, Ecuador has been growing at a rate slightly higher than its population growth rate, due to the contribution of other economic activities such as fishing (especially shrimp), agricultural and livestock production and, to a lesser degree, mining. The relative importance of the oil sector has decreased in the past year, while the agricultural, forestry, and fishing sectors show a slightly upward trend, as shown in Table No. 1.1.

Table No. 1.1.
STRUCTURE OF REAL GDP, 1982, 1986, AND 1987
(Total percentages) a/

	1982	1986	1987
Agriculture and Livestoc	12.5	12.2	14.0
Forestry and Fishing	2.4	3.1	3.7
Mining	0.3	0.7	0.8
Petroleum and Refining	9.7	14.2	6.9
Manufacturing	19.1	16.6	17.6
Services	56.0	53.2	57.0
TOTAL	100.0	100.0	100.0

a/ Based on 1975 sucres.

Source: National Energy Institute, World Bank.

1.3 The most dynamic sectors in Ecuador's economy are: services, the food industry, petroleum and gas, manufacturing, agriculture and livestock, and construction. Average annual growth rate for the petroleum sector during the decade 1977-1986 was (9.22%) and for the electricity subsector (7.13%). That both rates were higher than the rate of the entire GDP (3.37%) proves the importance of the energy sector in the economy.

1.4 High growth in the oil and electricity subsectors is explained by the substantial increase in investments made in recent years--by the Ecuadorian State Petroleum Corporation (CEPE) and by the Ecuadorian Electrification Institute (INECEL)--in petroleum and hydroelectric infrastructure. Petroleum income has been a determining factor in achieving these results. Contrast between the growth rate of these subsectors and the average growth rate of the economy is remarkable. Thus in 1983 the Gross Value Added of oil increased by 27.2% and the GVA of electricity by 14.9%. These figures coincide with the beginning of oil production in the Libertador field and the Paute project. In contrast, global GDP dropped 2.8%. In 1984, growth rates were 9.2% and 28.8%, respectively, versus 4.2% for GDP.

1.5 During the 1970s and early 1980s, oil ranked as Ecuador's most important export product. Oil exports increased from 0.4% of total exports in 1970 to 48% in 1973 and to almost 60% in 1982. Fuel oil exports accounted for an additional 5.2% in recent years. With the fall of world oil prices, exports of crude dropped to 44.9% of total exports in 1986. Only shrimp and fish exports, besides oil, increased their share of total exports between 1970 and 1986. In 1986, shrimp exports worth almost US$400 million made up approximately 17% of total exports.

1.6 Slow-down in economic activity over the past few years (in 1987 there was negative growth of 5.2%), reflects the impact of the drop in international oil prices and of the earthquake of March 1987, which caused suspension of oil exports for several months. This situation also affected per capita GDP, which fell from US$1,668 in 1981 to US$960 in 1987 in current terms, i.e., to figures below the pre-1978 level.

1.7 During the period 1986-1987, the non-petroleum economy barely grew at the rate of population, and growth of some sectors was even below population growth--such as export agriculture, which in 1986 increased to 1.1% and in 1987 decreased by 10.3%. The behavior of the industrial sector shows minor increases or growth for the years 1983, 1984 and 1986.

1.8 With regard to domestic demand for energy, global energy content of GDP, and energy content of GDP by sectors, available energy consumption figures indicate an energy intensity greater than elsewhere in Latin America, a logical result of price policies since 1972. Based on 1986 data, energy content of GDP is calculated at approximately 400 kgoe per thousand US dollars of GDP, one of the highest levels of energy intensity in Latin America, where the mean for the same year was 290 kgoe per thousand US dollars of GDP. The transportation sector is the largest consumer, with 41% of final total consumption (see para. 1.20).

1.9 In recent years, consumption of goods and services has increased sharply in Ecuador's economy, as a share of the Aggregate Final Demand: its share has grown from 63.8% in 1980 to 67.6% in 1987, contrasting with the pronounced decrease in Gross Capital Formation, which dropped from 20.3% in 1980 to 14.4% of GDP in 1987.

1.10 The influence of the energy sector on the economy, based on the current economic structure (intersectoral relationships of 1986), means that an increase of 10% in oil exports would result

in an increase of 1.1% in GDP, while a decrease of 10% in domestic demand for refined products, due to domestic price hikes and other energy conservation measures, would cause a decrease of only 0.1% in GDP. For each 10% decrease in domestic fuel consumption, therefore, there is a net increase of 0.5% in GDP.

1.11 According to the same analysis, although a 10% decrease in electricity consumption would mean a decrease in GDP of only 0.01% and would result in savings of little over 0.02% in foreign currency, it would channel significant additional resources to the electricity subsector.

Influence on the Public Sector

1.12 Ecuador's public finances have, since the 1970s, depended heavily upon petroleum revenues and external financing. Efforts to diversify taxation outside the energy sector have diminished as inflation rises and price policies lag behind. Public consumption and low-return investments have increased, and private consumption has been encouraged by an irrational subsidy policy, financed by a growing external debt.

1.13 In real terms, government expenditures have increased at an annual rate of 10% between 1973 and 1982, while foreign loans were used to cover the public deficit, thereby multiplying the external debt by 13. Oil exports, which were practically nil in 1970, reached 74% of total exports in 1983. When oil prices dropped and exports were suspended because of the earthquake in March 1987, the proportion dropped to 40%. Non-petroleum exports (which greatly flourished as a result of changes in foreign exchange policy since 1981) have been sustained in the past three years by shrimp and seafood exports, which increased their share of the total from 14% in 1981 to 27% in 1987.

1.14 If we consider that a reduction of US$1 per barrel in the price of crude means a decrease of approximately 1% in GDP and that during the current year oil prices have fallen to US$13/barrel from the budgeted price of US$17, then we can conclude that the growth of GDP will be reduced by approximately 4% during the current year. Furthermore, as reduction in oil prices affects mainly fiscal revenues, the government deficit will increase to almost 9% of GDP, as against the 5% budgeted at the beginning of the year.

1.15 The persistence of the public deficit reflects the excessive growth of this sector. The following factors contribute to this excessive growth: high level of public employment, worrisome inability to control spending, subsidy policy that is wasteful of resources, deficits in the operations of government enterprises, and low non-petroleum tax collections.

Description of the Energy Sector

Energy Resources

1.16 Ecuador has abundant energy resources. Hydroelectric resources represent a gross potential of approximately 93 GW, of which almost 20 GW are technically and economically usable (50 million TOE per year). Potential currently used is approximately 900 MW, i.e., less than 5% of usable energy resources. The country still has proven reserves in petroleum resources of approximately 1,100 million barrels (151 million TOE). At current rate of production, these would suffice for approximately 9.6 years of production. With the declining trend in annual production resulting from the main fields reaching maturity and from increasing internal consumption as a consequence of excessively subsidized prices, it is expected that Ecuador will become a net importer by about 2002 under the moderately optimistic scenario that new reserves will be discovered, or by the year 2007 using the optimistic scenario. Proven reserves of dry natural gas are estimated at 160,000 MMCF in the Gulf of Guayaquil, and at 270,000 MMCF in the oil fields of the Oriente as a whole. Mineral coal reserves, as yet undeveloped, are estimated at 15 million TOE. In addition, there are substantial non-conventional resources such as biomass, geothermal and solar energy.

Evolution of the Structure of Energy Consumption

1.17 Demand for commercial energy in the period 1974-1986 has been substantially covered by hydrocarbons (an average of 93% of final consumption). In fact, in 1977, hydrocarbons met 94% of demand. In 1986 this fell to 92% because of greater supply of electric energy. In the composition of hydrocarbons consumption, the increase in the share of LPG is worth noting: from 1% of the total demand in 1984, it reached almost 6% in 1986, with a per capita consumption of 230 kg, noticeably higher than the mean for Latin American countries at a similar level of economic development (150 kg per inhabitant).

1.18 Electric energy production per inhabitant in 1987 was 540 Wh/year, lower than the mean consumption in Latin America (700-800 kWh per inhabitant per year). But electricity consumption per customer was 1,600 kWh per year, which is comparable to consumption levels of European countries such as Spain and Austria. It is still expanding (8.1% annual growth per year in the period 1965-1987), despite higher relative prices than hydrocarbons (in potentially interchangeable uses). For example, as can be seen in the following table, the cost of LPG and domestic kerosene, expressed as useful energy for cooking, is four times lower than the cost of electric energy and six times lower than firewood (especially because of the latter's low efficiency). In the industrial sector, on the other hand, and as motive power, electric energy expressed in useful terms costs twice as much as diesel used as fuel.

Table No. 1.2.
RELATIVE PRICES OF ENERGY IN HOUSEHOLD AN
INDUSTRY SECTORS YEAR 1987

	COST USEFUL ENERGY (1987 US$/TOE)	LEVEL OF RELATIVE COST (1)
HOUSEHOLD SECTOR (2)		
-Electricity	477	3.60
-Domestic kerosene	133	1.02
-L. P. G.	131	1.00
-Firewood	821	6.20
INDUSTRIAL SECTOR (3)		
-Electricity	477	1.86
-Diesel	1256	1.00

(1) Base: LPG in Household Sector; diesel in Industrial Sector.
(2) Used for cooking.
(3) Motive power.

Source: INE-Latin American Energy Organization and World Bank Study of Energy Sector.

1.19 Final energy consumption in 1986 was 5.1 million TOE, with a mean annual growth rate of 4% (1980-1986). This figure, which may be considered high, was due in part to significant modernization of the economy and to low domestic prices for petroleum products and electricity.

1.20 Transport leads all sectors in energy consumption, with 41% of total consumption in 1986, up from only 16% in 1974, and growing at a rate of 19%, encouraged by indiscriminate subsidies on the price of hydrocarbons. It is interesting to note that Latin American average consumption for the transport sector is 25% total consumption with a declining tendency over the medium-term. The commercial and public sectors absorb 31% of the 1986 demand, followed by industry with 18%, while agriculture, fishing, and others add up to the remaining 10%.

Institutional Aspects of Energy Policy Management

1.21 A Higher Council of Energy (CSE Consejo Superior de Energia) was established to coordinate energy policies with the development of the country's other economic sectors. The Council's chief functions are: to establish national energy policies and submit them to the President of the Republic; to approve and control the development of the Master Energy Plan prepared by the National Energy Institute; and to regulate energy sector activities. The Executive Director of the National Energy Institute acts as advisor without vote. This Council has not, to date, been operative.

1.22 The Ministry of Energy and Mines (MEM) is responsible for the implementation and supervision of energy policies. The National Energy Institute (INE) is in charge of formulating national energy policy and coordinating and orienting sector management. Planning, implementation, and monitoring and operations in the main subsectors have been entrusted to the two main sector enterprises: the Ecuadorian State Petroleum Corporation (CEPE) and the Ecuadorian Electrification Institute (INECEL).

INE

1.23 INE was created in September 1978 as an agency under the MEM. It comprises a Technical Council, an Executive Directorate, and a Technical-Administrative Office. The Technical Council, similar to a Board of Directors, has nine representatives from different government institutions and is presided by the MEM Undersecretary. Its main function is to establish INE's basis, guidelines, and strategies.

1.24 INE, as the planning, advisory, evaluating, and coordinating agency of the energy sector, is responsible for the preparation of the Master Energy Plan. It is also responsible for short, medium, and long range programs, to address such issues as the possibility of rationalizing energy consumption, fuel savings, and the conservation of the ecological balance. In addition, INE promotes research relating to the development, demonstration and transfer of technology of new, renewable and non-conventional sources of energy. Organizationally, it is composed of the Executive Directorate and the Directorates of Energy Planning and Development and of Financial Management. It has a staff of 59, of which 50% are higher level technicians.

1.25 As part of overall planning and coordination of the Energy Sector, INE chairs the Committee responsible for projecting Energy Demand. This committee was created by a Ministerial Agreement, and its purpose is to establish and update the most probable path of national energy demand. It is formed by representatives from CEPE, INECEL, the National Development Council, and the MEM. As advisor in the management of the energy sector, INE also coordinated the preparation of this study.

CEPE

1.26 The State Petroleum Corporation (CEPE) was established in June 1972 as an entity under the MEM. CEPE's Board of Directors is chaired by the Minister of Energy and Mines; other members include the President of CONADE, the Chief of Staff of the Armed Forces, the Minister of Finances, and the Minister of Industry. CEPE's administrative organization is made up of the Office of the General Manager, the Office of the Operations Manager (Production and Refining), the Office of the Marketing and Transportation Manager, and the Office of the Financial Manager.

1.27 In conjunction with its activities in the production, refining, transportation, and marketing of hydrocarbons, CEPE is a majority stockholder in the CEPE-TEXACO Consortium with 62.5% participation, the largest stockholder in the CEPE-CITY Association. It is also a minority shareholder in the ANGLO and REPRETROL Refineries, with 12.50% participation, as well as in Austrogas (LPG distribution) and in Empresa Siderurgica Ecuasider (steel). CEPE is Ecuador's most important company, with sales estimated at US$1,400 million in 1988 and with 4,200 employees, of which 12% are management and professional personnel.

INECEL

1.28 The Ecuadorian Electrification Institute, INECEL, was created in 1961 to take charge of Ecuador's electrification. INECEL, which is responsible for the generation, transmission, and distribution of electric energy, set up 17 electric power distribution companies organized as stock companies and is a majority shareholder in each. The Ecuadorian Electric Company (EMELEC) is not among these companies: it is a private company, with foreign capital, serving the Guayaquil market. INECEL is responsible for the generation and transmission of energy through the National Interconnected System (SNI). The Board of INECEL is composed of the Minister of Energy and Mines, who presides; the Minister of Finance and Public Credit; the Minister of Industry, Commerce, Integration, and Fishing; the President of CONADE; the Chief of Staff of the Armed Forces; a representative of the regional electricity companies; a representative of the Institute of Electrical Engineers; and a representative of the workers of the electricity companies. In 1986 INECEL had 2,546 employees, of which 37.5% were executive and technical personnel, and the electricity companies had 6,748 employees (excluding EMELEC).

Technical Aspects of the Hydrocarbons Subsector

Reserves

1.29 Reserves represent the estimated oil volume that could be commercially recovered at a given moment under existing technical and economic conditions. These estimates should be revised as production begins and as more geological and/or engineering information becomes available or as changes occur in the economic conditions of the evaluation.

1.30 Relative degree of uncertainty may be expressed by classifying reserves as proven or unproven. Unproven reserves have a lower probability of being recovered and may be further classified as probable or possible to denote the progressive degree of uncertainty.

1.31 Proven reserves remaining in the fields currently under production are estimated at 1,083 million barrels. There are an additional 71.4 million barrels from fields as yet undeveloped. Probable reserves (with a lower degree of certainty than the proven ones) are 647 MMB.

1.32 With these resources, Ecuador could continue exporting petroleum until the end of this century. By then it will have extracted approximately 1,150 million additional barrels from its present reserves.

1.33 Substantial increase in international oil prices and a temporary abundance of foreign currency in Ecuador during the 1970s led to diminished exploratory activity and a subsequent decrease in reserves.

1.34 After 1984 official reserves were increased gradually and noticeably, mainly because of changes in the recovery factor of the deposits and, to a lesser degree, because of the discovery or incorporation of new fields. Thus, from 882 MMB in 1983, official reserves were increased to 1,126 MMB in 1985; to 1,219 MMB in 1986; and to 1,557 MMB in 1987.

1.35 There is insufficient technical evidence to infer that the water injection process near the aquifer -- which maintains pressure in the Sacha and Shushufindi-Aguarico fields -- is generating additional secondary reserves, since these deposits are subject to strong natural hydrostatic pressure. Proof of this is the great repressurization that these fields underwent during the months after the 1987 earthquake, when both production and water injection were stopped.

1.36 Furthermore, except in the case of the Libertador field, discoveries in the past 15 years have been rather small (fields with reserves of 10-50 MMB), and especially of medium gravity crudes (15-25API).

1.37 Proven natural gas reserves are located in the Gulf of Guayaquil and in the Oriente region. In the former, the geological and tectonic complexity of the area is the reason for the uncertainty and diversity of reserve estimates. A study made in April 1988 by the INE-CEPE-NHD Inter-institutional Commission, sponsored by the European Economic Community, estimated proven dry natural gas reserves at the Amistad field at 160,000 MMCF, a volume which at present does not guarantee the field's commercial value.

1.38 It is expected that associated gas reserves in the Oriente, estimated at 270,000 MMCF, will run out at the same time as oil reserves. Geographic dispersion of the fields and high cost of production and gathering account for the failure to exploit all the associated gas.

Production

1.39 Ecuador's petroleum activities date to 1911 with the discovery of Ancon No. 1 Well in the Santa Elena Peninsula on the Pacific Coast. During almost half a century it was a net exporter of

petroleum, producing more than 100 million barrels by the time it entered a new oil era with petroleum exports through Balao, Esmeraldas, in 1972.

1.40 In the ensuing decade, production was maintained, with minor fluctuations, at approximately 175-210 MBPD. With the incorporation of the CEPE fields in the Northeastern Amazon region, production increased to 236 MBPD in 1983 and to 255 MBPD in 1984. As a result of the fall in international prices, an expansionist production policy was put into effect as a mechanism to compensate for decreased export revenues. Thus, production reached 278 MBPD in 1985 and 291 MBPD in 1986.

1.41 Following the March 1987 earthquake, pumping was suspended for several months due to the destruction of more than 11 km of the Transecuadorian Pipeline. Production that year dropped 40% to an average of 174 MBPFD, but if the exports by proxy of 14.5 million barrels made by Venezuela and Nigeria are taken into account, the decline in production was only 26% compared to 1986. Average daily production from January to April, 1988, has been 307 MBPD.

1.42 While in 1972-1973 production came from three fields of the Texaco-Gulf consortium (Lago Agrio, Shushufindi, and Sacha), current production comes from 23 fields, of which 22 are in the Amazon Region; 12 belong to the CEPE-TEXACO consortium; 7 belong to CEPE and 3 belong to the CEPE-CITY association. The other field is located in the Santa Elena Peninsula. It belongs to CEPE and includes the Ancon area subfields.

1.43 Of the country's total production, 99.68% comes from the Amazon Region. In this region, the CEPE-TEXACO consortium produces 78.31%; CEPE, 19.73%; and CEPE-CITY, 1.96%, as shown in the following table.

Table No. 1.3.

DISTRIBUTION OF AVERAGE DAILY PRODUCTION
(January-April, 1988, BPD)

FIELD	DAILY PRODUCTION (BPD)	NATIONAL CONTRIBUTION (%)
Shushufindi-Aguarico	110,990	36.23
Sacha	66,961	21.86
Others	61,972	20.22
Subtotal CEPE-TEXACO	239,923	78.31
Libertador	41,257	13.47
Others	19,176	6.26
Subtotal CEPE	60,433	19.73
Subtotal CITY	6,009	1.96
Subtotal Oriente	306,365	99.68
Peninsula	990	0.32
Total	307,355	100.00

Source: National Hydrocarbons Directorate.

1.44 Of the 439 wells drilled in the Amazon Region to date, 295 are currently producing. Of these, 67% produce by means of artificial lifting using pneumatic, hydraulic, and electric, and the rest produce by natural flow. The other 144 wells have been abandoned, closed down because of lack of flow or mechanical problems, or transformed into water injection wells. In the Santa Elena Peninsula, only 560 of over 1,800 wells drilled since the beginning of the century are currently in operation, producing 1,000 barrels of oil per day.

1.45 A great part of Ecuador's oil production continues to come from the Sacha and Shushufindi-Aguarico fields, which account for 74% of the CEPE-TEXACO consortium production, which in turn accounts for 78.3% of national output.

1.46 Given the 1,083 million barrels of proven reserves still in the fields which are being exploited and the average production for 1988 of 310,000 b/d, the ratio between the country's reserves and production is only 9.6 years.

Natural Gas

1.47 Since oil fields in the Orient are dispersed and some show very low gas/petroleum ratios, only the production of associated gas in the Shushufindi-Aguarico and Libertador fields could be economically feasible. Expected production of associated gas from those fields in 1988 is 53 MMCFD, decreasing to 38 MMCFD in 1995 and to 15 MMCFD in the year 2005.

1.48 The LPG extraction plant at Shushufindi is operating at 65% capacity (that is, 15 MMCFD) because of insufficient collection, but with an increase in compressing capacity, it could process 25 MMCFD by the beginning of next year. At full production, the plant could produce 3,600 BPD of LPG and 1,200 BPD of natural gasoline, besides 14 MMCFD of dry gas (part of which is being used at the present time for generation of electricity and reinjection).

Refining

1.49 Ecuador has five refineries, with a total capacity of 137 MBCD. The new Amazonas Refinery and the one already in existence in Lago Agrio are "topping" units which operate at full capacity (joint production of 10 MBCD to supply their area of influence). Recent modernization of the Esmeraldas Refinery, which has conversion units, has raised its processing capacity to 85 MBCD. In the Santa Elena Peninsula there are two refineries with "topping" units (ANGLO and REPETROL) with capacities of 34 MBCD and 8 MBCD, respectively.

Distribution Systems

1.50 The Transecuadorian Pipeline transports the crude produced in the Oriente to the Pacific Coast Terminal in Balao, near the Esmeraldas Refinery. The pipeline is 500 km long and has a nominal transport capacity of 320 MBPD. There is also a connection with the Colombian Pipeline, Puerto Asis-Tumaco, which makes the transport of an additional 50 MBPD possible. This capacity could, with a small investment, be expanded to 70 MBPD if necessary. However, if the optimistic exploration/production scenario is considered, the maximum expected level of production could reach 347 MBPD, that is, a volume below the pipelines' present transport capacity. LPG from the Shushufindi extraction plant and surplus gasoline from the Amazon Refinery are sent to Quito through a pipeline of 6.7 MBPD capacity. Petroleum by-products from the Esmeraldas Refinery are sent to Quito through a pipeline for clean products with a 56 MBPD capacity; to Ambato through another line of 14.4 MBPD; to the Guayaquil area by sea and to the north of the country by tank trucks. Refined products from the Anglo and Repetrol refineries are transported to the south of the country and to Guayaquil in tankers and tank trucks. One part of the products for Guayaquil is unloaded in Tres Bocas and pumped to Pascuales through a 108 MBPD pipeline. There are 16 tanker ships with a total capacity of 300,000 tons which are chartered for the export of crude and fuel oil and for coastwise shipping of oil and products.

1.51 Present storage capacity is 1.6 MMB, distributed among the nine main terminals, plus an additional 2.8 MMB in the refineries. However, there is currently a critical shortage of LPG storage, barely 8-days' supply at the El Salitral terminal and at the bottling plants (14 days' if storage at the refineries is included).

Demand for Refined Products

1.52 Present demand for refined products is approximately 91 MBPD and requires a throughput of crude of approximately 108 MBPD. This produces a 14-MBPD fuel oil surplus which is exported. The deficit in LPG production (4 MBPD) is imported through the El Salitral terminal in Guayaquil.

Domestic Prices

1.53 Domestic prices for petroleum products in Ecuador are established by the Law of Hydrocarbons, which specifies that these must be adjusted to the historical costs of production, processing, and transport, plus a reasonable profit margin. Present interpretation of the Law has resulted in very low prices, relative both to international levels (opportunity costs) and to domestic prices, because nominal products prices, readjusted very sporadically, have been rapidly eroded by inflation. Consequently, 1988 domestic prices for refined products are barely a third of world prices and, in absolute terms, are lower than they were in 1980.

1.54 This price policy has led to the development of a very active contraband trade in refined products. INE estimates that 10% of domestic sales of refined products (or approximately 10 MBD) are illegally exported to neighboring countries where prices are substantially higher.

Technical Aspects of the Electricity Subsector

Generation

1.55 Nominal installed capacity at the beginning of 1988 was 1764 MW, of which 1100 MW corresponded to the National Interconnected System and the remainder to regional companies. However, a more accurate figure would be 1444 MW of firm power because of the availability factor or other limitations of the installations. Of the firm power, 52% corresponds to hydroelectric power plants. Transmission losses reduce that power to 1320 MW, which was the available amount in the main substations of the interconnected system to cover a maximum peak demand of 1020 MW in 1987. A summary of the structure of generation capacity as of January 1988 is shown in Table No. 1.4.

Table No. 1.4.

STRUCTURE OF GENERATION CAPACITY (JANUARY 1988)
MW VALUES AT GENERATION

TYPE OF PLANT	INECEL		REGIONAL COMP. 1) 2)		TOTAL 3) PUB.UTIL.		RELATION IP/FP
	IP	FP	IP	FP	IP	FP	%
HYDROELECTRIC	725	660	165	103	890	763	85.7
THERMOELECTRIC	375	353	499	328	874	681	77.9
TOTAL	1100	1013	664	431	1764	1444	81.8

IP = Installed power FP = Firm power
1)Includes some small hydroelectric plants.
2)Includes EMELEC.
3)The Oriente, Galapagos, and Municipality groups are not considered.
(IP = 22 MW, FP = 15 MW)

Source: INECEL, Internal Report, 1988.

1.56 It is also possible to rehabilitate an important part of the existing thermal capacity of the regional companies.

Transmission and Distribution

1.57 At the end of 1988 the transmission system in service will still have a radial configuration. The sealing of the first ring of 230 kV, which has its three most important poles in the Paute power plant and in the loads of Quito and Guayaquil, is scheduled for 1989. The present configuration is not very reliable and requires the functioning of thermal groups from Guayaquil because

of voltage problems. The system has a total of 1734 km. of high tension transmission lines (615 km. of 230 kV and 1119 of 138 kV). The sub-transmission and distribution network has a total of 3300 km., the greater part at 69 kV.

1.58 The 17 distributing companies, together with a cooperative, operate the sub-transmission and distribution systems, bringing service to a total of 1,181,000 customers (as of December 1987). Furthermore, these companies and INECEL are carrying out, with IDB financing, a Rural Electrification Program, which will add 38,000 new customers by the end of 1989. In view of the present low tariffs, the program will result in additional financial losses for the companies and INECEL.

Losses and Consumption

1.59 Energy losses in the distribution networks are rather high, with an average of 17% (registered in Quito and Guayaquil) and a high of 32% in some companies. This is evidence not only of technical problems in the installations but also of ineffective mechanisms for metering and billing. Table No. 1.5 shows a summary of the development of the electric subsector.

Table No. 1.5.

SUMMARY OF BASIC DATA OF ELECTRIC SUBSECTOR
PEAK DEMAND FOR POWER (MW)
GENERATION AND SALES (GWh)

YEAR	1970	1980	1984	1985	1986	1987
Peak Demand (MW)	193	673	798	867	940	1020
Gener. (GWh)	822	3101	4220	4547	4975	5345
Hydro.	372	856	3207	3251	3978	4532
Thermal	450	2245	1013	1296	997	813
Sales (GWh)	662	2615	3290	3540	3831	4211
Residential	270	1050	1332	1390	1508	1660
Commercial	102	382	514	547	607	662
Industrial	210	930	1062	1193	1266	1360
Others	80	253	382	410	450	530
Consumption						
Own (GWh)		84	75	77	81	84
Losses (GWh)	160	402	855	930	1063	1050

Source: INECEL.

1.60 Consumption of electric energy has grown at an average annual rate of 10.5% over the period 1965-1970, of 14.3% between 1970-1980, and of 8% over the years 1980-1987. Hydroelectric participation in total generation, 85% in 1987, has increased greatly since 1983, with the start-up of the Paute-AB project which has 500 MW of installed power. Potential production of INECEL's three main hydroelectric projects in service as of June 1988 is 3840 GWh in a year of average hydrology and 3254 GWh in a dry year.

1.61 Market structure has remained relatively constant, with the highest consumption of electricity being mostly for household use (40% of consumption), followed by industrial use (33%). The distribution by company is asymmetric; industrial consumption is greater in the Guayaquil area (EMELEC). Energy sales by company and sector in 1986 were as follows:

Table No. 1.6

ELECTRICITY SUBSECTOR
MARKET STRUCTURE IN 1986 (1)
SALES (GWh) (%)

	E. E. QUITO		EMELEC		OTHER COMPANIES	
	(GWh)	(%)	(GWh)	(%)	(GWh)	(%)
TOTAL	1002	26.2	1490	38.9	1339	34.9
Household	440	43.9	530	35.6	538	40.2
Commercial	146	14.6	248	16.6	213	15.9
Industrial	287	28.6	586	39.3	393	29.4
Other	129	12.9	126	8.5	195	14.5

Source: (1) INECEL, Economic-Financial Studies Unit, Bank of Historic Data of Electric Power Market.

1.62 EMELEC accounts for almost 40% of total sales, and together with the Quito Electric Company, 65%; the remaining 35% is shared by the other 16 companies.

Table No. 1.7

NUMBER OF USERS - DISTRIBUTION BY SECTOR AND COMPANY
(December 31, 1987, figures)

1SECTOR	E. E. QUITO	EMELEC	OTHER COMPANIES	TOTAL
Household	223,606	197,681	581,723	1,003,010
Commercial	34,283	29,076	86,685	150,044
Industrial	4,789	3,602	8,257	16,648
Official instiutions	2,293	1,059	7,215	10,567
Other	1	1	829	831
TOTAL	264,972	231,419	684,709	1,181,100

Source: INECEL, DDC, Statistical Bulletin No. 22.

1.63 It is important to point out that of the total number of users, 85% are household and 1.4% are industrial. Together, EMELEC and the Quito Electricity Company have 42% of the total number of users. The volume of sales and the number of users of the remaining 16 companies are too low to justify the existence of so many different companies; a reduction in their number could improve efficiency, service quality and, possibly, could reduce costs.

Financial Aspects of the Hydrocarbons and Electricity Subsectors

1.64 CEPE and INECEL are financially dependent on the government. Oil revenues are administered by the government through an allocation system that leaves the Corporation (CEPE) with fewer funds than proper management requires. This situation leads to excessive dependence on government transfers, which are essentially stopgaps.

1.65 The pressure has reached such levels that it not only hampers the development of the Corporation but also jeopardizes the development of the oil industry as a whole, since CEPE cannot honor its financial obligations to third parties, particularly operating companies, such as Texaco and City, and service contractors.

1.66 This situation results from legal measures which, since 1979, have curtailed revenues by establishing a fiscal policy which drastically reduces CEPE's share of oil revenues. In 1983, with the establishment of ceilings in the sucre/dollar exchange rate, CEPE's share of those revenues was frozen, while the purchase of foreign currency for its expenditures was made at the considerably higher official exchange rate. In 1984 and 1985 these measures were again reinforced. In 1984 the freezing of CEPE's revenues from the sale of fuels was ratified, and in 1985 a new exchange rate ceiling was established. Finally, in 1986, any new revenues that CEPE might have obtained from new production or discoveries were blocked.

1.67 CEPE's financial situation between 1980 and 1983 showed a surplus, as not all budgeted funds were utilized (only 65% to 88% of budgeted expenditures). This situation rapidly worsened and by 1985 deficits began to appear. CEPE's financial situation grew critical in 1988, when for the first time in CEPE's history there was an operational deficit that reached almost 43% of the approved budget (using an exchange rate of 300 sucres/dollar in 1988). For the five-year period between 1988 and 1992, CEPE's financial situation is expected to become unmanageable: if the investments programmed in CEPE's five-year plan and the current system of oil revenue distribution are maintained, the accumulated deficit will be approximately $1,800 million.

1.68 These legal measures have rendered CEPE's four main activities unprofitable: export of oil from the CEPE-TEXACO consortium, export of oil from the Northeast, export of fuel oil, and sale of refined products in the domestic market. Only two marginal activities, the sale of lubricants and transport through the Transecuadorian Pipeline, are not subject to currency restrictions or a price freeze.

1.69 The impact of these measures until 1985 was partially offset by the increase in oil exports from the Northeast and by the occasional appropriations granted by the government as stopgaps. By 1986, however, the accumulated negative effects threatened CEPE's finances.

1.70 Since 1973, INECEL has received oil resources through the creation of the National Electrification Fund (FNE). The FNE served as the local counterpart in granting foreign loans for those

large investments that over the past 15 years have probably transformed this sector into the country's best public service.

1.71 In the past four years, FNE revenues have decreased drastically because of the country's economic crisis, the fall in world oil prices and the establishment of exchange ceilings, as shown in the following table:

Table No. 1.8

INECEL'S OIL REVENUES
NATIONAL ELECTRIFICATION FUND (FNE)

YEAR	MM US$ Royalties (theoretical)	MM S/. S/.66.50 to US$1 (exchange rate ceiling)	MM US$ (actual) at official change rate)
1980	126.4	3161	126.4
1984	120.4	8004	106.3
1985	142.0	9442	97.8
1986	86.7	5767	46.7
1987	53.3	3543	20.8

1) Figures supplied by INECEL (Current terms)

Source: INECEL.

1.72 The decrease in revenues has been exacerbated by other government economic measures, such as elimination of customs duty exemptions, increase in fuel costs, devaluation of local currency, freezing of foreign exchange rate (at S/.66.50/US$1) for FNE's royalties and, since June 1988, temporary freezing of the monthly tariff increase. The government has not compensated the reduction in oil transfers with a real increase in tariffs. This move would have ensured the covering of costs and the creation of surpluses, thereby allowing for part of the expansion program to be self-financed.

1.73 Tariffs have, in constant terms, been eroded since 1982. Factors unrelated to the subsector, such as the inflation and foreign exchange rates, as well as political interference in the setting of the tariffs themselves, have contributed to this erosion. The deterioration becomes much more noticeable when tariffs are stated in their U.S. dollar equivalent, which is needed not only to cover the foreign currency component in projects already underway but, more importantly, for the servicing of the debt. Thus, the tariff dropped from 5.12 U.S.cents per kWh in 1980 to 3.83 U.S.cents in 1987. The highest value was reached in 1981: 6.52 U.S.cents per kWh.

1.74 In December 1977, the subsector, including the electricity companies (except EMELEC), owned total assets (revalued) of 524 billion sucres with a net worth of 305 billion sucres. The long-term liabilities, on that same date, were 177 billion sucres, (at the exchange rate of S/.222 per US$1 at the end of the year); i.e., almost 800 million dollars. Servicing of the foreign debt in this same year was 94 million dollars, of which 78 million corresponded to INECEL.

Role of Conservation and Alternate Sources of Energy

Energy Conservation

1.75 There is ample potential for energy conservation in the various consumer sectors as well as in the energy supply system. The industrial sector is, after transportation, the main consumer of commercial energy, with 17% (1986) of final consumption. Non-metallic mineral industries consume the greatest amount of energy: cement (44% of the commercial energy of the industrial sector), followed by foodstuffs, including sugar and beverages (26% of commercial energy). Energy audits made by INE in the main energy-consuming industries, extrapolated to the whole sector, prove there is potential for substantial energy savings.

1.76 The transportation sector, the main consumer of final energy (41%), uses only petroleum products -- land transport consumes 66%; sea, 23%; air, 7%; pipelines, 3%; and the railroads, 1%. The greatest potential savings in the sector would lie first in the transportation of cargo through the improvement of the efficiency of the units and an increase in the utilization factor and in the size of the units; and, second, in light transportation through the improvement of vehicle efficiency and size reductions.

1.77 It is possible to transport substantial quantities of energy and to improve the quality of service in public transport through an increase in engine efficiency and in the size of the units serving the main urban routes.

1.78 Maritime transport shows a growth in energy consumption between 1979 and 1984 of more than 200%, which seems excessive. Furthermore, fuel consumption per unit of transported cargo is far above international levels. Therefore, potential for saving does exist, and a detailed study of the situation is required.

1.79 The household sector also shows potential for energy saving. In urban areas, the main line of action could be to improve the efficiency of locally-made equipment, taking into consideration the limitations of local industry. Also, consumers should be informed about using particular appliances during particular hours so as to lower the peak demand for electricity. Finally, when economically justifiable, electricity could be partially substituted by other sources, such as solar energy.

1.80 In rural areas, firewood provides the main source of energy for cooking. Traditional stoves are inefficient, creating a demand for firewood that is higher than it should be. Firewood, moreover, is in limited supply in the central provinces and in Loja. This situation contributes to the problems of deforestation and soil erosion. Programs for the dissemination of efficient stoves, reforestation, and the promotion of alternative fuels, could help solve the energy problem facing some of the country's rural areas as well as contribute to the conservation of the environment.

Alternate Sources of Energy

1.81 The development and dissemination of alternate sources of energy and their technologies could help improve energy supply conditions. Since 1980, INE has developed a broad educational program on alternate sources of energy and on research, adaptation and demonstration of new technologies.

1.82 Small hydroelectric power plants, with locally-made equipment, could probably serve as an economic alternative, especially in isolated rural areas. Technology is available for the low cost construction of turbines (up to 150 kW, can be expanded to 300 kW), switchboards, and control systems, which have already been tested in operating installations.

1.83 Solar heating for water is a mature technology in Ecuador, and one already established as a commercial activity. Estimated current capacity for solar collectors production is 10,000 a year. Furthermore, passive solar energy offers important savings potential in mechanical air conditioning systems. Photovoltaic systems, which use little energy, could be an alternative. The systems could be applied in areas of social importance, such as health and communication in remote places. Once the prices of conventional sources are set at or nearer to their economic costs, other non-conventional sources, such as biomass, wind, and geothermal energy, could play minor specific roles.

1.84 The excessively subsidized prices of conventional energy make alternate sources of energy, as well as energy conservation, economically unattractive to consumers. The legal structure of the sector, through its institutional organization and allocation of large public resources, promotes centralized energy systems against decentralized ones. It also emphasizes the growth of energy supply, placing little emphasis on end-use efficiency, and does not encourage self-generation or co-generation by the producers, which could, at times, generate energy at lower costs.

Energy Scenarios

1.85 In analyses of the probable trends of the future growth of the economy, petroleum exports are expected to constitute the explanatory variable of the behavior of GDP, both in the short- and the medium-term.

1.86 To this effect, two basic scenarios have been designed which take into consideration the following: the middle output projection which will be analyzed in detail in Chapter 4, a single refining structure to define refinery throughput and the exports of refined products; and two estimates, by CEPE and by INE, of domestic demand for hydrocarbons. The incorporation of the international oil price variable takes into account a high and a low hypothesis of the evolution of these prices to establish the impact of oil exports on GDP.

1.87 Production projections and their behavior over time have been estimated according to three scenarios: pessimistic, in which maximum output (295 MBPD) would be reached this year (1988) and would later decline; optimistic, according to which output would reach 347 MBPD in 1994; and the middle or expected one, with a peak output of 312 MBPD in 1989. This last profile, used to calculate the impact of oil output on GDP, reflects the most probable (expected) reserve estimate, 1,100 million barrels as of December 31, 1987. An additional 568 MMB are expected to accrue from the exploration program which 13 international corporations are carrying out at a cost of about $400 million between 1988 and 1993.

1.88 Assuming that the installed refining capacity remains at the level of 1987 throughout the five-year period of this analysis, the average refinery throughput for the scenarios has been estimated at 118 MBD in 1988 and 125 MBD in 1992.

1.89 As to prices of hydrocarbons, which determine domestic demand and the value of exports, the following considerations have been made. The demand projections, made by CEPE (March 1988) and by INE (May 1988), do not take into account the effect of elasticity (price or income) of demand. The reductions in consumption resulting from increasing the price of refined products in the domestic market, in a range of 100% to 250%, will add to the exportable hydrocarbons surpluses. These additional surpluses seem to be included in INE's estimate of exportable amounts, which are higher than CEPE's.

1.90 Two scenarios have been considered for international oil prices: the first is based on World Bank estimates forecasting an Average Annual Growth Rate of 8.6% for the period 1988-1995 and of 7.6% for the period 1988-2000; the second, a more optimistic scenario with price increases a year in advance, shows average growth rates of 9.8% and 8.2%. As the following table shows, the two scenarios imply relatively stable real prices during the five year-period (1988-1992) without any significant real growth in oil prices.

Table No. 1.9

HYDROCARBONS SUBSECTOR
SCENARIOS FOR EXPORT PRICES
CURRENT US DOLLARS PER BARREL

YEARS	LOW SCENARIO	HIGH SCENARIO
1988	14	14
1989	14	15
1990	15	17
1991	17	19
1992	19	21
1993	21	24
1994	24	25
1995	25	27
1996	27	29
1997	29	30
1998	30	32
1999	32	34
2000	34	36

Source: Work Group, World Bank.

CHAPTER II

ANALYSIS OF ENERGY SECTOR PROBLEMS

Introduction

2.1 The preceding chapter showed at length how energy sector problems can have a substantial impact on the economy as a whole. This chapter will provide a comprehensive discussion of those problems, although it may go beyond the boundaries of the sector and delve into macroeconomic issues.

2.2 The problems will be discussed in the following order:

(a) Hydrocarbons

(b) Electric Power

(c) Conservation and Alternative Sources of Energy, and

(d) Institutional Management of the Sector as a Whole

Hydrocarbons

The Drop in World Oil Prices and in Real Domestic Prices of Hydrocarbons

2.3 The drop in oil prices in late 1985 created a multitude of problems for Ecuador. In the first place, the balance of payments suffered a tremendous setback, since the value of oil and refined product exports fell from US$1927 million in 1985 to US$982 million in 1986 and to US$817 million in 1987. Although prices recovered slightly in 1987, the earthquake that year interrupted oil exports. These were partially offset by Venezuelan and Nigerian oil loans (that are being repaid in 1988).

2.4 Declining world petroleum prices and the suspension of oil exports also had a substantial and negative impact on public revenues. The share of oil income in total public revenues dropped from 52.6% in 1985, to 41.5% in 1986 and to 31.7% in 1987.

2.5 At the same time, the domestic price of refined products plummeted due to inflation and depreciation of the sucre. Current prices of refined products are substantially lower than international prices (33% of the CIF price plus transport and distribution costs, in 1988). From 1981 to 1987 this ratio rose from 21% to 46% only because of declining international oil prices. This is explained by the fact that, under the Hydrocarbons Law, refined product prices are based on historical costs, and

therefore, domestic prices of crude are barely 50% of international prices. Moreover, the periodic readjustments required by inflationary conditions have not been made. Although refined product prices were raised four times this decade, they remain low when compared to international prices and currently rank among the lowest in Latin America and in the world.

2.6 Thus, the weighted average price of refined products, in real terms, dropped by one third in 1988. It fell from 58 sucres/gallon in 1987 to 39 sucres/gallon in 1988, due to the 50 percent inflation (in 1987 sucres) estimated for those years. As a result of this unfavorable situation, domestic consumption is on the rise, while production remains at a level that cannot be significantly increased in the short-term (see Section A.3 for production, domestic consumption and export projections).

2.7 The average price of refined products in Ecuador (in 1987 dollars) has ranged from 10 to 12 dollars/barrel throughout the present decade. Given the lack of readjustments, by 1984 prices started to drop, falling to US$8.1 per barrel in 1988, the lowest level of the decade, except for 1980.

2.8 Prices of refined products, with the exception of premium gasoline which reached its international price in April 1987, have been subsidized since 1980. During this period, the real price of LPG fell 53%, making LPG, once the country's most expensive product, its most heavily subsidized one. Until mid-decade, the price of diesel fuel was below the average price of refined products and at present, it costs only 60% of the price of premium gasoline. This causes a very serious distortion that will certainly grow, as this product faces supply problems in the short-term. The price of fuel oil has remained at 60% of the average price over the same period.

2.9 Current prices for refined products in Ecuador have caused substantial losses because of contraband trade (estimated by INE to be 10% of consumption, i.e., around 8000-10000 barrels per day). July prices for premium gasoline and diesel were a quarter of Colombian prices. Based on opportunity costs, and keeping the Hydrocarbons Law profit margins, the subsidy (including benefits foregone) for refined products in Ecuador is an estimated US$620 million in 1988.

2.10 Prices of refined products in Ecuador face a major constraint: the interpretation of the Hydrocarbons Law, according to which prices shall only cover historical costs including a reasonable non-specified profit. This makes it impossible to consider other cost concepts, such as: replacement costs, reserve depletion margins and opportunity costs.

2.11 According to econometric research work done for this study, it is estimated that a 10% increase in oil exports (due to lower domestic consumption and the elimination of contraband) could add approximately 1% to annual GDP.

Reserves, Output, Domestic Demand and Exportable Surplus

2.12 In June 1988, production of crude averaged 307 MBPD, while daily consumption (including contraband) totaled 107 thousand BPD, leaving an exportable surplus of approximately 200 BPD.

Reserves

2.13 Ecuador's oil industry is based on a fragile reserve structure, given the present and future needs for this non-renewable resource. Proven reserves have been falling from 1500 MMB in 1972, to 1023 MMB in 1979 and then to 882 MMB in 1983. But a modest though gradual improvement (1083 MMB) has been observed over the 1984-1987 period, mainly due to the better-than-expected performance of two of the major Oriente fields, Shushufindi-Aguarico and Sacha. Proof of this is the repressurizing of the deposits, caused by the natural pressure of water while the wells were shut down in the wake of the March 1987 earthquake. At the same time, the reserve/production ratio decreased from 55 years in 1972 to 15 years in 1979, to 11 years in 1983 and to 9.6 years in 1987. From 1972 to 1987 the Oriente fields produced 1186 MMB of oil. Associated natural gas reserves are estimated at 270,000 MMPC.

2.14 Official proven reserve figures were substantially raised from 882 MMB in 1983 to 1557 MMB in 1987, alleging improved recovery in the two above-mentioned fields through water injection in the "U" and "T" sands of the Napo formation. This explanation has no sound technical basis, as it is difficult to conceive secondary recovery in deposits that are subject to an active natural hydrostatic push.

2.15 According to the National Directorate of Hydrocarbons (DNH), discovery of new fields in the 1972-1987 period yielded additional reserves of 378 MMB versus a cumulative production of 1186 MMB. This implies an apparent decline in the probability of major discoveries. Exploration costs, meanwhile, are climbing as deeper drilling is required in more distant areas, under less familiar geological conditions.

2.16 Replacement cost of a new barrel in the North Oriente is estimated at 7.5 US$/bbl. It increases to 10.2 US$/bbl in the Central Oriente and to 13.7 US$/bbl in the South Oriente, as against a selling price of 12.7 US$/bbl at the end of June 1988.

2.17 To make up for diminishing reserves, legal and tax reforms were implemented early in the decade to attract foreign companies. Starting in 1986 these corporations -- under 13 Service Contracts -- have launched an intensive exploration effort, with a $400 million investment commitment that includes the completion of 20,000 km of seismic lines and 50 wildcat wells until 1992. Hydrocarbons have been found in 9 of the 12 wells drilled by these companies. The DNH evaluates the discoveries at a modest 20 MMB of proven reserves and 115 MMB of probable reserves. It is evident that a good part of Ecuador's short- and medium-term oil future, as well as CEPE's capacity to finance exploration, will depend on the results of this exploration endeavor.

2.18 According to this work group's projections, Ecuador will extract nearly 1150 MMB by the year 2000. To replace these reserves would require intensive exploration efforts in which international companies would be necessarily involved (to supplement CEPE activities). This is all the more apparent when considering that future discovery of new fields would need to triple the historical trend. Increasing investments, moreover, must be made in field development and in optimizing oil extraction in order to recover probable reserves of the order of 670 MMB.

2.19 With regards to natural dry gas, the only discovery thus far is the Amistad Field, located southwest of Puna Island in the Gulf of Guayaquil. The area's geological and tectonic complexity and the limited data available account for the uncertainty and the diversity of the reserve estimates. A recent study (April 88) prepared by an INE-CEPE-DNH Committee, sponsored by the European Economic Community, estimated proven reserves at 160 thousand MMCF. This volume is insufficient to ensure the commercial value of the field, which would require a minimum 365 thousand MMCF, that is, a daily production of 50 MMCFD over 20 years.

2.20 Should the necessary reserves exist, it is estimated (in a study conducted by SOFREGAZ) that there is a market in the industrial zone of Guayaquil for 38 MMCFD, 22 million of which would be used to replace oil in industry and 16 million for thermoelectric power. Thermal energy consumption would increase to 42 MMCFD in 1992 and to 48 MMCFD in the year 2000. There would be other potential markets in the refineries of the Peninsula (4.7 MMCFD) and in industries of the Chanduy and Posorja areas (8-14 MMCFD). No consideration has been given to the use of gas in industrial projects (fertilizers, steel and iron industry). These activities do not appear economic. In short, there is a significant potential market for natural gas in Guayaquil and in the Santa Elena Peninsula.

Oil Output

2.21 Current oil output is 307,000 b/d and is approaching the highest historical levels and the Trans-Ecuadorian Pipeline's maximum operating capacity of 320 MBPD. Should any substantial discovery take place, output could be transported to Colombia through the pipeline branch, which has a current operating capacity of 50 MBPD, and which could be increased to 70 MBPD at little additional cost. The foregoing analysis suggests that there is no need to expand the capacity of the Trans-Ecuadorian Pipeline because the peak output expected in the optimistic scenario -- 347 MBPD in 1994 -- would be below the combined capacity of the Ecuadorian and Colombian pipelines.

2.22 Ecuador's increasing oil output over recent years is not commensurate with the limited number of discoveries of new reserves. A large part of the country's production continues to depend on the Sacha and Shushufindi fields, which have so far been responsible for 74% of the CEPE-TEXACO Consortium, which in turn, accounts for 78.3% of national production.

2.23 Unless substantial new reserves are discovered, Ecuador will soon reach its peak output levels. It is most probable that output will continue to decrease consistently until the year 2000, when it will drop to 145 MBPD, close to domestic requirements and leaving little to export.

2.24 According to CEPE's demand projections and considering this study's medium-range scenario for the discovery of new oil reserves, Ecuador will become an oil importer around the year 2002. Considering the optimistic scenario, net imports would be needed around 2007.

2.25 Future output will come from increasingly distant and scattered fields, with mounting investments and operating costs. This prediction takes into account CEPE's bringing onstream the Coca, Payamino, Paraiso, Tiguino and Pucuna fields.

CEPE's Financial Difficulties

2.26 From the very beginning, CEPE's activities have been self-supporting. Funds derive from the company's entrepreneurial undertakings, from its shares in producing companies such as TEXACO and CITY, and, since 1985, from increasing government allocations of proceeds from domestic sale of refined products. By law such proceeds belong to the General Budget of the State. When in 1987 the pipeline suffered damages, CEPE received an $80 million capital contribution financed by a World Bank loan to the Ecuadorian Government. In general, however, CEPE's financial resources originate, either directly or indirectly, from its own business activities.

2.27 Table No.2.1 depicts the structure of CEPE's budgeted income from 1988 to 1992, under the following assumptions: recommended output projection; demand as projected by CEPE; domestic and foreign inflation and monetary devaluations assumed by the World Bank within the framework of the present study; international oil prices (downward trend); investments as under the Five-Year CEPE Plan; and adjustments in the prices of refined products according to the Hydrocarbons Law.

2.28 Although crude oil sales to refineries is the main income item, this is a mere accounting entry, for the same amount is allocated to CEPE crude oil purchases for the refineries (Table No. 2.2). Proceeds from sales of refined products represent the most significant income item. They are followed by crude oil and fuel-oil exports, income from pipeline transport services, and finally, income from shares in other companies. Income from compensatory crude is quite significant in 1988, owing to repayment of the crude oil borrowed from Venezuela for the domestic market in 1987. It should be noted that the domestic price of the compensatory crude is the only one received by CEPE in full, at the official controlled exchange rate of the Central Bank. From 1989 on, compensatory crude income will decrease due to reduced imports of refined products (which are paid with crude) and the completion of the repayment of the oil loan to Venezuela.

Table No. 2.1

BUDGETARY INCOME STRUCTURE
(in millions of 1987 dollars)

	1988	1989	1990	1991	1992
Income from shares in other ventures	2	1	1	1	0
Crude and Fuel-Oil Exports	55	51	46	39	34
Transportation of Crude	33	31	28	27	25
Sales of Refined Products	107	89	77	70	66
Refinery Throughputs	188	201	209	218	229
Compensation	85	30	20	27	27
Other	10	0	0	0	0
Total Income	479	403	380	382	381

Source: CEPE Five-Year Plan.

2.29 With regards to expenditures, other than the above-mentioned expenditure item (purchase of its own crude for the refineries), the main item is investments or capital expenditures, which in 1987 totaled 1100 million dollars, according to CEPE. The second most important item is the purchase of crude from TEXACO and CITY for the domestic market, followed by ANGLO refining tariffs, the purchase of refined products from REPETROL and inputs for the Esmeraldas Refinery. Another significant item is CEPE outlays in CEPE-TEXACO operations. On the whole, oil production operating and administrative costs are not very significant. Debt servicing for 1988 (based on existing outstanding debt) amounts to 10% of current expenditures.

Table No. 2.2

STRUCTURE OF BUDGETARY EXPENDITURES
(in millions of 1987 dollars)

	1988	1989	1990	1991	1992
CEPE in the Consortium	55	52	49	47	44
Pipeline Operation	17	16	16	15	14
CEPE-Own Output	18	36	50	48	63
Externally Marketing	5	5	5	5	4
Administration	28	26	25	24	24
Crude Purchases from CEPE	213	201	208	218	229
Crude Purchases from Comp.	62	61	62	66	74
Refining	66	66	64	61	55
Lubricants	5	4	3	2	2
Total Operating Expenses	468	467	483	487	510
Debt Servicing	51	66	67	63	55
Total Current Expenditures	519	533	549	550	565
Capital Expenditures	176	234	287	290	112
TOTAL EXPENDITURES	695	767	836	840	677

Source: CEPE Five-Year Plan and Working Group estimates and calculations.

2.30 Although it is likely that investment can be reduced (especially in processing and transport/storage, where substantial investments were recently made, and where domestic demand will tend to drop because of rising domestic prices and declining economic activity), the financial situation is obviously untenable. The underlying reason is that three of CEPE's four major activities are running at a loss. CEPE incurs losses on domestic sales of refined products, since there can be no cost recovery, and in the export of crude and refined products (fuel-oil) due to the rate of exchange ceilings of 44 sucres/dollar on which its income is based. Its fourth activity, exports of crude from the North Oriente fields, showed a slight surplus this year but will also run into a deficit as of 1989. Furthermore, CEPE's external indebtedness for 1988 totals US$289 million while its internal debt is S/.3000 million. The cumulative deficit for the 1988-1992 period amounts to 1900 million dollars, that is, 46% of its budget. Considering that the operational deficit (excluding investment) is 19%, CEPE would be unable to service the debts already contracted.

Table No. 2.3

CEPE: BUDGETARY INCOME AND EXPENDITURES
1988-92 IN 1987 DOLLARS

	1988	1989	1990	1991	1992
Current Income	479	403	380	382	381
Current Expenditures	519	533	549	550	565
Current Deficits	40	130	169	168	184
Investments (1)	176	234	287	290	112
Total Deficit (2)	216	364	456	458	296

(1) Includes US$186 million to modernize the Peninsula refineries, which amount had been omitted. Expenses are broken down as follows: US$39 million a year in 1989-1990; US$98 million in 1991 and US$10 million in 1992.

(2) For the year 1988, 50% of investment has been financed with external loans that have reduced the deficit.

Source: CEPE and Working Group estimates.

2.31 CEPE's financial situation is due to falling income resulting from legislative measures begun in 1980 and adjusted in 1982 and 1985. These measures, in turn, reflect the overall decline in oil revenue caused by lower oil prices.

2.32 Key factors responsible for CEPE's financial woes are: first, non-recovery of costs in the different stages of processing due to legal provisions and exchange rate ceilings that freeze its sucre income; and second, requirements whereby CEPE expenditures (70%) are made in dollars at the Central Bank's managed market rate (250 sucres/dollar in June 1988).

2.33 Assuming present allocation of oil revenues and an improvement in the four key variables affecting the Corporation's budgetary balance--(a) international oil prices; (b) price of refined products for the domestic market; (c) oil production; and (d) monetary devaluation--,CEPE's financial condition

will not improve. In the case of the last two variables, indeed, budgetary imbalance will worsen. As a result, CEPE's economic position for the immediate future will grow more critical. The company must either stop all investments or change its system of oil revenues distribution.

CEPE's Financial Future if the Present System of Allocating Oil Revenues is Maintained 1/

2.34 Table No. 2.4 provides a sensitivity analysis of CEPE's financial position for the five-year 1988-1992 period, considering variations in international oil prices, in refined product prices for the domestic market, in oil output, and in exchange rates.

Table No. 2.4

SENSITIVITY OF CEPE'S BUDGET DEFICIT TO 10% INCREASES IN FOUR MAJOR VARIABLES

VARIABLE	Deficit Decrease (-) Increase (+) MM SUCRES	PERCENTAGE VARIATION AS AGAINST THE CURRENT DEFICIT
- Refined product prices	- 2735	- 2.6%
- Oil output	+ 2364	+ 2.2%
- Exchange Rate	+ 9630	+ 9.0%

Source: Work Group.

2.35 The deficit is virtually insensitive to a 10% increase in international oil prices, due to CEPE's limited share in oil and fuel-oil export earnings. CEPE's income therefore remains constant, at some 50 million dollars a year. No improvement in CEPE's income can be expected from future increases in international oil prices.

2.36 A 10% variation in domestic fuel prices, as indicated above, will not significantly alter CEPE's income, given its determined fuel sales market share. Any fuel price increase or reduction would primarily affect the General Budget.

2.37 An expansion in oil output would generate a larger budget deficit, as unit cost of production in the new fields cannot be recovered due to the exchange rate ceilings.

2.38 Monetary devaluation represents the worst threat to CEPE's finances. This is because CEPE computes sucre income at a constant exchange rate when company expenditures are effected at the

1/ Oil revenues as used in this paper mean the gross value of domestic and foreign sales of crude and refined products. Oil rents, of course, refer to the economic surplus, which is the difference between income and costs.

managed market rate. Continuing devaluations will prove the major reason for CEPE's financial failure in the next few years if the current system of oil revenue allocation is maintained.

2.39 CEPE has proved unable to recover its operating costs, let alone generate resources for new investments, because of the many legal measures affecting the allocation of oil revenue, and, too, because of developments in the national economy. Its external debt totals $289 million in 1988, but will reach $344 million in 1989 and $300 million in 1990. By 1992, it will drop to 196 million, (excluding any additional borrowing during the 1988-1992 five-year period).

Analysis of Problems in CEPE's Investment Program

2.40 CEPE's investment program needs to be further prioritized. Each department submits its program separately, without taking into account either CEPE's situation or the country's general economic situation. This is evidenced in CEPE's Five-Year Investment Program of June 1988.

2.41 Recent large-scale investments have been undertaken in processing (especially refining), and thus this area's requirements will not be a high priority in coming years. This is especially true when considering that demand could drop because of decreasing economic activity, and because of possibly substantial price increases. In view of the reserve situation mentioned earlier, investment efforts should concentrate on exploration and production. CEPE's investment program, however, places emphasis on processing and transport projects, which together represent 64% of the total investments. Moreover, the processing investment program contains a multitude of programs with no established economic or social priorities. Given present economic troubles, this situation should be reviewed and corrected.

Table No. 2.5

CEPE: INVESTMENT PROGRAM
(in millions of dollars)

	1988	1989	1990	1991	1992	TOTAL
Exploration	9	20	21	15	16	81
Production	77	52	44	43	43	259
Processing (a)	10	76	133	158	34	411
Transport and Storage	67	75	80	64	10	296
arketing & Other Services	14	12	10	10	9	55
TOTAL	177	235	288	290	112	1102

(a) This includes the US$186 million to modernize the Peninsula refineries that were not covered in the investment program, although the works were included. It is assumed that the investment schedule will be as follows: US$39 million per year in 1989 and 1990; US$98 million in 1991 and US$10 million in 1992.

Source: CEPE and Work Group estimates.

Exploration

2.42 Exploration investments shown in the CEPE Plan and those proposed in this study differ as follows:

- Under CEPE's Plan, only 14 wildcat wells and 5000 km of seismic would be made, whereas this study's proposal calls for 23 wells and the same 5000 kilometers of seismic. In CEPE's Plan, each well costs US$800,000, whereas in this proposal, the cost is estimated at US$2 million, a figure more in line with recent experience.

- The above changes in the Five Year Investment Program result in a US$32.1 million increase in exploration investments.

Exploration Investments by Oil Companies

2.43 Exploration investments by the service companies are greater than those established in the respective contracts. Higher seismic and drilling costs account for this. During the years 1985 through 1988, there was a 40% increase above committed investments. This additional percentage was applied to investments for the 1989-1992 period.

Production

2.44 Production investments provided for in CEPE's Program and those proposed in this study differ as follows:

- Under CEPE's Program, 16 fields would be developed, with the drilling of 70 wells, at a cost of US$660,000 per well. Artificial lift would be carried out in the Libertador, Bermejo Sur, Tetete-Tapi, and Cuyabeno-Sansahuari fields.

- The proposed investment program leaves out the development of 8 wells included by CEPE but incorporates other fields: Capiron, Tivacuno, Curaray, and Primavera. Investment estimates are based on the amount of investment per barrel of Initial Peak Production (IBIPP), according to the models used by CEPE to assess investment in the North Oriente, South Oriente, and Central Oriente. These investments are roughly $3500/IBIPP in the North Oriente, $5500/IBIPP in the Central Oriente, and $8300/IBIPP in the South Oriente. Figures cover all investments in drilling, in production and storage facilities, in opening roads and laying flow lines.

- No provision has been made for investments in the probable substitution of the gas-lift system by other artificial lift systems when the water cut in the wells increases. It is, however, appropriate to point out that the estimated amount for each well is around

$500,000. The proposed production plan for the five-year period requires $80.7 million more than CEPE's Program provides for.

Processing: Refining and Use of Gas

2.45 These undertakings involve investments that are required to meet domestic demand for refined products. Forecasts are that the growth rate of demand for refined products will be 3.6-4.7% a year throughout the 1988-1992 period according to INE and CEPE projections. According to the two demand projections, the refineries would have a fuel-oil production surplus for export and a LPG shortage that would have to be covered by imports.

2.46 Table No. 2.6 summarizes the refinery throughputs estimated by CEPE in order to satisfy the domestic demand for refined products. It also includes the fuel-oil exportable surplus and the amount of LPG to be imported.

Table No. 2.6

REFINERY BALANCES
(in thousands of barrels per day)

	1988	1989	1990	1991	1992
Refinery Throughputs	108	112	117	121	125
Refined Product Production	105	110	115	119	123
Refinery Consumption	5	5	5	5	5
LPG Prod. (Oriente)	2	3	4	6	6
Exportable Fuel-Oil	14	14	15	16	19
LPG Imports	4	3	4	3	5

Source: CEPE demand projections for refined products.

2.47 Current demand for refined products includes approximately 10% of petroleum products that are illegally exported because of low domestic prices. This contraband could be totally eliminated with a more rational price policy.

2.48 Ecuador's total refining capacity suffices to supply refined products, except for LPG, during the next 5-7 years (depending on the demand behavior). If product prices were increased and maintained at a more reasonable level (that is, at the level of replacement of used reserves or of international prices), superfluous consumption and contraband trade would be minimized, and installed capacity would cover from 7 to 9 years. Considering that three years are required to build or expand a refinery, the first year of investment would fall outside of the five-year period studied in this paper.

2.49 CEPE's Five-Year Investment Program allocates only US$6 million to modernize the Peninsula refineries, but US$192 million are required for conversion units in those refineries. This project would reduce fuel-oil exports by 35% starting in 1993 and produce LPG and gasoline. The world

oil supply situation in the short-term does not provide sufficient economic incentives for the construction of new refineries or for the expansion of high-conversion facilities, as compared with the importation of products.

Gas Plants

2.50 With regards to the associated gas in the Oriente fields, the LPG extraction plant in Shushufindi is operating only at 15 MMCFD (approximately 60% of its gas-processing capacity). It is being expanded by the addition of three new compressors that will make it possible to attain the maximum capacity of 25 MMPCD.

2.51 CEPE is preparing an LPG extraction project with a 15 MMCFD capacity for the Libertador Field at an estimated cost of US$31 million. It is anticipated, however, that gas production in this field will decline rather quickly, as shown in the following table. Consequently, the limited availability of gas suggests that the plant may be oversized and that its economic justification could be impaired. Alternatives suggested for consideration include the fractionation of the liquids extracted at the compression sites where gas is reinjected.

Table No. 2.7

PROJECTED GAS PRODUCTION
(in millions of cubic feet per day)

	1989	1990	1991	1992	1995	2000
Libertador Field	12.9	12.9	12.9	11.8	9.2	6.1

Source: Work Group Estimates.

Other Industrial Projects

2.52 CEPE, in its Five-Year Program, has budgeted US$172.8 million for investments with other companies to manufacture special products (aromatics, solvents, basic oils for lubricants/paraffin, methanol and ammonia-urea). Most of these investments (US$147.6 million), are for a lubricating oil plant. Whereas the solvent plant could provide good economic returns, aromatics and methanol will probably give only marginal returns. Basic lubricating oils and the ammonia/urea plants are not economically sound projects, given the size of the plants and the international market prices for those products. CEPE has budgeted US$5.6 million to study the need for an asphalt plant in the Amazonas Refinery and a fertilizer ammonia/urea plant in the Oriente. There is no justification for a new plant, since the Esmeraldas Refinery has adequate asphalt capacity. Although gas is available in the Oriente, a fertilizer plant should be located in the areas of greatest consumption. There is no justification for a small-sized ammonia/urea plant in light of current and projected international prices for import of these products.

Transport and Storage

2.53 Two major problems emerge in this area. The first is the lack of LPG storage capacity, especially in the southern region of the country, and particularly in Guayaquil. The second is that several projects are now underway and will very probably have to reach completion, unless they can be discontinued without substantial losses (for example, if materials and/or equipment already purchased for the Monteverde-Manta Products Pipeline can be used in other more profitable activities).

LPG Transport and/or Storage Projects, Under Consideration or Implementation

(i) Expansion of the Tres Bocas Terminal and construction of the fuel-oil and LPG transfer lines for storage at El Salitral, with a subsequent fuel-oil extension to the INECEL plant. This project includes two fuel-oil tanks. It is considered necessary, since the beltway around Guayaquil will block access to the formerly used wharfs (US$3.1 million).

(ii) LPG storage expansion in the El Salitral Plant ($23.6 million). Current LPG storage facilities in Ecuador are insufficient, particularly in the Guayaquil area, which has a mere 5 days of reserves and could be left without supplies. Nearly 4 MBD of LPG are imported via Guayaquil, while an additional 2 MBD are brought from the Esmeraldas Refinery in tank trucks. An LPG tanker has been leased as floating storage.

(iii) Supplementary works for LPG-bottling plants ($7.2 million). LPG distribution is a private business; for project iii, consideration could be given to limiting CEPE activities to bulk sales.

Other Transport and Storage Projects Under Consideration

(i) Clean-products pipeline from Libertad-Monteverde-Manta and Monteverde-Pascuales. It includes a seaport terminal and storage facilities for clean products in Monteverde with nine new tanks ($44.1 million). Bids for construction will be received in September, and it will be entirely financed by the Government of Argentina.

(ii) Clean-products pipeline, Pascuales-Naranjal-Cuenca and Naranjal-Machala ($63.3 million).

(iii) New packaging plant for lubricating oils ($78.6 million).

(iv) Expansion of Trans-Ecuadorian Pipeline ($2.7 million).

Of these projects, some of which are at the planning/design stage or are now underway, none have been prioritized. The projects total almost $200 million, and it is obvious that many of them should be critically reassessed and postponed until the situation improves.

CEPE: Institutional Aspects

2.54 A large number of official organizations are active in the energy sector: the MEM is the energy policy-making body; the INE is the planning and advisory agency; CEPE-INECEL has operational and administrative responsibilities; and the National Directorate of Hydrocarbons is in charge of technical control and supervision of finances of the oil sector. A weak interface among the above organizations, however, impairs proper functioning of this institutional system. A number of factors contribute to this weak interface: the organizations, for a variety of reasons, fulfill their tasks only in part; they exceed, in practice, their areas of responsibility; or they suffer from an innate inability to discharge their duties; or finally, they are incapable of adapting because of historical inertia.

2.55 The DNH exceeds the limits of its responsibilities, for it not only controls and supervises the operators (including CEPE), but also exceeds its authority by intervening in the planning and execution of activities internal to CEPE, such as domestic marketing, and by intervening in the management of CEPE's partner companies (such as the CEPE-TEXACO Consortium and the service companies).

2.56 CEPE's inherent institutional inadequacies emerge from its inability to perform its functions efficiently, free of legal and financial obstacles. The Corporation Charter that established CEPE in 1972 conceived it as an institution dependent on the Central Government's administrative organization and system of control. It was not meant to be a corporation with its own autonomous administrative and operational management, governed by business standards and practices. The highest level of decision in CEPE (the Board), whose members represent the Ministry of Finance, Ministry of Defense, CONADE (National Development Council), Ministry of Industries and Ministry of Energy and Mines, represents almost all the interests of the State and also determines the major guidelines for management of the Corporation. The Board, however, intervenes in even the details of CEPE's operations. This should normally be the duty of the General Manager and of the Area Managers. Moreover, as CEPE is burdened by rules governing the centralized public administration, under the Organic Law of Financial Administration and Control (LOA FYC), cumbersome administrative and control procedures prevent it from responding to the dynamics of the oil industry. Thus, decision-making is curtailed through fear of the General Comptroller's Office and its audits. The Office's public-fund monitoring system is based on compliance with bureaucratic formalities typical of ministerial departments rather than on performance.

2.57 CEPE, moreover, was created without any internal economic, business-oriented procedure. CEPE's objectives are set forth in the Hydrocarbons Law and in its Corporate Charter as being exploration, production, transport, refining and marketing of hydrocarbons. No mention is made of economic performance, which explains why CEPE's income bears no relation to its business performance. CEPE is allocated funds, irrespective of cost recovery needs or expansion of activities. It is considered as yet another party sharing in oil revenues, but not as the entity generating these revenues.

2.58 Finally, development of the oil industry has brought new institutional functions, which have not been assimilated by the existing system. CEPE's partnership with TEXACO, within the CEPE-TEXACO Consortium, should have brought about the establishment of a new enterprise headed by a Management Committee to represent CEPE interests and to provide management standards for the operator, Texaco Petroleum Co. of Ecuador. But the juridical nature of the Consortium remains legally undefined (de facto corporation), and in practice, the operator implements its own administrative

procedures in the Corporation. The Trans-Ecuadorian Pipeline continues to be managed under the same rules that applied when it was the exclusive property of Texaco and Gulf, although it is now wholly owned by CEPE. Service contractors operating for CEPE in exploration and production of hydrocarbons depend much more on the DNH than on CEPE, as would be the case if they operated under concession contracts. This results in the duplication of administrative and control tasks, which are often carried out in both CEPE and DNH, and add to the burden of the operators.

2.59 To conclude, since TEXACO's share in the CEPE-TEXACO Consortium will revert to the State in 1992, it is essential to change the current juridical, financial, and managerial status of CEPE so that it may take on the entire responsibility for the Consortium's oil operations.

Electricity

General Introduction to the Subsector

2.60 To recapitulate the main data on the electricity subsector, it should be noted that in 1987 the system showed a peak demand of 1020 MW and a consumption of 4211 GWh. To meet this demand, the system generated 5345 GWh, 85% of which were from hydroelectric and 15% from thermal generation. Total losses (transmission/distribution) represented 21.2% of generated power. This represents a very sizeable loss, and the problem must be studied with a view to establish loss reduction programs. To meet consumption requirements, the system has a total installed capacity of 1764 MW, equivalent to a total firm power supply of 1444 MW, at generation, 763 MW of which are hydroelectric and 681 MW, are thermal.

2.61 Available data for the January-May 1988 period show a substantial decrease in the historical rate of growth of consumption of 8%, an annual average of only 3.5% (estimated). Peak demand over the same period was 983 MW, which could indicate a peak estimated demand of 1070 MW by December 1988. Firm capacity has a large reserve margin to cover current demand. By late December 1987, the system had 1,181,100 registered consumers, and electricity reached about 63.5% of the population.

2.62 A wide range of problems currently affect the electricity subsector. The subsector's difficult economic and financial situation requires urgent short-term measures and the simultaneous development of medium- and long-term recovery programs. The problems may be grouped as follows, in decreasing order of importance:

(a) Very low tariff levels and an unbalanced tariff structure that fails to promote the rational and balanced use of energy. Insufficient government measures.

(b) Worrisome financial situation of the subsector, and of INECEL in particular, with a worsening trend in the last few years.

(c) Serious technical problems in the major hydroelectric power plant (Paute): uncertainty regarding the costs and efficiency of the measures proposed; potential unknown technical

and cost implications for other hydroelectric projects now under construction (Paute, phase C) or under study (Sopladora).

(d) Excessively large expansion program (relative to anticipated demand). The program is badly underfinanced and requires revision. Difficulties in comparing alternatives (to determine the least-cost program) because of differences in the level of detail of power project studies.

(e) Deficiencies in the organization, operation and management of the subsector. Insufficient coordination between INECEL and other electricity companies. Inadequate legal framework.

(f) Status of EMELEC not yet defined; no detailed studies on alternative solutions and on their impact on INECEL.

Electricity Tariffs

Objectives

2.63 The tariff policy is probably the most sensitive issue facing the electricity subsector, directly affecting its revenues and and its ability to finance expansion projects. An analysis of tariffs in Ecuador must be based on accounting criteria (i.e. average costs and revenue needs of the utilities) because there are no estimates of Long Run Marginal Costs (LRMC) on which to base tariffs.

2.64 The Basic Electrification Law determines that INECEL's Board of Directors is responsible for approving the tariffs to be applied by the distribution companies. These tariffs must cover direct operating and maintenance costs and depreciation rates and ensure a reasonable profit. Tariff Regulations stipulate the need for annual profits to permit an "adequate" contribution to investment. These percentages are determined annually by INECEL's Board of Directors.

2.65 In practice, the Government has never designed a tariff policy consistent with these legal provisions and has restrained adjustments essential to the healthy economic and financial development of the subsector. Thus, since at least 1980, tariffs have failed to cover even operating costs, not to mention a contribution to investment. Erosion of real tariffs grew worse with the suspension of the monthly 2% and 3% increases in July 1988.

Tariff Evolution

2.66 The major tariff policy measures are reflected in two increases: (a) starting in July 1983, a 2% cumulative monthly increase on bulk sales by INECEL to the companies and by the latter to users; and (b) starting in October 1985, an additional 1% monthly cumulative increase on sales to final users. The following table shows that these increases have failed even in offsetting inflation. Deterioration is even more significant in terms of the US$ equivalent. The largest decrease took place between 1982 and 1984, and was never recuperated.

Table No. 2.8

TARIFF EVOLUTION (1)
(Values in Current and Constant Currency)

YEARS	1980	1981	1982	1983	1984	1985	1986	1987
Average low-tens. tariff								
Current money (S./kWh)	1.28	1.63	2.01	2.17	2.86	3.48	4.64	6.51
Constant Currency (1980) (S./kWh)	1.28	1.40	1.47	1.08	1.09	1.02	1.07	1.20
Current US$ (c/kWh)	5.10	6.52	6.01	4.98	3.80	3.61	3.75	3.83
Bulk Sales Tariff								
Current money (S./kWh)	0.63	0.91	0.97	1.14	1.45	1.85	2.35	2.99
Constant money (1980 - S./kWh)	0.63	0.78	0.71	0.57	0.55	0.54	0.54	0.55
Current US$ (c/kWh)	2.52	3.64	2.94	2.61	1.93	1.92	1.90	1.76

1) Average Annual Values

Source: INECEL.

2.67 For consumers of low-tension electricity, tariffs went down from 6.52 USc/kWh in 1981 to 3.83 in 1987 (in current dollars). For bulk sales, tariffs fell continously since 1981, from 3.64 USc/kWh to 1.76 in 1987 (also in current dollars).

2.68 It is impossible to compare tariffs with their economic costs since no approximate estimates of RMC are available. But in accounting terms, operating income never reached positive internal net generation of funds. An analysis made within the framework of the present study establishes for 1988 an average tariff to the final consumer of about 12.8 S./kWh and a tariff for block sales of about 7.5 S./kWh as the amounts required to cover annual operating costs (including interest charges) without contributing to self-financing. These figures are much higher than those expected to prevail in the current fiscal year.

2.69 The present tariff structure is too low as well as inappropriate. It classifies consumers according to their economic activities but ignores differences in tension levels, time of day, and does not reflect the user's location on the load curve. It thus fails to send appropriate signals about the actual cost of electricity and penalizes (in relative terms) those consumers whose use-patterns are better for the system.

Household Tariffs

2.70 Households account for nearly 40% of total consumption and 85% of registered consumers. Specific annual consumption per household user (in 1987) was 1630 kWh. This is a very high figure in light of the country's level of development. This consumption is equal to that of Brazil or Portugal in 1987 and similar to that of Spain in 1984. Furthermore, specific consumption by company differs considerably: 2670 kWh/customer/year for EMELEC, 2150 kWh/customer/year for the Quito Electric Company (E. E. Quito) and 1070 kWh/customer/year in the remaining companies. Figures for

Quito and Guayaquil are higher than the average figures for the household (residential) sector in Italy or Greece 2/, for example. The main reason for such high specific consumption in Guayaquil is probably the intensive use of air conditioning. But generally speaking, high consumption is encouraged by low tariffs and the rather uncontrolled use of electric power, plus possible inefficiencies in electrical appliances. There are also the "socially-oriented" consumption quotas with frozen and excessively low tariffs which in many countries are limited to 30 - 50 kWh per month, while in Ecuador they range from 80 to 150 kWh.

2.71 Distribution of consumers by levels of consumption in the case of the major companies (Quito and EMELEC) is different from the rest. These differences in load characteristics make for differences in profitability and argue in favor of the concentration of companies. Tables No. 2.9 and No. 2.10 show the distribution of household users by level of monthly consumption as a percentage of the total number of household users and as a percentage of total monthly household consumption.

Table No. 2.9

HOUSEHOLD CONSUMPTION OF ELECTRICITY
DISTRIBUTION OF USERS AS A PERCENTAGE OF THE TOTAL
NUMBER OF HOUSEHOLD USERS

COMPANY	LEVELS OF CONSUMPTION (in KWh/month) (% of users)								Cum.	Cum.
	0-20	21-50	51-80	81-120	121-150	151-300	301-500	500	0-80	0-150
E.E.Quito	12.9	11.7	14.3	18.7	9.4	19.6	7.2	6.2	38.9	67.0
EMELEC	7.8	8.4	12.6	12.4	13.0	28.5	9.2	8.1	28.9	54.3
OtherComp	24.5	23.7	15.9	13.8	6.6	11.8	2.5	1.0	64.2	84.6
Ecuador	10.5	17.9	14.9	14.6	8.6	17.0	4.9	3.7	51.2	74.4

Source: INECEL.

Table No. 2.10

HOUSEHOLD CONSUMPTION OF ELECTRICITY
DISTRIBUTION OF HOUSEHOLD CONSUMPTION AS A PERCENTAGE
OF TOTAL HOUSEHOLD CONSUMPTION

Company	LEVELS OF CONSUMPTION (in kWh/month) (% of consumption)								Cum.	Cum.
	0-20	21-50	51-80	81-120	121-150	151-300	301-500	500	0-80	0-150
E.E.Quito	0.3	2.4	5.3	10.5	7.1	22.9	15.3	36.4	8.0	25.5
EMELEC	0.2	1.4	3.8	5.8	8.1	26.8	15.8	38.2	5.4	19.3

Source: INECEL.

2/ This comparison should be taken as an illustration, since it is not known whether the classification of "residential" has the same meaning in all the countries mentioned.

2.72 Tariffs for household use are distorted in that, as consumption increases, users who make the most of installed capacity and who use non-peak hours better are penalized. Average prices per kWh (as of June 1988) for different values of monthly consumption and different companies are shown in Table No. 2.11.

Table No. 2.11

AVERAGE PRICE PER kWh FOR HOUSEHOLD USE
(values in S/. kWh as at June 1988)

Monthly consumption (kWh)	E.E. Quito	EMELEC	STO. DOMINGO
		R-1 TARIFF	
20	1,20	1,90	1,75
100	2,60	1,58 (R-2)	2,96
		R-2 TARIFF	
120	8,98	1,53	10,28
150	8,93	2,38 (R-2) 8,83 (R-3)	10,28
300	9,35	9,03 (R-3) (*)	10,28
1000	9,90	9,19 (R-3) (*)	10,28

(*) R-3 Tariffs only available in EMELEC (Guayaquil)

Source: INECEL

2.73 The 80 kWh, 120 kWh, and 150 kWh figures correspond to consumptions which are subject to frozen tariffs in most of the companies and in Quito and Guayaquil. 29% of EMELEC customers, 39% of E.E. Quito customers and 64% of the customers of the remaining companies have consumptions lower than 80 kWh/customer/month. If the benefits of the "subsidized" category of Guayaquil (i.e., 150 kWh/month) were extended to all others per month, this would come to include 67% of the Quito registered customers and 85% of the customers of the remaining companies, as against 54% in Guayaquil. Tariffs are frozen at unrealistically low prices, ranging from 0.90 to 1.50 S/kWh. Thus, despite specific prices of up to a maximum of 10 S/. kWh in 1987, the average price for household users was only 6.7 S/. kWh in 1987. It may be said, therefore, that 50% of Quito consumers, 54% of Guayaquil consumers, and 72% of consumers in the rest of the country--who total some 635,000--have highly subsidized tariffs of less than S/.3 per kWh (as of June 1988). These customers account for almost 22% of total household consumption.

Conclusions

2.74 Although it would be feasible to make a similar analysis of commercial and industrial tariffs and to detect distortions in these supply areas, the above analysis is sufficient to warrant a radical change in tariff levels and structure. This would permit/require the correction of existing defects, discouragement of inappropriate uses of the resource, increase in revenue to better reflect costs, reduction

in investment (both for generation and distribution), reversal of the trend towards growing financial losses, and the opportunity of allowing utilities to raise some resources, with a view to contributing towards investment needs.

Financial Situation

Subsector Evolution

2.75 The electricity subsector, and INECEL in particular, is in a financial situation that has gradually and rapidly deteriorated since the beginning of the eighties. The main reasons are:

a) high level of investment in new hydroelectric projects (Paute AB, Agoyan, Paute C);

b) depressed tariffs;

c) decreasing flows of oil funds allotted to the subsector;

d) increasing foreign indebtedness;

e) ballooning debts among distributing companies to INECEL, (especially EMELEC); and

f) growing costs due to inflation and currency devaluations.

2.76 Annual cumulative losses have increased liabilities and decreased net worth. The financial evolution which the subsector has undergone over the past few years is summarized in Table No. 2.12. Net income prior to interest payments had a favorable trend but did not even reach 1000 million sucres (5.9 million dollars) in 1987. Financial charges increased continuously, rising from 4,053 million sucres in 1984 to 10,538 million sucres in 1987. At official exchange rates, they grew from 53.8 million dollars to 62 million dollars (data taken from the balance sheets).

2.77 The combination of low revenue and high annual financial charges resulted in substantial and growing net operating losses throughout the period. Losses amounted to 9,754 million sucres in 1987 (57.4 million dollars).

Table No. 2.12

THE ELECTRICITY SUBSECTOR
Profit and Loss Statements
(in Millions of Current Sucres)
(parentheses indicate negative amounts)

YEAR	1984	1985	1986	1987
Net operating income	(1429)	(1252)	(1047)	(3766)
Net income before payment of interest	(1497)	(1378)	195	784
Interest charged to operations	(4053)	(5394)	(7215)	(10538)
Net operating profit/loss	(6000)	(6722)	(7020)	(9754)

Source: INECEL

Oil Revenues

2.78 Government allocation of oil revenues has proved among the sector's major sources of funds. These funds have steadily decreased, not only because of the drop in oil prices and the suspension of production in 1987, but also because the exchange rate (at which "royalty dollars" are converted to sucres) has been frozen at S/.66.50 since 1983, while the official is used for debt service and for payment of imported goods. Oil funds dropped from 6,165 million sucres in 1982 to 2,639 million sucres in 1987. 3/
See Table 2.13.

Table No. 2.13

EVOLUTION OF OIL REVENUES TRANSFERRED TO INECEL
(in millions of sucres and millions of current dollars)

	1980	1984	1985	1986	1987
Millions of "royalty dollars"	126.4	120.4	142.0	86.7	53.3
Millions of sucres	3161.0	8004.0	9442.0	5767.0	3543.0
Millions of dollars (actual)	126.4	106.3	97.8	46.7	20.8

Source: INECEL.

Debts

2.79 Decreasing oil revenues led to increased borrowing, accounting for the increase in the long-term debt of the subsector (INECEL+Companies) from 44 to 177 billion sucres over the 1984-1987 period. In current dollars, and at the official year-end exchange rate, liabilities rose from 580 to 800

3/ Different INECEL sources (Planning and Accounting) present different figures. The Accounting figures are used here.

million dollars over the 1984-1987 period. Nearly 80% of the total debt is INECEL's. Variations in the debt ratio (long-term debt/net worth) over the four-year period were as follows:

Table No. 2.14

THE ELECTRICITY SUBSECTOR
LONG-TERM DEBT/NET WORTH
(REVALUED ASSETS)

YEAR	1984	1985	1986	1987
Debt ratio	0.33	0.42	0.50	0.58

Source: INECEL.

2.80 Although the ratios are increasing, they are still low and below 1. Low ratios are due to the revaluation of assets, which in the 1984-1987 period represented between 70% and 80% of total assets. If increases at historical book values are computed on the basis of 1982 values, and using the assets, values obtained are much higher and increasing, as shown in Table No. 2.15.

Table No. 2.15

THE ELECTRICITY SUBSECTOR
LONG-TERM DEBT/NET WORTH
(NON-REVALUED ASSETS)

YEAR	1985	1986	1987
Incremental change in the debt ratio	2.3	4.3	6.9

Source: INECEL

2.81 The servicing of the debt (interest plus amortization) has remained relatively constant in current dollars (around 100 million dollars a year) but, of course, grew in current sucres, from 8,000 million in 1984 to 16,000 million in 1987 with the sucre's depreciation. In percentage terms, interest has increased at a faster pace than amortizations.

Bad Debts

2.82 Internally, bad debts (arrears due INECEL) amount to approximately 11,000 million sucres, of which EMELEC's are about 9,000 million sucres. This is quite alarming. EMELEC continues to pay for the energy it purchases from INECEL at the 1983 price (0.92 sucres/kWh), which is very low.

Source and Use of Funds

2.83 Finally, it is important to compare the source and use of funds over recent years, as shown in the following table. It should be noted that the internal generation of funds is always negative and that with few exceptions investment is entirely financed by borrowing.

Table No. 2.16

ELECTRICITY SUBSECTOR. 1984-1987
STATEMENTS OF SOURCE AND USE OF FUNDS
(in millions of current sucres)

	1984	1985	1986	1987
Gross internal generation	3644	4712	8036	11279
Debt service (*)	(7976)	(9279)	(13150)	(15889)
Net internal generation	(4332)	(4567)	(5114)	(4610)
Capital contributions	6112	7308	6060	2566
Loan disbursements	5533	4893	14204	16628
Direct investments in works	3378	9074	13197	10531
Financial investments	2093	653	455	1577
Direct loans/investments(%)	164	54	108	158

(*) Interest and amortization

Source: INECEL.

2.84 The foregoing is an analysis of the consolidated electricity subsector (excepting EMELEC). A similar analysis of INECEL alone would reveal an even worse situation due to the following factors: a) the most important direct investments and capital requirements are those of INECEL (hydroelectric facilities); b) the external debt is almost wholly INECEL's responsibility; c) as a result, INECEL's net internal generation of funds is even more negative than that of the consolidated subsector and requires a larger participation of external sources in investments.

Planned Expansion

Demand Projections

2.85 The government is giving top priority to attaining 100% electricity coverage by bringing service to the remaining, mostly rural, 36.5% of the population. In late 1987, INECEL completed the 1987-2010 Master Electrification Plan for Ecuador. The demand forecast is based on what it considers the "least favorable" scenario, with a 3.0% annual GDP growth per year. A 3% real growth per year in GDP would be considered a solid performance under present conditions (see Table 2.17).

Table No. 2.17

MASTER ELECTRIFICATION PLAN. POWER SUPPLY AND DEMAND PROJECTIONS
(1988-1997)

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Consumption (GWh)	4431	465	4911	5170	5514	5802	6097	6403	6692	6695
Growth rate (%)	5.1	5.4	5.3	6.7	5.2	5.1	5.0	4.5	4.5	
Power Generation(GWh)	5385	5650	5944	6241	6634	6967	7306	7659	7994	8332
Demand (MW)	1027	1067	1122	1175	1255	1310	1371	1434	1492	1553

Source: INECEL, Master Electrification Plan.

2.86 By using a different methodology, INE obtains lower projections: 4722 GWh in 1990, 5956 GWh in 1995, and 6436 GWh in 1997. The difference between projections for 1995 is approximately 355 GWh. Although demand estimates were changed in April 1988, new macroeconomic scenarios have not been considered. Moreover, the probable fall in GDP in 1988 and the elasticity of consumption to a significant rate increase have yet to be taken into account.

Power Generation Program

2.87 The Master Plan expects to meet demand until 1995, with existing generation capacity and two new hydroelectric projects: Paute, Phase C, now underway, and Daule-Peripa.4/

The projects have the following characteristics:

Table No. 2.18

ELECTRICITY SUBSECTOR: POWER CAPACITY AND POWER GENERATION
OF THE PAUTE AND DAULE-PERIPA PROJECTS

	Power Capacity (MW)		Energy (GWh)	
Project	Installed	Firm	Primary (dry year)	Mean (mean year)
Paute AB	500	377	2495	2631
Paute ABC	1000	769	2270	5138
Daule-Peripa	130	74	432	505

Source: INECEL, Master Electrification Plan.

4/ Daule-Peripa is a multipurpose project, and a good part of the civil works are already completed.

2.88 Phase C of the Paute project increases firm power capacity by 390 MW and nearly doubles power generation in a mean year. However, primary energy (in a dry year) drops by 220 GWh (equivalent to primary energy in Pisayambo, which is already operational). The cause of this reduction is unclear. It is recommended that this point be carefully studied in reviewing the Master Plan as soon as more data becomes available on the influence of sedimentation in the reservoir and on the efficiency of the dredging operations planned. Available primary energy has a bearing on the location (in the merit order) of the hydroelectric component, on optimum dispatch and on total operating costs.

2.89 Two new hydroelectric plants, Paute Mazar and Sopladora, are scheduled to begin service in the latter part of the 1990's. They have the following characteristics:

Table No. 2.19

INECEL: DATA ON THE PAUTE A,B,C, MAZAR, AND SOPLADORA PROJECTS

Project	Power Capacity (Mw) Inst.	Firm	Energy (GWh) Primary-Mean (dry year)	(mean)	Investment Cost (million dollars) (2)
Mazar	180	92	428	631	507
Sopladora (A)1)	400	336	1229	2442	338
Sopladora (I)1)	400	336	1730	2442	338
Paute ABC(A)	1000	769	2270	5138	-
Paute ABC(I)	1000	769	3260	5262	-

(1) (A)Operation without constructing Mazar; (I) operation integrated with Mazar.
(2) January 1987 dollars

Source: INECEL.

2.90 The Paute-Mazar project is located upstream of the Paute-Molinos Project, Phases A,B,C. It is not very valuable by itself (primary energy equal to that of Daule Peripa, with greater installed capacity and much greater cost). Owing to its substantial regulatory capacity it does, however, provide important benefits for firm power generation of the downstream projects, such as Paute ABC and Sopladora. The project can also control part of the silt carried by the river towards the Amaluza reservoir (Paute) --a serious technical problem which remains unsolved. Mazar is at the design stage, while the Sopladora project is at the prefeasibility stage. Project cost and the influence of sediments discharged from the upstream Amaluza reservoir have yet to be identified.

Investment

2.91 The INECEL Master Plan, which includes transmission, distribution, and other investments (excluding EMELEC), would give rise to the following investment program:

Table No. 2.20

MASTER ELECTRIFICATION PLAN
1988-1996 INVESTMENT PROGRAM
(in millions of June 1987 dollars)

YEAR	88	89	90	91	92	93	94	95	96	TOTAL 88-92
Generation	66	63	82	95	100	95	110	115	138	406
Transmission	43	24	10	9	4	3	3	3	3	90
Distribution	83	53	56	44	49	48	49	49	48	285
Other Invest.	29	37	26	17	15	5	4	10	4	124
Subtotal	221	177	174	165	168	151	166	177	193	905
Interest on Construction	9	9	15	18	17	21	24	29	8	68
TOTAL	230	186	189	183	185	172	190	206	201	973

Source: INECEL

2.92 The program has substantial investment requirements, particularly in the short-term. These requirements fail to reflect the stagnation of demand, the sector's financial situation, and the government's ability (as the National Electric Fund) to make capital contributions. Investments in the different items budgeted also appear unbalanced, for there is an excessive allotment to "distribution"and a very high percentage in "other investments".

Tariff Adjustments

2.93 The plan assumes that monthly tariff increases mentioned earlier (2% for bulk sales and 3% for final consumers) will continue until 1990. It later reduces increases on sales to users to 10% a year and maintains 27% a year on bulk sales.5/ Net internal generation is negative until 1991; the program lacks financing and has high annual deficits, as shown in Table No. 2.19. This makes its implementation unfeasible.

5/ In actual fact, with the step increases assumed for the Plan, bulk sales tariffs would show negative growth rates (in real terms) in 1988 and 1989.

Table No. 2.21

MASTER ELECTRIFICATION PLAN 1988-1996
Source and Use of Funds
(in millions of June 1987 dollars)

YEAR	88	89	90	91	92	93	94	95	96	TOTAL 88-92
Total invest.	230	186	189	183	185	172	190	206	201	973
Net Int. Gen.	-94	-57	-22	-12	10	40	56	68	43	-175
Loans (1)	122	79	72	74	67	60	69	73	90	414
Deficit	202	164	139	121	108	72	65	65	68	734

(1) Disbursements on outstanding loans or on loans under negotiation.

Source: INECEL, Master Electrification Plan.

2.94. The deficit for the 1988-1992 period runs to $734 million (at June 1987 prices), although loan disbursements of 414 million dollars are assumed to take place. Assuming the extreme case that the entire deficit were to be financed with tariff-based revenues, annual average tariffs required would be as follows:

Table No. 2.22

AVERAGE ANNUAL TARIFFS
(in U.S. cents/kWh, June 1987 currency)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Master Plan(1)	4.26	4.88	5.80	5.80	5.80	5.80	5.80	5.80	5.80
Deficit Cov.(2)									
cents/kWh	7.79	7.66	8.05	7.70	7.44	6.79	6.65	6.63	6.68
Sucres/kWh(3)	13.2	13.0	13.7	13.1	12.6	11.5	11.3	11.3	11.4

(1) Tariff changes over time assumed in the Master Plan
(2) Tariff required to completely cover the deficit
(3) Conversion at 170 S/. per dollar (June 1987 dollars)

Source: INECEL and Work Group Estimates.

2.95. The above tariffs are the averages on bulk sales to EMELEC and to final users: tariffs for final users would be higher, reaching a maximum in 1990, and then drop, in real terms. At June 1988 prices, the average tariff for the final user would be nearly 20 S/.kWh. The analysis shows the impossibility of implementing the Plan and the need to find alternative plans, with lower investments, in the next few years.

Technical Problems

Sedimentation of the Amaluza Reservoir (Paute)

2.96 Sedimentation of the Amaluza Reservoir is a crucial technical problem, threatening phases A, B and C of the Paute Hydroelectric Plant with a total installed capacity of 1000 MW. The problem is aggravated by the postponement of the upstream Paute-Mazar project, since one of the objectives of this project was to stop the river's carrying of solid. The financial burden implied by the construction of such a project requires alternatives to the Mazar project.

2.97 Solution of the sedimentation problem of the Amaluza reservoir appears even more remote since the postponement of the Mazar project. The alternative selected comprises deep dredging, dredging upstream of the lower portion of the reservoir, and the possible raising of the water intake. A number of uncertainties still exist, since the two-stage dredging solution, both deep (still at the testing stage) and conventional (upstream, at 2 to 5 km from the dam) could have high costs or, even worse, be inadequate and turn the Paute Plant into a run-of-the-river without any regulation capacity.

2.98 Precise estimates of the cost of the Amaluza dredging project are unavailable, but the figures provided thus far range between US$2 and US$6 per cubic meter of silt. As the annual volume of dredging is estimated at nearly 3 million cubic meters, this would entail annual dredging costs of $6 to $18 million. Estimated equipment costs for the first phase (deep dredging) are $12 million.

Feasibility Studies of Hydroelectric Projects

2.99 Another technical problem is the inadequacy of studies on those hydroelectric projects considered for incorporation into the system in the medium-term, such as Sopladora, Chespi San Francisco, and even Coca-Codo-Sinclair itself. Thus far, and in the INECEL expansion plans, they are compared with Paute-Mazar, despite the lesser degree of information available on them. The feasibility studies of the Sopladora, San Francisco, and Coca projects are underway or about to start. INECEL has a $36-million IDB loan available for these studies, and they should be completed in two years (late 1990). Disbursements on the above loan have been suspended since October 1987.

Power Losses

2.100 In the last few years, power losses in the subtransmission and distribution grids have averaged 17%-18% of available power in the substations of the National Interconnected System. Sharp loss variations exist among the different companies, though statistics on some of them are not

very reliable, as they show large-scale, inexplicable changes over two consecutive years. This could be accounted for by poor metering and computing 6/ However, while the Quito and Guayaquil load centers, which make up 65% of the overall market, incur losses of around 16%-17%, there are regional companies whose losses exceed 30%. This high level of power losses might be caused not only by aging distribution grids in population centers and by inappropriate subtransmission systems (overloaded), but also by unmetered users, by the poor or by fraud or theft. The better loss performance in Quito and Guayaquil, moreover, is due to substantial internal generation in medium-tension grids, which is instrumental in reducing overall losses.

2.101 Priority investments in the distribution networks (that contribute to loss reductions) should be made in Guayaquil, since EMELEC has minimized its investments to a minimum for several years, probably because its concession was to terminate in 1985. 7/ The detailed identification of the studies and investments required for this system should include a definition of the future institutional framework of the EMELEC area.

2.102 The distribution companies have no incentives to reduce losses, for the institutional arrangements in effect allow them to pass on their own financial losses to INECEL without any consequences to themselves. Loss-reduction programs are badly needed, and these would surely improve the worst cases. The results would reduce company demand on INECEL, and consequently, reduce total consumption and required generation.

Operation of the Interconnected System

2.103 Operation of the generation system, including power generated by INECEL and that generated by the other companies is not being optimized. This has resulted in the operation of inefficient thermal power plants, rather than of the most efficient ones; and occasionally, in the operation of thermal plants while water has spilled from hydroelectric plants. Their output is approximately 9.93 kWh/gallon, while the Quito Electric Company produces almost 14.9 kWh/gallon and INECEL nearly 13.3 kWh (excluding Esmeraldas). Table No. 2.21 compares output of the major thermal plants in 1987 and computes the plant factor, exclusive of availability. Whereas EMELEC attained a plant factor of almost 21%, INECEL only achieved 15%, and the Quito Electric Company, which has the most efficient plants, barely reached 3.5%. One of the problems is that EMELEC's thermal plants are the most inefficient in the system.

6/ Losses are measured by the difference between the power purchased from INECEL (or internally generated) and the power sold to final consumers. No one can guarantee that this power is measured within the same period as the power generated.

7/ The EMELEC distribution network in Guayaquil, which is entirely aerial, poses serious safety problems for the population and would require complete overhauling in the short term.

Table No. 2.23

MAJOR THERMAL POWER PLANTS
BASIC OPERATING DATA IN 1987

Company	Available capacity	Efficiency (kWh/gallon)	Generation 1987	Plant Factor
EMELEC	171	9.93	312	20.8
E. E. Quito	55	14.92	17	3.5
INECEL excluding Esmeraldas	256	13.38	338	15.1
Esmeraldas	125	14.80	---	----

Source: INECEL.

2.104 Operation of the EMELEC power plants at a national level has been impossible to coordinate, as the company insists on operating them on its own. Voltage control in Guayaquil, which EMELEC regards as a real problem, could be achieved without power generation but with EMELEC units functioning as synchronous compensators.

2.105 It is not clear, moreover, why the thermal steam plant in Esmeraldas, which began operating in 1982 with a working capacity of 125 MW, generated power only in 1982 and 1983 (with plant factors of 42% and 33%) and stopped operating from 1984 to 1987. The plant is modern and efficient, consumes residual fuel (which is cheaper than diesel), and is geographically located "opposite" Paute, so that its operation would both lower costs and increase system reliability.

Table No. 2.24
THE ELECTRICITY SUBSECTOR

CONSOLIDATED PROFIT AND LOSS STATEMENTS 1983-1987
(in millions of current sucres)

YEAR	1983	1984	1985	1986	1987
Power Sales (GWh)		3288	3588	3830	4204
Operating Income					
Power Sales	5817	7798	10198	14947	22596
Other Income	119	156	211	283	414
	5936	7954	10409	15230	23010
Operating Expenditures					
Operating Expenses	4091	4322	6263	7585	9868
Depreciation	1723	5061	5398	6598	9376
Total Operating expenditures	5814	9383	11661	14183	19244
Net Operating Income	122	(1429)	(1252)	1047	3766
Other non-operating Income (net)	(278)	(518)	(126)	(852)	(2982)
Net Income before interest	(156)	(1947)	(1378)	(195)	(784)
Financial charges (interest)	(1335)	(4422)	(6325)	(9081)	(11328)
Interest during construction	---	369	931	1866	790
Interest charged to operation	(1335)	4053	(5394)	(7215)	(10538)
Net operating profits or (losses)	(1491)	(6000)	(6722)	(7020)	(9754)

(1) INECEL and the Distributing Companies (excluding EMELEC)

Source: INECEL.

Institutional and Legal Problems

Planning Problems

2.106 Planning in the electricity subsector lacks an appropriate linkage with sector development and with overall nationwide development. Despite the establishment of the National Energy Institute and of the Higher Council of Energy, no coordinated programs have been officially approved. There is an evident lack of objectives as well as non-existent or insufficient coordination on methodologies. INECEL planning has been isolated from the rest of the energy sector. INECEL, however, has designed concrete plans for the medium- and long-term. At present, planning in

INECEL has lost importance, and the Master Electrification Plan has not even been officially approved. Power generation planning, moreover, is not integrated with the planning of distribution and marketing, nor is any control exercised over them.

2.107 Planning is very poor in some of the electricity companies and non-existent in others. High investments are scheduled and not implemented, given the absence of criteria as a basis to assess projects, identify priorities, and coordinate budgets under financial constraints. Failure to receive income, or merely management difficulties (for example delays in bidding and contracting), account for this poor planning. In the distribution area, only 39% of investments materialized as budgeted in 1987. Nonetheless, larger investments without any funding have been proposed for future years. INECEL's lack of control and leadership over electricity companies, even though it is generally their major shareholder, with often up to 95% of shares, is a crucial problem. INECEL's authority in investment decision-making, in allocation of resources, and in exacting payment (for power sales) is hindered by political intervention.

2.108 At an organizational level, there is no clear-cut separation of duties. This is particularly true between the Board and INECEL management. The Board is an administrative body that often causes unnecessary delays in decision making, because of the many topics for discussion and time limitations. Political intervention is also often responsible for distortions in sectoral planning, giving priority to works that are of secondary importance. Because Board members represent interests other than those of the electricity subsector, the Board does not support the subsector's autonomy in administrative and financial matters.

Legal Framework

2.109 The legal framework of the electricity subsector is inadequate, not only because of contradictory legislation, but also because the laws by which it is governed fall within public sector legislation. Consequently, the centralist approach practiced by public sector legislation means that decisions can only be taken at the highest levels of the administration. Owing to the complexity of this legal system, there is uncertainty about whether or not the State will fulfill its commitments. This forces contractors to take into account the risk factor, which results in higher costs. The inadequate legal framework is exemplified by the obsolete Procurement Law or rather, by the lack of a public procurement law which could take into account the notable size and characteristics of projects typical of the electricity subsector.

Public Relations Problems

2.110 Due to ineffective public relations, the subsector suffers from a deteriorating image, both with the public and in political circles. Thus, information on labor issues and the need for tariff increases have not been adequately communicated. Users should be informed on the proper use of energy and how to save it so as to diminish losses and improve the load curve. It would also be

useful to undertake a public information campaign on the subsector's precarious financial situation, pointing out that hydropower (although water is a free and renewable resource) requires enormous initial outlays and that benefits accrue over long periods of time.

Problems in Energy Conservation and in New and Renewable Sources of Energy

2.111 Implementation of energy conservation measures and development of renewable energy sources, as an integral part of energy policies, could help solve some of the pressing problems of the sector, as will be discussed below.

Energy Shortages in Rural Areas

2.112 Food Cooking. Fuelwood and biomass are the main energy sources used for cooking in low-income households in rural areas (68% of final energy). Most users gather firewood free of charge. Given the uneven distribution of the resource and of the population, annual forest increment is not enough to meet firewood requirements in the central provinces of Chimborazo, Tungurahua, Cotopaxi, or in Bolivar or Loja. Rapid deforestation of these provinces has occurred together with a shortage of energy for cooking, particularly in the poorest households.

2.113 An economically viable alternative could be the use of more efficient stoves (such as the one developed by INE together with GTZ, which increases efficiency by a factor of 2.2), and reforestation, as is currently being done under the "Plan Bosque" (Reforestation Program).

Electricity in Rural Areas

2.114 Whereas in urban areas electricity is universally available, in rural areas the service only covers 34% of households (1985). It would be possible to decentralize the electricity supply system by using the country's water resources (through mini-hydroelectric plants near demand points) and by using Ecuadorian-made equipment. The minihydro sometimes proves more economical than the extension of the grid. Photovoltaic energy could be an alternative for basic services which require little energy, such as communications and health, in the absence of other sources of energy. Its costs per unit of useful energy are US$ 1.1/kWh in communications and twice that figure in health.

In-House Comfort in Rural Households

2.115 As shown by several INE projects, the use of passive solar energy both for cold climates and warm-humid climates makes for a significant improvement in home comfort. This is achieved without the use of conventional energy and with little increase in construction costs.

Obstacles to the Development of New and Renewable Sources of Energy

2.116 Legal, institutional, and financial obstacles obstruct the development of new and renewable energy sources. These obstacles could hinder the use of locally available energy sources (water, biomass, solar, wind, geothermal, etc.) and the adaptation of supplies to final uses. Supported by the subsidized prices of conventional energy, the energy supply system has remained centralized and concentrated in its primary sources (hydrocarbons, biomass and hydroelectricity), and therefore, has become more vulnerable. Lack of options for the user of final energy has encouraged the use of energy forms whose quality exceeds requirements. This state of affairs is discussed below for each consumer sector.

Households

2.117 The problems faced by rural households were discussed earlier. The urban household sector, for its part, is the largest electric power consumer, and consequently, its habits have a strong bearing on the load curve and on peak power demand. Studies undertaken by members of the Work Group suggest that the medium-income and high-income population groups tend to use electricity, because of its convenience, for heating purposes that would be better served by other, more efficient sources.

Industry

2.118 Industry accounts for 17% (in 1986) of final energy consumption; its greater concentration and organizational methods facilitate energy conservation programs. INE's energy audits show a potential savings of the establishment of 13% at domestic market prices (in 1987). With the establishment of more realistic prices, energy conservation would become more profitable and would warrant special support by the government and INE.

2.119 Co-generation of electricity with residual process heat would be an option to improve the efficient use of such heat in industry. Several industries in industrialized and developing countries

have already achieved this. Such an alternative would require legal and organizational changes to provide flexibility and incentives for investments.

Transport

2.120 The transport sector is the major consumer of oil products, and overland transport is the largest energy consumer in this sector (70%). Cargo carriers are in the lead, followed by light transport and then by mass transport. Cargo transport has a greater specific savings potential (48%). Buses (urban 46%, rural 41%) can also save fuel by using diesel engines, by improving maintenance and the use factor (especially in cargo) and by putting larger-sized vehicles into service. As for light vehicles, the 19% specific savings estimated for the year 2000 would derive from greater efficiency and smaller-sized units. In maritime transport, consumption tripled from 1979 to 1984. This could also point to illicit exports of fuel, so that substantial savings potential appears to exist in this area.

Deforestation and Ecological Deterioration

2.121 Ecuador is undergoing a very serious deforestation; the "Reforestation Plan" estimates that 300,000 Ha/year are affected. Energy consumption would account for 11% of that figure, so that its responsibility at the national level is not great. In five provinces, as already mentionned, firewood consumption exceeds forest growth, thus bringing about rapid deforestation. This process causes erosion and soil degradation and requires an effective environmental protection policy, particularly in the more fragile zones. A major component of this policy should be an aggressive reforestation program (Plan Bosque), supplemented by widespread use of efficient stoves and fuel substitution in critical areas.

System of Sector Institutions

2.122 This section will discuss the problems that arise in the management/supervision/coordination of the sector as a whole (the establishment of general policies, etc.).

Management, Supervision, and Coordination of the Sector as a Whole

2.123 As described above, the structure of the energy sector is acceptable in theory. But in practice it is inefficient, chiefly for the following reasons: the agencies responsible for establishing the sector's major policy guidelines (CSE and MEM) lack the time and resources to set clear medium- and long-term guidelines. They simply resolve short-term problems as they arise. INE should be primarily responsible for sector management, but this institution lacks the financial means and number of technical personnel required (or the required levels of remuneration) to fulfill its duties under its

Charter. Although they have a good technical level and are relatively efficient businesswise, the autonomous entities, CEPE and INECEL, lack coordination and operate under significant legal constraints and excessive political interference (see para. 2.125).

Institutional Situation of INE and Subsector

2.124 Under its Charter, INE's role is to act as the governing body of Energy Planning and as technical support for the formulation of policies for approval by the Higher Council of Energy (CSE) and for implementation by the Ministry of Energy. Despite its legal mandate, INE has performed its role only in part. Two factors account for this: the absence of a real awareness of its integrating function for global energy policy, and the presence of major executing agencies, which, because of their administrative and technical importance, impose the guidelines for oil and electric power planning. Mention must also be made of the interest shown by both CEPE and INECEL in conducting their own activities. This is why INE has been engaged in comprehensive and regional planning, with energy supply and demand studies, short-term trend analyses, energy balances, energy information systems, alternative energy sources, etc. INE's main contribution to sectoral coordination has been the creation of the Committee of Demand, whose objective is to harmonize demand projections in the subsector. Coordination for the study and its execution has been one of INE's most important tasks to date.

2.125 Although CEPE and INECEL are autonomous and decentralized institutions, this autonomy is more apparent than real, as political interference reaches down to technical decision making levels. INE, in conjunction with CEPE's and INECEL's boards of directors, should provide INECEL's hydrocarbons and electricity policy orientations. The MEM, which appoints most board members, currently presides over both companies' boards of directors.

CHAPTER III

OPTIONS FOR THE SOLUTION OF ENERGY SECTOR PROBLEMS

Introduction

3.1 This chapter analyzes alternate solutions to those problems of the energy sector discussed in the preceding chapter. It follows the same order: hydrocarbons, electricity, institutions, and conservation and alternative energy sources.

Hydrocarbons

Measures for the Subsector

3.2 Characteristics of oil sector planning discourage a long-term approach: hence only short-term recommendations are provided below.

Domestic Prices of Refined Products

(i) An adjustment of prices of refined products is recommended, to be based on replacement costs of crude oil rather than on historical cost; on depreciations and amortizations, computed on the basis of the revalued assets for the refining, transport, and distribution stages and a real "profit margin" for investment in each of those stages. To this end, an immediate review of CEPE accounting and financial systems is also recommended, to establish the new value of its assets.

(ii) A new price structure is recommended for refined products: the price of diesel fuel should draw closer to the price of premium gasoline while LPG prices should draw close to the average for all refined products. Kerosene for household use should be cheaper than LPG in order to encourage its consumption in rural areas, via a retail sales scheme (5-gallon containers).

Technical Aspects

(iii) To ensure reliable figures for proven reserves and production projections, it would be advisable to form an inter-institutional group of impartial experts which will make

simulations and monitor the performance of deposits in the different oil fields. This would be done with Ecuadoran computing facilities, and, in the initial stage, with external technical assistance and software.

(iv) Particular emphasis should be placed on the extraction of medium density crudes, with gravities between 15 and 25 API, taking advantage of the presence of lighter crudes, since this could be the only way to extract and transport these crudes.

(v) Study and evaluation of heavy crudes (8-15 API) in the Pungarayacu, Oglan, etc. fields must continue, given the importance of reserves.

(vi) Certain official production rates in the Consortium fields have not been modified since 1978. They are not, therefore, in keeping with current conditions of deposits and should be revised.

(vii) Exploration in the Amistad field and in other off-shore areas should be left to foreign investors, given the high risk involved.

(viii) Rehabilitation of the Santa Elena Peninsula fields should be reassessed in the light of current economic conditions.

Financial Aspects of CEPE

(ix) Reform of the current oil-revenue allotment system. This would enable CEPE to recover costs in each activity and have a percentage of the overall oil revenue (between 5 and 10%). This will enable CEPE to generate reasonable self-financing for minimum planned investment. As analysis of, and legal changes for, these reforms may possibly take one year. It is proposed that, for the immediate future, CEPE recover its costs plus a percentage (20%) of profits on the domestic sale of refined products, which are at present destined for the Government Budget. This requires only that the president of the Republic issue an Executive Decree regulating Article 73 of the Hydrocarbons Law.

Recommendations for CEPE's Five-Year Investment Program

(x) Reinforcement of mechanism coordinating the investment budget in the planning department, in order to evaluate the economic viability of projects and assign them priorities.

(xi) Expansion of investment in geophysics, so that CEPE may have sufficient exploration objectives to drill at least five wells a year.

(xii) Modification of CEPE's exploration program by increasing the number of wildcat wells from 14 to 23, so as to gradually offset the decline in the exploration program of foreign oil companies, starting in 1990.

(xiii) Modification of CEPE's production program by adding the development of fields in the Central Oriente, such as: Capiron (N-E), Tivacuno, Curaray, and Primavera.

(xiv) Study of the expansion of the Peninsula refineries at the close of the five-year period, as part of the search for the most economic alternative to meet refined product demand.

(xv) Comparative technical-economic studies of the size, location, and type of gas plant and identification of the best use for the gas of the Libertador Field.

(xvi) Limitation of CEPE's investments in other industrial companies, leaving such investments to the private sector.

(xvii) It is not necessary, at present, to study the expansion of the Trans-Ecuadorian Pipeline.

(xviii) All investments proposed by CEPE for pipelines must be subjected to economic analysis and ranked in relation to all other CEPE projects.

(xix) Projects for LPG bottling plants and lubricating oil packaging plants should be left to private firms and removed from CEPE's investment program.

(xx) Analysis of current refined product (particularly LPG) storage capacity in each of the terminals and their areas of influence, to check whether capacity is adequate.

Institutional Aspects

(xxi) Congress should enact a new Law for CEPE to provide it with financial and operational autonomy and the power to establish affiliated companies and subsidiaries. This new CEPE would be under the control of the National Directorate of Hydrocarbons in technical matters, and of the Superintendency of Companies in financial matters. This law should make provisions for the financial reforms described above in Paragraph 3.2 ix.

(xxii) The Hydrocarbons Law should be amended as follows:

- It should explicitly introduce the concept of replacement cost as a production cost and allow the Executive Branch to eventually apply economic or opportunity costs as bases for domestic price setting. This is necessary because Ecuador's economy is likely to go from oil-exporter to oil-importer within the next decade.

- The Advisory Committee on Petroleum Policies should become the Energy Policy Advisory Commission and should include the Planning Department of INE.

- New articles should be included in the Hydrocarbons Law focusing on exploration and production of unassociated natural gas. These new provisions should address, in particular, its selling price on the domestic market and the economic equivalence between natural gas and substitutes, such as fuel oil.

- Overall priority should be given to CEPE in allocation of oil revenues, so that it may recover its costs at each stage in addition to a percentage of the profits to finance the expansion of its activities.

(xxiii) CEPE should be prepared to take on the operational responsibilities of the CEPE-TEXACO Consortium, the Trans-Ecuadorian Pipeline, the joint field with CITY, and the ANGLO and REPETROL refineries. To this end, it must prepare itself by strengthening its management and staff.

Domestic Price System

3.3 Establishment of prices for refined products in Ecuador is based on historical costs alone, according to an interpretation of the Hydrocarbons Law which precludes consideration of other factors such as replacement cost of each barrel consumed, allowance for depletion of existing reserves, or economic or opportunity costs. This state of affairs accounts for the rapid decline of real domestic prices, requires subsidies, lowers public revenues, leads to waste in the use of refined products and reduces exportable surpluses, all of which hurt the balance of payments and economic growth.

3.4 A change in price level and structure, and in determining costs, would prove a key short-term remedy to the fall in real domestic prices of refined products as well as to the imbalances resulting from current cost interpretation. To this end, three alternative concepts of costs and a narrower price structure are proposed. A program for the immediate adjustment of refined product prices is also proposed.

Cost of Crude

3.5 Assuming the recommended rate of production and the sequential coming on stream of the fields as established therein, Table No. 3.1 shows that the historical cost of crude oil in 1988 was US$6.8/barrel. This figure is 35% lower than replacement cost (10.6 US$/B), and 51% below economic cost (14 US$/B). As can be observed, the historical cost is far from reflecting investments the country must make to incorporate a new reserve barrel and the benefits forgone by selling it at that cost on the domestic market instead of at the international price.

Table No. 3.1

RAW MATERIAL COSTS UNDER DIFFERENT CONCEPTS OF CURRENT COSTS
(US$/B)

YEAR	1987	1988	1989	1990	1991	1992	1995	2000
Historical Cost	7.7	6.8	7.2	7.3	7.5	8.0	8.6	10.0
Replacement Cost	10.2	10.6	10.9	11.3	11.7	12.1	13.4	16.0
Economic Cost	16.3	14.0	14.0	15.5	17.3	19.2	25.1	34.4

Source: Work Group Estimates.

3.6 The following criteria have been considered for replacement cost calculations:

- In the short-term (early 90s), the Central Oriente will be the main region where new reserves will be established if exploration efforts by foreign companies are successful.

- Replacement cost reflects the incorporation of between 100 and 200 million barrels of reserves.

- Cost of capital is 12%, while development and production investment per initial barrel of peak production ranges between $5,300 and $5,700.

3.7 Table No. 3.2 summarizes the replacement cost structure for the North, Central and South Oriente areas of Ecuador's Amazon Region, updated to 1987. The barrel obtained by foreign company exploration and production is certainly more expensive in the Central and South Oriente. However, taking into account that exploration investment by CEPE would have to be doubled or tripled, owing to exploration risks, the difference between the two (Oil Co versus CEPE) is not very significant. Insofar as the North Oriente is concerned, the replacement cost is lower there, and this zone has been reserved for CEPE.

Table No. 3.2

UNIT COSTS OF REPLACEMENT IN 1987 DOLLARS
(1987 DOLLARS PER BARREL)

NORTH ORIENTE

RESERVES MMB	EXPLOR.	PRODUCT.	OPER.C. COST	TRANS. ONLY	CEPE	COMP.	IBIPP
100	0.75	1.84	2.25	1.64	6.48	7.98	3331
125	0.65	1.81	2.17	1.65	6.27	7.82	3395
150	0.58	1.67	1.95	1.67	5.88	7.53	3380
175	0.57	1.63	1.85	1.68	5.73	7.42	3363
200	0.55	1.53	1.68	1.70	5.47	7.23	3344

CENTRAL ORIENTE

RESERVES MMB	EXPLOR.	PRODUCT.	OPER.C. COST	TRANS. ONLY	CEPE	COMP.	IBIPP
100	1.43	2.86	3.79	2.05	10.13	10.76	5325
12	1.26	2.76	3.70	2.07	9.79	10.57	5413
150	1.14	2.61	3.40	2.09	9.23	10.19	5495
175	1.08	2.48	3.13	2.11	8.81	9.90	5477
200	1.09	2.37	2.89	2.13	8.48	9.66	5361

SOUTH ORIENTE

RESERVES MMB	EXPLOR.	PRODUCT.	OPER.C.	TRANS. COST	CEPE ONLY	COMP.	IBIPP
100	2.14	5.34	5.11	3.25	15.04	13.82	8595
125	1.54	4.30	5.32	3.42	14.58	14.19	8637
150	1.38	4.02	4.91	3.48	13.78	13.68	8680
175	1.31	3.81	4.64	3.52	13.28	13.36	8662
200	1.31	3.65	4.50	3.55	13.01	13.18	8585

Source: CEPE and Working Group Estimates.

IBIPP: Investment per barrel of initial Peak Production.

3.8 As can be observed, production costs per barrel range from $7 to $8 in the North Oriente, from $10 to $11 in the Central Oriente, and from $13 to $15 in the South Oriente. According to the analysis of reserve prospects, potential for new discoveries in the Ecuadorian Oriente would be limited to medium and small deposits. It is quite unlikely that giant deposits, such as Shushufindi and Sacha, will be discovered in the future. Therefore, the analysis of replacement costs is based on reserve discoveries of 100 to 200 million barrels from small structures typical of the Central Oriente.

3.9 Economic costs are based on the low oil export- price growth assumed by the World Bank: an 11% annual growth rate from 1990 to 1994, and 6.5% from 1995 to 2000, in current terms.

Fuel Prices: Historical, Replacement, and Economic Costs

3.10 Once the cost of crude has been considered, the profit margin applied in the pricing of fuels (30%) under the Hydrocarbons Law has emerged as the determining factor in setting the prices of refined products. This margin is applied or not in response to fiscal interests or social impact and is not a permanent element of a mandatory nature. Thus, it was not applied in the 1987 fuel price increase, although the methodology of 1984 was used (when a profit margin was applied).

3.11 Table No. 3.3 shows the series of average refined product prices, taking into account historical costs, replacement costs and economic costs, with and without the 30% profit. Clearly, the lowest series is that of the Hydrocarbons Law, which is bereft of profit. The Hydrocarbons Law price with the 30% profit is similar to the replacement cost. The economic cost, however, exceeds the Hydrocarbons Law price, with and without profit. Economic costs are expected to drop slightly until 1990 and then to rise slowly, in real terms, until the year 2000. Prices according to the Hydrocarbons Law and replacement costs remain practically the same, in real terms, because only transport, refining, and distribution costs grow at the general rate of inflation, in current values. Although the historical costs in the new fields are higher than those of the older fields, their output is still relatively low (and does not yet influence cost levels under the Hydrocarbons Law).

Table No. 3.3

AVERAGE PRICES OF REFINED PRODUCTS
(IN 1987 DOLLARS/BARREL)

	CURRENT	1988	1989	1990	1991	1992	1995	2000
Prices under Hydrocarbons Law 0% Prof.	8.12	11.73	11.23	10.31	10.22	9.99	9.68	12.13
Prices under Hydrocarbons Law 30% Prof.		16.97	16.26	15.02	14.74	18.08	14.29	17.15
Prices at Replace. Cost 0% Prof.		15.55	15.09	14.27	14.21	14.03	13.66	16.05
Prices at Replace. Cost 30% Prof.		23.02	22.47	21.47	21.28	21.26	19.95	22.60
Prices at Opportunity Cost 0% Prof.		19.12	18.00	18.05	18.93	19.80	22.56	26.64
Prices at Opportunity Cost 30% Prof.		28.66	26.89	27.11	28.27	29.95	33.72	39.05

Source: World Bank and Work Group Estimates

3.12 The floating element of 30% profit as an integral part of the makeup of fuel prices has the following drawbacks: in the first place, since it is based on historical costs, it does not reflect the profitability of revalued investments in the refining, transport, and distribution stages. In the second place, the 30% is applied at each stage to the cost of the raw material, plus the cost of that stage, as if the profit margins belonged to different companies. It would be logical to have profit margins as a percentage (at least equal to economy-wide cost of of capital) of the non-amortized investments at each

stage. However, we must also consider that a 30% margin can undervalue the real return on investment given existing levels of inflation.

3.13 The following table shows the cost, profit, and tax structure that should be in effect for 1988 according to the Hydrocarbons Law, if prices were established according to that Law.

Table No. 3.4.

STRUCTURE OF COSTS, TAXES, AND PROFITS
OF A GALLON OF REFINED PRODUCTS
UNDER THE HYDROCARBONS LAW IN 1988

		S/./G.	%
1.	COSTS		
	Raw Material Cost	45.69	37.4
	Refining Cost	10.42	8.5
	Import Costs	4.16	3.4
	Transportation and Storage Cost	9.36	7.6
	Marketing Cost	6.55	5.4
	Subtotal Costs	76.18	62.3
2.	TAXES	11.00	9.0
	Subtotal Costs + Taxes	87.18	71.3
3.	PROFITS	35.09	28.7
	Refining	13.51	11.0
	Distribution	21.58	17.7
	TOTAL COSTS + TAXES + PROFITS	122.27	100.0

Note:Other costs could legitimately be added to these: the depletion allowance and an amount destined to cover the cost of cleaning up environmental pollution problems created in and around currently exploited oil fields.

Source: DNH and Work Group calculations.

Alternatives for Refined Product Price Levels

3.14 To analyze the impact of the price of refined products on macroeconomic variables, the price series according to the Hydrocarbons Law and prices according to replacement costs and to economic costs with 30% profit margin structure were considered. Increases over present-day prices would be around 115%, 190% and 260%, respectively.

Average Level of Refined Product Prices

3.15 Although constraints of the Hydrocarbons Law cannot be avoided (unless the law is amended), a pricing policy should be designed that will bring refined product prices closer to actual domestic replacement costs and to (international) economic costs.

Hydrocarbons Law Option (Low Option)

3.16 This alternative assumes that, under the provisions of the Hydrocarbons Law, prices at historical costs will be readjusted and that their real value will be maintained. According to this proposal, in 1988 the average price should be increased by 115% as of June (125 S/./G.). With respect to current prices, this alternative would imply a 114% increase in raw material costs, owing to monetary devaluation. By repaying the loans for the expansion of the Esmeraldas and the Amaznas Refineries, this alternative would increase refining costs by 128%. The cost of imports has been reduced by 58%, owing to the increase in domestic refining capacity. On the whole, costs plus taxes are increased by 45%. As for the profits that were not considered in 1987, for 1988 they are estimated at 40% of costs plus taxes, due to the aggregation of the various stages, on which a cumulative 30% is applied.

Opportunity Cost Option (High Option)

3.17 This policy is based on the international price of crude and on what Ecuador forgoes by selling the crude at domestic historical cost. Under this alternative, the average price of refined products, as of June 1988, would be 212 S/./G., that is, four times the current price (58 S/./Gal). According to this proposal, the establishment of refined product prices would permit the economy to move gradually from oil exporter to oil importer by the late 1990s. The establishment of refined product prices, under this alternative, requires that the Hydrocarbons Law be amended. (This was also proposed in this paper. See paragraph 3.2, "Institutional Aspects").

Replacement Cost Option (Recommended Option for the Short-Term)

3.18 This alternative takes into account the costs of gradual replacement of current reserves, in terms of the costs of exploring, developing, and producing the new fields that have been discovered. According to the exploration policy developed by CEPE, it is estimated that the replacement cost in the Central Oriente zone is the most representative. With this replacement cost, the average price of refined products would come to 170 S/./G. in 1988, i.e., nearly 200% higher than the current prices.

3.19 According to this policy, pricing of refined products would not require modification of the Hydrocarbons Law, but rather a reinterpretation that would take into account the need to replace reserves consumed. This is the option recommended by the Work Group.

3.20 Prices according to the three alternatives are shown in the following table:

Table No. 3.5

AVERAGE PRICES OF REFINED PRODUCTS ACCORDING TO THE THREE ALTERNATIVES - IN 1987 US$/B

	1988	1989	1990	1991	1992	1995	2000	2005
Low Alternative	8.1	17.0	16.3	15.0	14.7	15.1	14.3	17.1
High Alternative	8.1	28.7	26.9	27.1	28.3	30.0	33.7	39.1
Rec. Alternative	8.1	23.0	22.5	21.5	21.3	21.3	20.0	22.6

Source: World Bank and Work Group Estimates

Refined Products Price Structure

3.21 As discussed in Chapter II, the price structure of refined products in Ecuador shows two major distortions: the first has to do with diesel fuel and the second with LPG. Thus, the ratio of the price of Diesel No. 2/Premium Gasoline is 60%, and that of LPG/average price is 56%. The proposed change in the refined product price structure, independent of the high and low alternatives for the average price, is aimed at decreasing such distortions in the short-term, considering social aspects of the LPG prices and the advisability of showing the growth of LPG consumption.

Table No. 3.6

PRICE STRUCTURE
%

	Current	Proposed
"Super" gasoline	190	150
"Extra" gasoline	155	130
Diesel 1	95	115
Diesel 2	95	115
Residual Fuel	60	60
Kerosene (Home Use)	52	80
LPG	56	100
Average Price	100	100

Source: DNH and Work Group.

3.22 The proposed price structure is narrower than the current one and makes it possible to approximate the international structure, particularly in gasolines and other middle distillates. It would decrease diesel fuel subsidies, and to a lesser extent, LPG subsidies. The relative price of super gasoline/extra gasoline will make for higher consumption of super gasoline, while the relative reduction of the price of extra gasoline would be offset by the increase of diesel fuel prices. Kerosene for household use and LPG would remain competitively priced (though with a relative price advantage to

kerosene, which is used in the poorest households), and the incentive for using fuel oil instead of diesel No. 1 would be maintained.

3.23 This is an indicative price structure and may be modulated and progressively adapted as prices are adjusted. Table No. 3.7 shows individual prices of refined products, under the current structure and under the proposed structure, given the recommended alternative of the average weighted price of refined products.

Table No. 3.7

REFINED PRODUCT PRICES
(1987 dollars per barrel)
(REPLACEMENT COSTS, UNDER THE CURRENT STRUCTURE)

	CURRENT	1988	1989
Super Gasoline	15.4	33.1	42.9
Extra Gasoline	12.6	27.1	35.1
Diesel 1	7.7	16.5	21.5
Diesel 2	7.7	16.5	21.5
Residual Fuel	4.9	10.5	13.7
LPG	4.5	9.8	12.7
Kerosene Home Use	3.8	8.2	10.6

(REPLACEMENT COSTS, UNDER THE PROPOSED STRUCTURE)

	1988	1989
Super Gasoline	26.6	34.5
Extra Gasoline	23.0	29.9
Diesel 1	20.4	26.4
Diesel 2	20.4	26.4
Residuum	10.6	13.8
LPG	17.7	23.0
Kerosene Home Use	14.2	18.4

Source: DNH and Work Group Calculations.

3.24 These price structures demonstrate the effect on the relative prices of hydrocarbons in the household, transportation, and industrial sectors. Kerosene for household use is less expensive than LPG for cooking purposes and supports the recommended policy of promoting the use of kerosene in rural areas. Diesel 2 maintains its comparative advantage over extra gasoline in transportation, so as to give moderate encouragement to "dieselizing" heavy transportation. Fuel oil also maintains its comparative advantage over diesel 1 for heat generation.

Table No. 3.8

RELATIVE PRICES OF REFINED PRODUCTS
WITH THE RECOMMENDED PRICING OPTION

SECTOR	CURRENT STRUCTURE COST USF. ENER. US$/TOE	REL. PRICE	PROPOSED STRUCTURE 1987 COST USF. ENER. US$/TOE	REL. PRICE
HOUSEHOLD (1)				
- KEROSENE	226	1.00	395	1.00
- LPG	246	1.09	438	1.13
TRANSPORT				
- DIESEL 2	618	1.00	759	1.00
- GASOLINE	1.438	2.33	1.225	1.61
INDUSTRIAL (2)				
- FUEL OIL	149	1.00	150	1.00
- DIESEL 1	258	1.73	316	2.10

NOTE: (1) Cooking; (2) Heat

Source: OLADE, INE.

Program for the Immediate Adjustment of Refined Products Prices

3.25 As an immediate measure, historical costs must be revised by introducing the revalued assets in depreciation estimates adding all exploration costs and estimates of the minimum return on investment. This will offer a precise idea of current costs. The concept of crude oil production costs set forth in the Law should be reinterpreted as the replacement cost in order to readjust future prices until the Hydrocarbons Law is changed to allow for the use of economic costs in the pricing formula. Furthermore, legal changes should empower the Executive Branch to gradually incorporate such cost in the pricing of refined products, so that the national economy will gradually adjust to an oil-importing situation, as is anticipated for the late 1990s.

3.26 The specific for the average price of refined products is that by mid-1988 the level of the Hydrocarbons Law be reached (125 current sucres/gallon), that is, a 115% increase over current prices, and that these prices be kept stable in real terms. Starting in 1989, the aim should be to reach replacement cost, in real terms and in the short run. This implies that the increase for that year, in real terms, should be about 30%. Subsequently, current prices should be adjusted, at least to offset inflation.

Table No. 3.9

REAL INCREASE IN REFINED PRODUCT PRICES

	APRIL 1987	JUNE 1988 CURRENT	JUNE 1988 NEW (*)	1989	
87 SUCRES/GALLON		58	39	84	110
PERCENTAGE VARIATION			-33%	115%	30%

(*)If the price adjustment takes place in the last quarter of 1988, the increase should be around 140%, owing to cumulative inflation.

Source: Work Group.

Proposals for a Financial Solution for CEPE

3.27 Chapter II suggested that to prevent CEPE's financial collapse in the short run, its entrepreneurial activity should be rescaled and structural changes in the oil revenue distribution system should be made. The measures that will lead to CEPE's financial rehabilitation by establishing investment priorities and by bringing changes to the allocation of oil revenues are described in the following paragraphs.

Establishing Investment Priorities for CEPE

3.28 CEPE's investment program, according to the Five-Year Plan updated in June 1988, provides for a $1,102 million investment over the 1988-92 period. Of this amount, 64% represents processing and transport projects that should be of low priority. This study proposes a five-year program of US$ 653 million, 23% of which is earmarked for processing and transport. The program would emphasize exploration and development/production. The proposed program is described in the following paragraphs.

3.29 The following discussion of certain specific projects included in CEPE's Five-Year Program aims to review each of these projects. The first recommendation, which is of the utmost importance for CEPE, addresses the preparation of CEPE's investment budget. It is recommended that CEPE reinforce the team that coordinates the investment budget in the planning department to improve the economic analysis of projects submitted by the several sectoral departments. This team, which would use consistent economic criteria, must have authority to prioritize projects submitted, on the basis of economic returns. Thus, the total investment budget would only include those projects that are absolutely essential to CEPE and economically viable, and they would be classified according to economic priorities for the optimum use of the scarce investment funds.

Exploration

3.30 During the last three years, CEPE's exploration efforts have declined substantially: only three wells have been drilled, and 2200 km of seismic lines have been run in the Amazon Region and 3247 km in the Gulf of Guayaquil. In contrast, the activities of the international companies grew with the drilling of 15 wildcat wells and the running of 15,000 km of seismic lines in that time span. This imbalance will be corrected in the future: beginning in 1990, the international companies' exploration investments will significantly decrease, upon the expiration of the exploration period that appears in the contracts, in accordance with the Hydrocarbons Law.

3.31 CEPE estimates a US$79.2 MM investment over a five-year period for the drilling of 14 wildcat wells and the running of 5000 km of seismic lines. Minimum investments, totalling US$111.4 MM, envisaged in this study, will increase the number of proposed wells to 23, with the same length of seismic lines.

3.32 The difference between the investments is due to the higher cost of the wildcat wells estimated in this study (US$2.0 MM/well) compared to the CEPE plan (US$800 thousand/well). For the above-stated reasons, CEPE will increase its exploration activities as of 1990 to five wells a year, and will drill 15 wells a year over the 1993-2000 period. This figure is based on the fact that the Corporation will have more resources available for exploration from its 25% share in the net income of the contracts.

3.33 The limited seismic work carried out by CEPE in recent years reduced the potential number of prospects to be drilled in 1988-1992. This situation will change after 1993, with the reactivation of seismic investment since 1988.

3.34 Oil-company investment in exploration will reach US$370.1 MM by 1992. This covers the drilling of 40 wells and the running of 5000 km of seismic lines.

3.35 Wildcat and outpost wells will have to be drilled in the Amistad Field in order to determine whether or not it has commercial gas reserves. Any gas-use project will have to be based on a reliable evaluation of proven reserves. If the project is to be economically viable, it should guarantee a production capacity of 50 MM PCD of gas for 20 years, equivalent to a reserve of 365 billion cubic feet. This high-risk exploration should be left to foreign investors.

Production

3.36 Production investments proposed in this study for 1988-1992 are higher by US$80.6 million than those envisaged by CEPE. This is because CEPE does not consider the development of fields in the Central Oriente, such as Capiron (N-C), Tivacuno, Curaray, and Primavera. On the other hand, it underestimates the amount of investment for development wells (US$660 thousand/well), as compared with US$1.2 million/well in the proposed plan (based on more recent cost experience).

3.37 The investment policy proposed in this study is based on the Optimistic production hypothesis. According to this hypothesis, the Tiputini-West Field and the undeveloped zones of the Northeast would be incorporated between 1992 and 2000 and, as of 1995, the Tiputini-Yasuni-Lorocachi deposits. Petroleum companies would invest around US$500 million in production up to 1992, while CEPE would invest US$340 million over the same period under the proposed program.

3.38 Oil-company investments decrease from 1992 on and disappear by 1995, assuming the continued historical average of positive exploration results, or 50%. As of 1992, a substantial portion of the exploration efforts will fall to CEPE, for the above-mentioned reasons, and also because the CEPE-TEXACO Consortium exploration area will have reverted to the Corporation under its contractual provisions.

3.39 Investments in field development could be financed by international organizations, given the very high profitability of this type of operation, as is the case of the North Oriente fields. Exploration investments would be made by CEPE on its own.

Oil Refining

3.40 It is recommended that CEPE's project of installing conversion units in the Peninsula refineries be reviewed at the close of the present five-year period. Such a review should study the most economical means to meet demand and take into account new available technologies that provide greater flexibility in the slate of refined products, particularly of LPG, gasoline and diesel, while minimizing the output of fuel oil.

3.41 Another gas-liquefaction plant with a 15-million cubic feet/day capacity, in CEPE's Campo Libertador, near Shushufindi, is now up for bidding. Any future scheme to use that gas should take into account the potential production decline that the Shushufindi-Aguarico Field, as well as the Campo Libertador, will experience as of 1992 with declining volumes of gas. CEPE should consider substituting the gas-lift system with electric or hydraulic systems when the water content of wells increases. This would imply that the amount of gas available in the fields will diminish significantly over the coming years as will the volume of liquids for recovery by the gas-lift compressors.

3.42 Prior to making a decision regarding the new liquefaction plant, it would seem advisable to make comparative technical-economic studies of the following alternatives, among others:

- The plant with a 15 MMCFD capacity in Libertador, now under bidding.

- A plant similar to the above, but installed in Shushufindi.

- Expansion of the present plant in Shushufindi.

- A fractionating plant for liquids obtained in the gas-lift compressors to be installed in Libertador and for the current surplus of the Shushufindi compressors.

Industrial Projects in Association with Other Companies

3.43 It is recommended that CEPE act as supplier of raw materials to the aromatics plant (US$4.5 million) that is to be established next to the Esmeraldas Refinery. It is also recommended that the private sector be the sole investor. As for plans for a methanol processing plant (US$9.9 million) to be located near the future Libertador gas plant, it is recommended that they be cancelled because the project is not profitable.

3.44 Plants for processing essential oils for lubricants/paraffins (US$147.6 million), as well as the ammonia-urea plant (US$10.2 million), should be postponed because these investments have low economic returns and uncertain markets. Besides, the ammonia-urea plant would depend on whether gas actually exists in the Gulf of Guayaquil and on its profitability and economic prospects at the time this is confirmed.

3.45 CEPE's investment program includes US$5.6 million to study the possibility of building an asphalt plant in the Amazonas Refinery and an ammonia-urea plant in the Oriente. For reasons already mentioned in Chapter II (adequate capacity for asphalt and absence of economic justification for an ammonia-urea plant), it is recommended that these studies be cancelled.

Transport and Storage

3.46 CEPE's investment program for a new seaport terminal in Monteverde, for products pipelines to Libertad-Monteverde, Manta and Monteverde-Pascuales, should be evaluated separately. The products pipeline project, Pascuales-Naranjal-Cuenca and Naranjal-Machala, should also be evaluated separately, comparing its costs with those of the current transport and distribution system.

3.47 CEPE's budget provides for the expansion of the Trans-Ecuadorian Pipeline (US$2.7 million). Based on oil production estimates of the Work Group, it is recommended that planned basic and detailed engineering work be postponed until the reserves and output potentials require an expansion.

3.48 The following table provides an alternative five-year investment program, in line with the above recommendations:

Table No. 3.10

CEPE: RECOMMENDED INVESTMENT PROGRAM a/
(in millions of 1987 dollars)

	1988	1989	1990	1991	1992	TOTAL
Exploration	14.1	22.0	27.1	23.9	24.3	111.4
Production	76.7	47.7	68.3	68.3	79.1	340.1
Processing	9.7	33.0	0.9	0.9	0.8	45.3
Transport & Storage	39.1	26.9	17.8	8.5	9.3	101.6
Marketing & Other Serv.	14.4	9.8	8.1	8.0	8.5	48.8
Total	154.0	139.4	122.2	109.6	122.0	647.2

a/It includes an increased amount for the Libertador gas plant, up from $26.7 million to $31 million (most recent estimate).

Source: Work Group.

3.49 The proposed five-year investment totals US$647.2 million, or US$455 million less than CEPE's original program. Emphasis is on exploration and production investments, with only 23% allotted to processing, transport, and storage.

Alternate Financial Solutions for CEPE By Means of Allocation of Oil Revenues

3.50 As may be seen in Table No. 3.10, reduction in CEPE's investment program for the 1988-1992 period, although it entails a 41% reduction in comparison with the original five-year plan, will bring only a partial solution to the Corporation's unbalanced budget. The deficit would still remain high (40%) and operational deficits would still persist.

Table No. 3.11

CEPE'S FINANCIAL SITUATION WITH MINIMUM INVESTMENT PROGRAM
(in millions of 1987 dollars)

ITEM	1988	1989	1990	1991	1992	TOTAL	ANNUAL AVERAGE
Income	479	403	380	382	381	2025	405
Current Expen.	519	533	549	550	565	2717	543
Surplus (Op. Deficit)	(40)	(130)	(169)	(168)	(184)	(692)	(138)
Capital Expen.	(154)	(139)	(122)	(110)	(122)	(647)	(129)
Surplus (Total Deficit)	(195)	(270)	(291)	(278)	(306)	(1340)	(268)
% SURPLUS (Deficit)	(29)	(40)	(43)	(42)	(45)		(40)

*) The dollar rate of inflation is assumed to be 3.5% a year.

Source: Work Group.

3.51 The alternate solutions proposed below are based on three rationales: the first deals with the need for confronting CEPE's financial troubles by eliminating basic causes (exchange rate ceilings and non-recovery of costs); the second refers to the possibility of changes in revenue allocation because of the impact on other recipients; and the last to consideration of legal obstacles that must be overcome. These solutions will be examinned in light of the general hypotheses in this study with regard to production of crude, domestic demand for refined products, investment, inflation and monetary devaluation, and the increases of refined product price to levels allowed by the Hydrocarbons Law.

3.52 Alternate solutions are evaluated with regard to CEPE's deficit for the 1988-1992 period and to the degree of self-financing of investments as shown in Table No. 3.12. Chapter IV analyzes the impact these solutions would have on the income of other oil revenue recipients.

3.53 As shown in the following table, unless fuel prices are increased at least to the levels established by the Hydrocarbons Law, and are maintained in real value, CEPE's deficit will rise to 43%, and the corporation will have no resources of its own for investment. The base case includes fuel price readjustments, and it is against this case that several alternative solutions are compared.

Table No. 3.12

CEPE: FINANCIAL ALTERNATIVES FOR THE 1988-1992 PERIOD

ALTERNATIVE	SURPLUS (DEFICIT) MM 1987 US$	SURPLUS (DEFICIT) %	SELF-FIN. INVEST. MM 1987 US$	SELF-FIN. INVEST. %
Base case, non-adj. Fuel Prices	(1453)	(43)	0	0
Base case, adjust. Fuel Prices	(1340)	(40)	0	0
Elimination exchange rate ceilings	(53)	(2)	594	92
Cost recovery with current income	(420)	(13)	228	35
Cost recovery + 5% Oil Income	(259)	(8)	389	60
Sales Costs Recovery +20% Prof. of Refined products	(371)	(11)	376	43

Source: Work Group.

Elimination of Exchange Rate Ceilings

3.54 With this alternative solution, which assumes that CEPE will receive its income from the North Oriente crude-oil exports, from the CEPE-TEXACO Consortium and from fuel oil exports at the Central Bank managed rate of exchange instead of at the rate of 44 and 66 sucres/dollar, CEPE's deficit would practically disappear and 92% of its investments would be covered. Revenues would increase by US$1306 million compared to the base case, with an annual average of US$257 million, mainly because of the above-mentioned increases in the sucre value of export earnings.

3.55 This alternative requires that Law No. 138 on Rural Roads and Law 02 on Wage Increases be changed by Congress and that Law 08 on the Second Wage Increase be amended. Such a solution would generate income for CEPE far above that required to maintain a sound rate of self-financed investment (from 30 to 40%) on the one hand, and it would have a significant negative impact on the Government Budget on the other. If adopted, it would have to be implemented pari-passu with a high profits tax on CEPE.

Cost Recovery If Current Revenue Allocation System Is Maintained

3.56 CEPE's deficit for 1988-1992 would drop to 12% as its income grows by US$919 million, mainly due to recovery of costs of crude oil and fuel oil exports, and to sales of refined products on the domestic market. This would allow 35% of investments to be self-financed.

3.57 The viability of this solution would imply the enactment of a new law to strengthen the provisions of the current Hydrocarbons Law (which states that CEPE must recover its costs in all its

activities) and overrule other existing laws and regulations which prevent CEPE from recovering its costs. Further legal changes would not be necessary.

3.58 This alternative, however, contains a basic flaw: that CEPE, by virtue of economic logic, would tend to be inefficient, since its income would depend on cost increases rather than on the impact of international oil prices, or of refined product prices on the domestic market, or on the efficiency of its entrepreneurial activities.

Cost Recovery Plus Percentage of Oil Revenue

3.59 From the standpoint of CEPE's own operational economic logic, this alternative is without any doubt the only long-term solution, not only because of its financial implications, but also because it could serve to transform the Corporation into a real enterprise.

3.60 The assumption underlying this analysis is that in addition to recovering its costs and eliminating all current interests in other companies, CEPE would receive 5% of the oil profits generated by each of its activities. As a result, the budget deficit would drop from 40% to 8%. Income would increase by US$1,080 million over the five-year period, and 60% of investment would be covered due to improvement in income from all corporate activities.

3.61 Besides the legal changes mentioned above, this solution requires the derogation of the provisions governing CEPE's current share of oil revenues.

Cost Recovery Plus Percentage of Profit of Refined Products

3.62 For the immediate future, in order that CEPE may cover its 1988 budget deficit and reduce deficits in the 1988-1992 period, it is proposed that CEPE recover the costs of refining and distributing products in the domestic market, plus a 20% profit margin in each of these activities. This option would reduce the deficit over the five-year period to 11% and generate US$968 million in additional income.

3.63 This would require no legal changes. The only requirement would be that the Regulations of the Law (without number) of the National House of Representatives, plus Ministerial Resolution No. 440 of the Ministry of Finance, be revoked and that regulations for the implementation of Article 73 of the Hydrocarbons Law be issued.

3.64 It is clear that this is but a partial solution that can only be effective if fuel prices in the 1988-1992 period are systematically adjusted to the levels of the Hydrocarbons Law.

Recommendations

3.65 The alternatives of eliminating exchange rate ceilings, recovering costs and having a percentage of profits should be considered within global reordering of oil revenues. In this manner, CEPE's financial situation and the public sector's medium- and long-term financing priorities would be considered. This reorganization is imperative for CEPE's normal development and for ending the present chaotic allocation of oil revenues. Its implementation will require several months of analysis, decisions, and legal reforms.

3.66 The third option is proposed as an immediate alternative which would permit covering the 1988 deficit and would provide some relief for the 1989 deficit. This alternative is all the more viable as it must go hand in hand with the fuel price increases suggested for this year.

Measures Related to Institutional and Legal Aspects

3.67 Three sets of reforms must be undertaken in the oil sector: an overall organizational restructuring, legal and financial reforms within CEPE, and improvements in supervision of oil company operations.

Organizational Restructuring

3.68 The MEM should mould INE into a strong and permanent advisory body responsible for the formulation of regulatory policies for CEPE and INECEL and the follow-up and adjustment of such policies. To this end, by amending the Hydrocarbons Law, the advisory committee on petroleum policies should be transformed into an advisory committee on energy policy, with the participation of INE, whose Director should be a member of CEPE and INECEL Boards of Directors. To speed up the implementation of this proposal, it is suggested that officials of INE be posted to CEPE and INECEL, in order to reinforce coordination in sectoral planning with better knowledge of these firms. In addition, INE's administrative and salary status should be improved.

3.69 The DNH should focus on technical control of CEPE and the operators and abandon its financial audit role in favor of the Superintendence of Companies. In this regard, we suggest that the Law of Companies be amended so that the Superintendence is allowed to cover public enterprises such as CEPE and INECEL which are now outside its purview.

Judicial and Financial Reforms

3.70 A drastic reformulation of CEPE's enabling legislation is required to grant CEPE managerial and financial autonomy. CEPE's new Law should include the following major features:

- The same rules that apply in private sector management should be applied to CEPE's operational, financial and human resources management.

- CEPE may establish affiliated companies and subsidiaries as required over time, so that in the medium-term and once it has achieved an appropriate managerial and administrative development, it can become a holding company.

- All of CEPE's equity stock must remain with the Ecuadorian State in the case of main activities such as exploration, production, transportation along products pipelines and oil pipelines, and also external marketing. In other activities, such as domestic distribution and marketing of products and their processing, stock ownership could be opened, with national and foreign private capital, to affiliated companies or to mixed (public-private) companies. This will ensure access to capital, technology and managerial know-how.

- CEPE's top management should represent the interests of the Ecuadorian State in the management of oil resources while retaining the administrative and operational autonomy of a corporation. To this end, it is suggested that the Board of Directors include permanent delegates of the Executive Branch, appointed by the Presidency of the Republic, rather than delegates from the different ministries.

- CEPE should be audited periodically, just as private corporations are, and it should also be audited by the Superintendence of Companies.

3.71 CEPE's new Incorporation Charter should include the Corporation's financial rationale, under the following guidelines: cost recovery at each stage of the industry and a percentage of oil profit generated by each activity, according to their characteristics. The Board should fund a reserve for investment in exploration on an annual basis and according to the financial results of CEPE and to the need for exploration programs. This would apply until the 25% of net earnings from service contracts for hydrocarbons exploration and production begin to materialize, in accordance with the Hydrocarbons Law. As for the production, transport, marketing and refining stages, CEPE should turn over to the Ecuadorian State as income tax no less than 90% of oil profits.

Supervision of Operators (Oil Companies)

3.72 In compliance with contractual commitments, in the 1988-1992 period CEPE should take over the operation of the CEPE-TEXACO Consortium, operation of the Anglo and Repetrol refineries and operation of the CEPE-CITY Consortium joint field. To this end, it is suggested that once the new legal charter for CEPE is drawn up, a new subsidiary company should be established for the joint management of oil production in the North and Central Oriente fields. Likewise, a subsidiary should be established to manage the refineries. It is recommended that, in each case and well enough in advance,

the necessary improvements in management staffing and procedures should be carried out, with assistance from other public companies and international organizations.

3.73 CEPE's administration of the companies providing services for the exploration and production of hydrocarbons should comply with contract provisions and include persons of vast experience in the oil sector.

Electric Power

Measures for the Electricity Subsector

3.74 The current situation can only be solved by implementing a consistent set of measures, some of which must be taken in the very short-term, while others should be taken through medium-term programs. A summary of measures recommended for the Electricity Subsector follows.

Expansion Plan

- Reduction of investment with the following considerations:

  a) Deferment of the Paute-Mazar Project and consideration, instead, of a steam generated thermal plant of 125 MW for 1996 or 1997.

  b) Revision of the Demand Projection.

  c) Reprogramming of works in progress.

  d) Execution of indispensable, scheduled works: Daule-Peripa, dredging, transmission, studies.

  e) Reduction of investment in other activities.

- Tariffs: Establishment of an adequate tariff level that will permit covering costs in the short-term and contribute to investment in the medium-term. For this purpose, it is recommended that the tariff for bloc sales be increased by 100% and the tariff for final consumer, by 40%, after which they should be maintained at their real value with regular increases to keep up with inflation.

- Reduction of Power Losses: of the electric companies from 17% to 15% over the years 1989-1990, and then to 12-13% over the years 1992-1993.

- Capitalization of the Subsector: It is essential that the Government make annual capital contributions to INECEL, as required by investment needs. The exchange rate ceiling of S/.66.50/dollar for oil royalties should be eliminated.

- Structuring of the Subsector: EMELEC should be integrated into the sector according to the law and to its contract, so as to avoid the bad debts problem and optimize energy generation.

- Cutback of the number of Distributing Companies: to total of 9.

Institutional and Legal Aspects

- Change INECEL's legal framework, transforming it into a state-owned company, under the supervision of the Superintendence of Companies, in order to:

- Limit the influence of the Board of Directors on internal management.

- Revise Board membership.

- Reestablish control over the electricity companies.

- Establish more normal and balanced labor relations.

- Improve coordination within INECEL and between INECEL and its affiliated distribution companies.

- Implement a Public Relations and Information program that addresses subsector issues.

Expansion Plan

Investment Reduction

3.75 The Master Electrification Plan requires comprehensive updating in order to be in line with present and future financial conditions. This updating can be achieved by studying alternatives that will drastically reduce investment, especially in the short/medium term. The possibility of limiting electricity coverage to priority areas in addition to a reasonable reduction in the degree of reliability of the service should be considered as a means to lower investments needs.

3.76 It does not seem reasonable to include as medium-term alternatives facilities that are at the preliminary study level and which, therefore, almost always seem more attractive than other projects with more advanced studies. Before comparisons can be drawn, all projects should be at the same stage

of preparation. This would lead to the optimization of projects and a more accurate and adequate determination of the least cost sequence.

3.77 Within the context of the present paper, an alternate expansion program was analyzed based on the following hypotheses:

Demand projections should be revised downward (as a consequence of slower economic growth). A comparison of the Master Plan and the Alternate Plan projections is shown in Table No. 3.13.

Table No. 3.13

INECEL: MASTER PLAN AND ALTERNATE PLAN
REQUIRED PEAK POWER AND GENERATION PROJECTIONS

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Energy (GWh)										
Master Plan	5385	5650	5944	6241	6634	6967	7306	7659	7994	8332
Altern. Plan	5246	5495	5812	6119	6444	6758	7175	7530	7851	8196
Peak Power (MW)										
Master Plan	1027	1067	1122	1175	1255	1310	1371	1434	1492	1553
Altern. Plan	1021	1066	1131	1181	1245	1296	1380	1439	1496	1555

Source: INECEL and Work Group Estimates.

3.78 The difference in energy is enough to delay a new project for about half a year. Variations in peak demand are of no significance. Future alternative Expansion Plans should use lower demand projections.

Generation

- Reprogram generation facilities under construction (Paute C), within contractual terms.
- Construct Daule Peripa and start-up in 1993 (as in the Master Plan).
- Execute first dredging phase (deep dredging) of the Amaluza Reservoir (as in the Master Plan) and study definitive alternative solutions for silting in the Amaluza Reservoir.

- Postpone the Mazar project.

- Recondition part of the thermal generation facilities of the distributing companies between 1989 and 1993, thus postponing, by at least one year, start-up of new major plants.

- Consider construction of a steam plant (125 MW) for start-up in 1996, to be followed by a hydropower project (possibly San Francisco) in 1998. This solution is relatively theoretical because of the limited information available on the feasibility of the project. This could be supplemented by studying other alternatives such as medium-capacity hydroelectric plants, if economically and/or financially justified.

Transmission

- Continue projects in the Master Plan, although technical studies for postponement of the Paute-Pascuales-Prosperina line (25 million dollars at June 1987 prices) would seem advisable.

Distribution (Excluding EMELEC)

- Limit INECEL investments in distribution to 60% of the amount budgeted under the Master Plan.

- Allocate to distributing companies a maximum annual amount of $20 million, that should include sums for reconditioning thermal facilities.

- Complete rural electrification works which have financing. In the future, consideration shall be given only to those works that have specific government appropriations or which are financed with soft loans.

Other Investment Studies

- Continue the studies that are funded, the most important of which are the feasibility studies for the San Francisco, Sopladora, Coca-Codo Sinclair, and Chespi projects (the latter not yet financed).

Other Assumptions

- Use a discount rate of 10% instead of the 8% used in the Master Plan.
- Use more realistic costs for fuels (i.e. lower).

Investment Schedule

3.79 The Alternate Plan would give rise to the following investment flows:

Table No. 3.14

ALTERNATE EXPANSION PLAN

(1988-1997 Investment Program)
(in millions of June 1987 dollars)

YEAR	88	89	90	91	92	93	94	95	96	97	TOTAL 88-92		
Generation	36	71	22	12	38	26	81	160	100	51	179		
Transmission	26	35	24		2	2	1	2	13	16		6	89
Distribution	76	48	29	30	26	29	30	26	26	25	207		
Other Invest.	12	16	11		4	3	3	2	3	2		3	46
Subtotal	148	170	86	48	69	59	115	262	144	85	521		
Interest during Construction	9	9	6	6	6	8	11	19	26	22	36		
Total	157	179	92	54	75	67	126	221	170	107	557		

Source: Work Group.

Compared with the Master Plan (Table No. 2.20, Chapter II), it will be noted that in the 1988-92 period alone, the Alternate Plan shows a reduction of $416 million ($973 million versus $557 million). This means that investments are reduced to less than 60% of their initial value. The reduction is maintained throughout the 1993-97 period, although in less significant amounts.

3.80 The Alternate Plan has the following Source and Applications of Funds.

Table No. 3.15

ALTERNATE EXPANSION PLAN
(Source and Application of Funds)
(in millions of June 1987 dollars

EAR	88	89	90	91	92	93	94	95	96	97	88-92
Total Investment	157	179	92	54	75	67	126	221	170	107	557
Net Internal Generation	-21	-82	-76	-68	-34	-12	-10	- 6	-16	-33	-281
Loans (*)	99	60	20	18	28	21	72	153	98	46	225
Deficit	79	201	148	104	81	56	64	74	88	94	613

* Disbursements on outstanding loans under negotiation

3.81 In view of the tariff assumptions in this study, to adopt the Alternate rather than the existing Master Plan would cut the deficit for the 1988-92 period from $734 to $613 million, which means a reduction of $121 million. Net internal generation of funds remains negative throughout the 1988-97 period, but in the Alternate Plan there is a hefty reduction of loan disbursements (postponement of costly projects).

3.82 Top priority would be given to revising the expansion plan, beginning with the revision of demand projections. Quite probably, after Paute C and Daule Peripa, the next power plant will not be required until 1996 or 1997. As no new short-term investments are necessary, feasibility studies for the new hydroelectric projects should be done in time to revise the expansion plan on the basis of more accurate project characteristics and costs.

Tariffs

3.83 Tariffs must be fixed at levels that will cover power supply costs in the short-term and contribute to investment in the medium-term. Measures adopted should include mechanisms to prevent the future deterioration of tariffs due to inflation, and consider a tariff structure that differentiates use by level of tension, time of day and season of the year.

3.84 In the short-term, a positive net internal generation of funds should be pursued. This could be achieved gradually, with annual increases, in real terms, for a few years, or quickly, with substantial increases. The study of tariffs determined global average costs for bulk sales and sales to final users. In 1988 sucres, these costs are 7.5 S/kWh and 12.8 S/kWh, respectively. On the basis of the

provisions in force until June 1988, it was estimated that this year distributing companies would be paying an average of 3.8 S/kWh for bulk sales, and final users, an average of 9.15 S/kWh.

3.85 The above figures are already outdated, due to the suspension in June 1988 of monthly increases. There are advantages to electricity tariffs being increased in conjunction with the prices of refined products. The first substantial increase should aim to cover supply costs, plus depreciation and financial charges. This would mean a 100% increase for bulk sales and a 40% increase for sales to final users.

3.86 On the assumption that tariffs will be increased in August/September 1988, the new average costs would be almost 7.5 S/kWh for bulk sales and 13 S/kWh, on the average, for sales to final users.1/

3.87 These tariffs could be maintained in real terms for one year. (This would require regular nominal increases equal to the rate of inflation). At the end of this period, a new increase would be made for adjustment purposes. After the second increase, tariffs should rise moderately, in real terms, until revenues contribute 20-30% of investment under the then approved expansion plan. Tariff increases should bring about some decrease in the growth rate of demand, that would, in turn, reduce the need for investment.

3.88 These increases could be used to introduce a more appropriate tariff structure, one more in tune with the expected results of the long-run marginal costs study, and which would involve:

a) Different increases according to different tension levels.

b) Standardize tariff blocks in all the distributing companies.

3.89 In bulk sale tariffs and in final user tariffs, all increases should be done simultaneously.

Reduction of Distribution Losses

3.90 Distribution losses should be reduced to acceptable values such as 15% in 1990-91 and 12%-13% in 1992-93. To this end, a campaign should be launched to measure and identify the major

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1/ Price hikes for refined products will increase the operation costs of the electricity sector in relation to those used for the tariffs study. Consequently, it will be necessary to estimate this effect and add it to the proposed tariff increase.

causes of loss through specific programs. The sequential implementation of these programs by company will be according to the absolute loss figures.

Capitalization of the Subsector

3.91 Tariffs alone cannot solve the financial deficit in the short-term. Solving this deficit is imperative for executing the new programs included in the expansion plan and for completing those in progress. It is essential that the government make annual contributions to INECEL's capital, according to investment needs, borrowing capacity, and income from power sales. Furthermore, the S/66.50 per dollar exchange rate ceilings should be eliminated from eventual royalties allocated by the National Electrification Fund. Annual contributions could be determinned on the basis of these royalties.

Structure of the Subsector

3.92 It is necessary to integrate EMELEC into the structure of the subsector, according to contract terms and to current legislation, since unilateral decisions taken by this company have given rise to a very significant debt with INECEL and have also hindered the optimization of power generation (operation of inefficient plants and non-operation of efficient plants).

Institutional and Legal Aspects: Changes in INECEL's Legal Framework

3.93 The most far-reaching measure recommended on these matters is changing INECEL's legal framework, in order to turn it into a public company, under the control of the Superintendence of Companies. This would enable INECEL to analyze its performance and to integrate its social role with its economic interests: in other words, to pursue corporate efficiency. The following improvements could be obtained from this measure:

Limit political interference by the Board of Directors, whose responsibilities would be:

- to define the policies that should be considered in the Master Electrification Plan;
- to approve the Master Plan; and
- to control its implementation.

3.94 Revise the composition, functions, and type of involvement of INECEL's Board of Directors, so that it may be institutionalized and include representatives from entities with related interests. It is also recommended that users be represented on the Board.

3.95 Reestablish control over the electricity companies, so as to harmonize planning and oversee investment.

3.96 Establish more normal and balanced labor relations that will enable middle management to regain its authority and create incentives for increased productivity.

3.97 Revise and simplify the Basic Law of Electrification and related laws, by eliminating controls that have no place in the operations of an ordinary stock company, i.e. controls such as approvals by bureaucratic entities, the law regulating bids, etc. Alternatively, a Law for Public Contracts could be enacted to take into account the size and complexity of power projects.

INECEL: Internal Organizational and Public Relations Aspects

3.98 INECEL's intra-subsectoral coordination with the distribution companies should be improved by simplifying relations until such time as the Institutional Development Study, sponsored by the World Bank, is completed and implemented.

3.99 It is also recommended that both the quality and timeliness of accounting information be radically improved. It should be systematized within INECEL and consolidated with the distribution companies.

3.100 INECEL should implement a comprehensive public relations program to improve the subsector's image. This image appears distorted to consumers, who only hear of tariff increases, and to the government, which mistakenly regards the subsector as successful and solid.

Energy Conservation Measures and Alternate Sources

3.101 The energy sector and the national economy can benefit from energy conservation and alternate sources of energy by integrating their development into the national energy policy.

3.102 Though lower subsidies for conventional energy products and continued development by INE will contribute to the promotion of energy conservation and to the use of alternate sources of energy, this needs to be complemented by certain policy and organizational changes that can be effected through the following policy measures:

Policy Measures

3.103 To update energy policy objectives this study recommends the following steps:

- Diversify sources and technologies, in order to bring energy supplies more in line with demand.

- Include environmental protection as a factor in the selection of energy projects and as a goal in the management of the energy sector.

- Update legislation and organization of the energy sector to make possible, when economically and technically feasible, the use of decentralized energy sources.

- Unblock private initiative by permitting co-generation.

- Establish expeditious financial arrangements (through development lending institutions) for investment in the conservation of energy and in alternate sources of energy, so long as the macroeconomic benefits exceed microeconomic benefits.

Specific Measures for Energy Conservation

In the Industrial Sector

- Continue the energy conservation program, by means of energy audits, training programs, technical assistance to the industrial sector, etc., that INE has been carrying out since 1981.

- Promote the optimum use of process heat in industry through co-generation, particularly in the sugar, paper, chemical, and glass industries. Elaborate and enact pertinent legal reforms.

- Study the feasibility of substituting non-commercial fuels (bagasse, industrial wastes, old tires, town garbage, etc.) and/or geothermal fluids (industrial parks in areas with geothermal reservoirs, not subject to volcanic risk, and with environmental safeguards for oil products).

In the Transport Sector

- Revise legal regulations in order to improve the efficiency and use of the existing vehicle fleet, particularly cargo vehicles (which are the largest fuel consumers), which have a relatively low load factor, and mass transport vehicles (which have greater potential for improving specific consumption of fuel per passenger/km).

- Reorganize urban traffic in order to improve its flow.

- Carry out a detailed study of fuel consumption (which is quite high) in shipping to develop a strategy for saving fuel.

In the Household Sector

- The urban household sector has a potential for saving on electricity consumption. This can be achieved by improving the efficiency of home appliances, controlling the time of use, and utilizing other energy sources.

- It is possible to locally produce better and more efficient lamps, fans, air conditioners, refrigerators, stoves, heat pumps, etc., than those currently used; this process should be encouraged.

Specific Measures for Alternate Sources of Energy

Solar Energy

- Employ, whenever possible and feasible, solar water-heating systems in projects promoted or built by the public sector.

- Consider photovoltaic systems in communications (IETEL) and health facilities (IEOS), in remote sites.

- Prepare design manuals for passive solar energy (INE), in coordination with the United Nations Environmental Program.

- Train professionals of the construction industry in the principles of passive solar energy (INE).

- Transmit knowledge about passive solar energy to local agencies responsible for urban development (INE).

- Continue improving kilns for drying wood, grains and fish (INE).

Mini-Hydroelectric Plants

- Program the construction of mini-hydro plants already identified, using domestic technology (INECEL-INE), after having made a financial evaluation.

- Acquire better understanding of the potential of mini-hydroelectric plants.

Geothermal: Completion of Feasibility Studies

- Continue work on the low-enthalpy project in the Valle de los Chillos (INE). If results are favorable, the feasibility of an industrial park should be considered.

- Continue work on the bi-national high-enthalpy project with Colombia (INECEL).

- Increase the number of studies of geothermal potential (INECEL-INE-Polytechnic Schools).

Biomass

- Coordinate (INE-Ministry of Agriculture) a program of incentives for forest plantations in Chimborazo, Cotopaxi, Tungurahua, Bolivar, Loja (the provinces with the largest firewood shortages). Aside from supplying industry, this would improve firewood supplies to households and other users.

- Promote training in forest management.

- Identify environmental protection projects with generation of energy, such as:

  treatment of sewage, using Imhoff tanks, processing of slaughterhouse wastes and of other industries, processing of solid garbage for heat generation, etc.

CHAPTER IV

IMPACT OF PROPOSED MEASURES ON THE ECONOMY

4.1 This chapter analyzes the impact that oil export measures would have on main economic indicators such as GDP, Balance of Payments, Public Finances, and domestic prices. The effects of the proposed measures, especially of prices and institutional changes (such as the distribution of oil revenue), on sector enterprises have been estimated and are covered in Chapter III, as are certain effects on the Government Budget.

4.2 The following summarizes the main conclusions reached concerning the effect of the proposed measures.

i) Under the optimistic hypothesis of growth in non-petroleum exports, a reduction in non-productive consumption, and a substantial increase in capital formation, it has been estimated that GDP growth for the four scenarios will fluctuate between 3.8% and 2.1% over the period 1988-1995. Only the first two would avoid the gradual impoverishment of the population, since Ecuador's annual demographic growth rate in coming years is estimated at above 2.6%. Under the low growth circumstances, the economy would suffer recession and high inflation.

ii) Results show the strong impact of the volume and prices of oil exports on economic growth.

iii) Readjustment of refined product prices, as well as change in their structure, would tend to increase exportable petroleum surpluses, as the additional revenue would lower consumption and smuggling, and increase investments.

iv) Increase in fuel prices would have a lower inflationary effect than is generally believed. Econometrically, a 100% increase should not have an impact greater than 3.6%. The real figure could be slightly higher because of psychological and speculative factors. This could be attenuated at the consumer level through monetary measures and proper controls. Furthermore, 15%-20% of the additional revenue could be used to subsidize mass transport and other needs which could palliate the impact of higher energy prices on the poorer sectors of the population.

v) The volume of petroleum exports would diminish between 1988 and 1995 due to the depletion of reserves, technical restrictions of production, and increase in domestic demand. For the high reserve scenario, the drop would be at an annual average rate of 6.6%; for the low reserve scenario, the drop would be 9.8% a year.

vi) This situation makes it essential to rationalize CEPE's investments, giving priority to exploration and field development which yield immediate returns. This would make it possible to increase exportable petroleum surpluses in the short run. High-risk investment should be undertaken by foreign companies.

vii) The two hypotheses of international prices and projections of the value of crude exports (and equivalent) in current prices show rates which range from 2.6% for the high scenario to -2.0% for the low scenario. Considering an average annual dollar inflation of 3.5%, a real decrease in the value of petroleum exports occurs under all scenarios.

viii) Revenue prospects from hydrocarbons exports, which are rather disheartening, require that non-petroleum exports be encouraged to compensate for future decrease of crude exports, which will tend to disappear by the end of the nineties.

ix) For both scenarios, the size of the Trade Balance will resemble that of recent years, with a slight growth in current dollars but a decrease in real terms. Consequently, it is necessary to attract foreign capital.

x) Thus, containment of public and private consumption is fundamental, as is the establishment of investment priorities to channel investment into those other export activities which, in the medium- and long-term, may become alternate sources of foreign exchange.

xi) The deficit in the Public Sector Budget, as is true in CEPE's and INECEL's budgets, can be diminished by increasing refined product prices and electricity tariffs and permitting only high priority investments.

xii) In view of the importance of oil exports, lower domestic consumption of oil products should be encouraged, and a fund should be created for investments in energy conservation.

xiii) Because electricity is used less than oil in productive sectors and households, an increase in electricity tariffs would have a lower inflationary effect than an increase in oil tariffs. The incidence of electricity as a production input, even in branches which use electricity intensively, such as the cement industry, does not exceed 3% of total production costs. Even though the increase in electricity tariffs does not have the same useful economic effects as an increase in the prices of refined products, it would help lower future demand and therefore reduce investment and foreign currency requirements.

xiv) Current inflation levels and trends require immediate price revisions at the suggested levels and the maintenance of these prices in real terms. A delay in revision, or the setting of lower prices, would be quickly nullified by inflation and would require repeated drastic increases, at much higher economic and social costs.

xv) The strong impact of the exchange rate on economic activity, CEPE and INECEL finances, the Public Sector Budget, Balance of Payments, etc., requires careful handling of the foreign exchange policy. The present framework generates great distortions; consequently, this policy should be revised so as to maintain a real dollar exchange rate which would make investment, import and export decisions easier, and artificial exchange rate ceilings should be eliminated at the same time.

Impact on Economic Indicators

4.3 Estimates were made of the impact caused by marginal variations in different parameters on the principal economic indicators (GDP and Value Added) by changing the structure of the input-output matrix. It is assumed that petroleum exports are the main explanatory variable of the behavior of GDP in the short- and medium-term.

Impact of Increased Crude Exports

4.4 Under the present economic structure (1986 intersectoral relations), an increase of 10% in petroleum exports represents an increase of 1.1% in GDP and in the Value Added of the economy. On the other hand, a 10% decrease in domestic demand for refined products, due to a price increase or some other energy conservation measure, produces decreased economic activity which results in a reduction of 0.1% in GDP. Consequently, for each 10% increase in fuel exports (which would require a reduction of approximately 20% in domestic consumption), a net increase of approximately 1% is obtained in GDP. 1/

Impact of Reduced Electricity Demand

4.5 Using the same type of analysis, a reduction of 10% in electricity consumption would cause a small decline in GDP (0.01%) and slightly higher savings of foreign exchange (0.02%). However, it should be borne in mind that substantial indirect savings of foreign currency would result from the decrease in electricity demand because of reduced construction programs, which have a large imported component. This would, moreover, help channel substantial financial resources into the electricity subsector, reducing INECEL's deficit considerably and therefore its need for government subsidies (and the growth of money supply). The foregoing, and the size of investment reduction, would

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1/ A 100% to 150% increase in the prices of refined products could cause a substantial decrease in the smuggling of those products out of the country and a 10% reduction in domestic consumption, thus increasing exports by approximately 10%, which could result in a 1% increase in GDP.

conserve electricity by setting tariffs which discourage waste, by reducing losses (technical and economic), and by improving the efficiency of end use equipment, etc.

Impact of Inflation

4.6 Based on the production and final consumption structures of 1986, estimates have been made, as shown in the following tables, of the impact of the increase in refined product prices and electricity tariffs on inflation at the gross production and final consumer levels. These estimates are shown in the following table.

Table No. 4.1

STRUCTURE OF DOMESTIC CONSUMPTION AND FINAL ENERGY DEMAND
AVERAGE PERCENTAGE OF ENERGY CONSUMPTION IN PRODUCTION AND FINAL DEMAND

PRODUCTIVE SECTORS	INTERMEDIATE CONSUMPTION	FINAL DEMAND
Agriculture-Livestock	4.2	7.9
Petroleum + Gas	1.6	10.6
Refining	9.0	1.8
Mining	0.4	0.1
Food Industry	20.9	18.3
Metalworking	6.4	7.6
Manufacturing Industries	16.2	13.7
Electricity	1.9	1.4
Construction	7.4	7.3
Transport	5.7	5.7
Services	26.32	5.4
TOTAL	100.00	100.0

Source: National Accounts, Central Bank of Ecuador.

4.7 Approximate opportunity costs of refined products are 250% higher than present market prices. The following table shows the rise in production costs by sectors for increases of 100% and 250% in current prices. As shown, the highest impact, apart from the impact on the sector's own consumption (as on Petroleum Refining), is on the Electricity (thermal generation) and Transportation (gasoline and diesel) sectors.

Table No. 4.2.

IMPACT OF FUEL PRICE INCREASES ON PRODUCTION COSTS
(PERCENTAGES)

SECTORS	100% INCREASE	250% INCREASE
Agriculture-Livestock	0.8	2.0
Petroleum + Gas	0.1	0.2
Refining	24.56	61.2
Mining	1.8	4.6
Food Industry	0.5	1.2
Metalworking	0.7	1.7
Manufacturing Industries	0.5	1.3
Electricity	17.64	44.0
Construction	0.7	1.9
Transport	10.72	26.8
Services	0.5	1.2
- Inflation Production:	3.6	9.0
- Inflation Final Consumption:	3.1	7.8

Source: Work Group and INE.

4.8 Likewise, the rise in production costs and in final consumption prices caused by Electricity tariff increases of 100% and 250% is shown in Table No. 4.3. As shown, the greatest impact is on the Mining and Services sectors. The impact, however, is minor in general.

Table No. 4.3.

IMPACT OF ELECTRICITY TARIFF INCREASES ON PRODUCTION COSTS
(PERCENTAGES)

SECTORS	100% INCREASE	250% DECREASE
Agriculture-Livestock	0.10	0.20
Petroleum + Gas	0.10	0.21
Refining	0.04	0.08
Mining	1.17	2.33
Food Industry	0.49	0.99
Metalworking	0.52	1.03
Manufacturing Industries	0.37	0.74
Electricity	10.31	20.61
Construction	0.17	0.35
Transport	0.03	0.06
Services	1.12	2.23
- Inflation Production:	0.80	1.40
- Inflation Final Consumption:	0.60	0.70

Source: Work Group and INE.

Effect of the Reestimation of Reserves and Price Changes on Petroleum Production, Domestic Consumption and Exports

4.9 Official estimates show a reserve/production ratio of almost 14 years, based on a daily production of 310,000 barrels. This study's estimation, however, shows 9.5 years. That is, the duration of reserves is shorter by 4.5 years.

4.10 To analyze the effect of this reestimation, three scenarios have been studied for the discovery of reserves: low, middle (the expected case), and optimistic. A description of these scenarios follows.

Low Scenario (Pessimistic)

4.11 The reserve figures used are the official ones, except in the Shushufindi-Aguarico and Sacha Fields. In these fields, the figures do not take into account the secondary reserves which are supposed to accrue through the injection of water to maintain pressure.

- Beginning in 1990, nine fields will be incorporated, with a production equivalent to 50% of expected production in the middle scenario. Total production in 1988 is 95% that of the medium (expected) scenario and will gradually decrease to 169,000 BPD until the year 1997.

Middle Scenario (Expected)

4.12 Reserve figures used are the official ones, except those for Shushufindi-Aguarico and Sacha, from which 349 million and 123 million barrels, respectively, have been subtracted since it is deemed that official reserve figures lack sufficient technical substantiation. Consequently, projections include 229.5 million barrels for Shushufindi-Aguarico and 74.2 million barrels for Sacha. Future recovery of these volumes is considered feasible if the required investments are made and if the yield of deposits is the same as that of production projections. The most important investments to be made are in artificial lift, infill and development wells, and in production installations for the new fields.

- 1988 output was estimated by the National Hydrocarbons Directorate and is based on actual output in the fields from January to June 1988, with the exception of the Shushufindi-Aguarico and Libertador Fields, in which production is stabilized until 1991. In this scenario, practically all other fields have declining production.

High Scenario (Optimistic)

4.13 In the CEPE-owned fields currently in production, proven future reserves would increase

by 78.9 million barrels, plus 36.7 million barrels from the incorporation of four fields (Primavera, Curaray, Balsaura, and Tiputini) and 556.7 million barrels if the other nine blocks of the Oriente, not considered in the middle scenario, turn out to be positive.

- This scenario requires greater investments in the development of wells, production facilities, exploration, and incorporation of fields.

4.14 This scenario differs from the preceding one in that longer periods of stable output are expected in Shushufindi-Aguarico, Auca, Dureno-Guanta, Sansahuari, and Tetete-Tapi together with an increase of 5,000 BPD in Libertador. This scenario includes an additional 17 fields which would yield up to 71,000 BPD and the production of 9 blocks, which would add as much as 120,000 barrels, giving a total maximum production of 347.1 thousand BPD in 1994. This scenario was used to determine the investment program recommended for CEPE for the years 1988 through 1992.

Table No. 4.4

SCENARIOS FOR PRODUCTION AND REMAINING RESERVES

YEARS	LOW SCENARIO		MIDDLE SCENARIO		HIGH SCENARIO	
	PROD. (MBPD)	R. RES. (MMB)	PROD. (MBPD)	R. RES. (MMB)	PROD. (MBPD)	R. RES. (MMB)
1988	294.7	946.2	310.2	1021.5	310.2	1033.6
1989	286.9	846.1	312.3	1034.1	319.9	1034.1
1990	277.8	823.7	304.2	974.9	318.9	1017.4
1991	258.0	738.8	289.3	903.4	309.2	961.8
1992	247.4	719.7	286.1	904.7	324.4	1007.9
1993	228.9	939.6	280.2	883.9	326.1	1122.9
1994	212.1	565.4	257.5	823.9	347.1	1247.7
1995	196.7	496.7	236.9	771.3	346.2	1170.8
2000	85.9	276.1	145.6	482.4	275.7	927.4
2005	17.5	195.4	87.2	275.5	164.4	585.5

Source: Work Group estimate

Evaluation of the Three Scenarios

4.15 Comparison of the low and medium scenarios shows that, in the pessimistic scenario, daily output would be lower by almost 16,000 barrels in 1989, 40,000, in 1995 and 60,000 in the year 2000. Production according to the optimistic scenario would be similar to production of the middle scenario in 1988, 109,000 more in 1995 and 130,000 more in the year 2000.

Refined Product Demand and Exportable Petroleum Surplus

4.16 Based on the estimated volumes of remaining petroleum reserves and production projections according to the middle (expected) scenario, the following exportable petroleum and refined product surpluses have been calculated using CEPE and INE figures for projected domestic demand.

High Demand

4.17 CEPE's demand projections estimates for refined products were used to calculate exportable surpluses. The estimated average annual growth rate over the 1988-1995 period is 4.3% starting from 33.1 million barrels in 1988 (see Table 4.5).

Table No. 4.5

PROJECTIONS OF PETROLEUM PRODUCTION, CONSUMPTION AND EXPORTS
MILLIONS OF BARRELS (CEPE DEMAND)

I T E M	1988	1989	1990	1991	1992	1995
Total Production	113	114	111	106	104	86
Refinery Throughputs	37	38	40	41	42	46
Imports of Crude Equiv.	7	7	7	7	9	7
Exports of Crude Equiv.	4	4	5	5	6	7
Total Domestic Consumption	43	45	47	48	51	52
Crude Exports	70	69	64	58	53	34
Total Crude Exports	74	73	69	63	59	41

Source: CEPE and Work Group estimates.

4.18 By 1995, the volume of petroleum exports will be 55% of the 1988 volume. This will cause a decrease in foreign currency revenue, which will have a negative impact on economic growth.

4.19 This decrease in exportable surpluses of crude and refined products, which will average an annual 8% over the period 1988-1992, is the result of the reduction in production (-3.7%) and of the increased domestic demand for refined products.

Low Demand

4.20 This estimate of exportable surpluses is based on INE's projection of domestic demand for refined products, which forecasts an average annual growth rate of 3.7% based on 27.8 MM barrels a year in 1988, that is, 16% less than CEPE's estimate for that year (See Table No. 4.6). It should be noted that the difference between INE's and CEPE's demand projections is that CEPE's includes contraband while INE's corrects for the estimated amounts of contraband. This study prefers to use INE's projections because it is expected that a better price policy will eliminate or strongly reduce contraband in the future.

Table No. 4.6

PROJECTIONS OF PETROLEUM PRODUCTION, CONSUMPTION, AND EXPORTS
MILLIONS OF BARRELS (INE DEMAND)

	1988	1989	1990	1991	1992	1995
Total Production	113	114	111	106	104	86
Refinery Throughputs	37	38	40	41	42	46
Imports of Crude Equiv.	2	1	0	0	0	2
Exports of Crude Equiv.	9	8	9	10	11	15
Total Domestic Consumption	38	39	40	41	43	47
Crude Exports	75	75	71	65	62	39
Total Crude Exports	84	83	80	75	73	55

Source: CEPE and Work Group estimates.

4.21 Petroleum and refined product exports for 1995 are equivalent to 65% of estimated exports for 1988, which implies that between 1988 and 1992, exportable surpluses would be reduced by 29 million barrels.

4.22 In this scenario, the average annual reduction in exportable surpluses is 5.8%, in contrast with the 8% reduction of the preceding scenario.

4.23 In brief, in scenario (A) the average exportable surplus is 61 million barrels between 1988 and 1995 and in scenario (B) the amount increases to 73 million, a difference of 20%. The explanation lies in the difference between INE and CEPE estimates for absolute value of demand for the year 1988 and in the different growth rates during the period. The difference in base consumption (1988) is attributable to one factor: CEPE estimates are based on sales of products (thus including illegal exports), whereas INE estimates these illegal sales and excludes them. At present, the consumption estimated by CEPE is more reliable; however, in the future, with important changes in price policies, smuggling could diminish greatly, and INE's projection could prove more precise. INE's projection could therefore be considered as if it took into account the effect of price elasticity on domestic consumption (which is not done because of the lack of reliable elasticity estimates in the medium-term).

Petroleum Export Prices

4.24 The economic impact of higher world oil prices has been estimated on the basis of the intersectoral relationships and the structure of aggregate demand of 1986. Two international price hypotheses have been used to estimate oil exports, as shown in the following table.

Table No. 4.7

SCENARIOS FOR EXPORTS AND INTERNATIONAL OIL PRICES

	EXPORT (millions of barrels)		PRICE (current dollars per barrel)	
YEARS	HIGH	LOW	HIGH	LOW
1988	84	74	14	14
1989	83	73	15	14
1990	80	69	17	15
1991	75	63	19	17
1992	73	59	21	19
1993	92	58	24	21
1994	63	49	25	24
1995	55	41	27	25

Source: Work Group estimates and World Bank price projections.

Growth of GDP

4.25 To measure the impact of oil export projections on GDP, it was necessary to make the following two assumptions.

4.26 Non-petroleum export projections (traditional and new) were made based on historical trends and on the need to compensate in part for volume and price drops in oil exports. For this purpose, an average annual growth rate of 4.6% in current dollars was assumed.

4.27 As for the other components of Final Aggregate Demand, an upward trend in final consumption, particularly in the private sector, has been observed in recent years, which is detrimental to investment (Gross Capital Formation). This situation should change for two reasons: in the first place, because of the oil sector's own investment commitments resulting from service contracts, and in the second, because of the low level of savings and capital formation of the economy. The government should therefore make an effort to increase investment.

4.28 As to Total Final Demand, it was estimated that consumption would decrease from 67.1% in 1988 to 64.7% in 1995 and that Gross Fixed Capital Formations would increase from 14.8% to 21.2% over the same period of time.

4.29 Based on the input-output pattern of 1986 and the above-mentioned export and oil price projections, the estimated GDP growth rates over the 1988-1995 period are shown below. The probable export volume is the high estimate, and the most probable growth rates are, therefore, 3.8% and 3.3%.

REAL GDP GROWTH RATE
(1975 prices)

EXPORT/PRICE		ANNUAL GROWTH RATE (%)
High	High	3.8
High	Low	3.3
Low	High	2.5
Low	High	2.1

Trade Balance

4.30 The cumulative annual growth rate of the Trade Balance varies between 3.1% for the high-high and 1.87% for the low-low scenarios, as shown in Table No. 4.8.

Table No. 4.8

TRADE BALANCE
(Billions of Dollars)

YEARS	EXPORTS HIGH PRICES HIGH	EXPORTS HIGH PRICES LOW	EXPORTS LOW PRICES HIGH	EXPORTS LOW PRICES LOW
1988	1.55	1.55	1.47	1.48
1989	1.66	1.61	1.56	1.52
1990	1.79	1.69	1.69	1.60
1991	1.86	1.77	1.73	1.65
1992	1.97	1.88	1.80	1.72
1993	2.11	1.97	1.88	1.77
1994	2.04	2.00	1.80	1.77
1995	1.99	1.93	1.72	1.68
ANNUAL GROWTH RATE (%)	3.61	3.12	2.30	1.87

Source: Work Group.

Impact of Institutional, Legal, and Price Measures on Sector Enterprise Finances, General Budget of Government, Other Public Institutions

Hydrocarbons

4.31 Chapter II shows how CEPE's projected financial situation under the Five-Year Plan without change in its revenues, expenditures, and investments, would result in an accumulated deficit of

$1,900 million for the period 1988-1992. In view of this unmanageable situation, the following is an evaluation of results attainable through the different measures proposed in Chapter III in order to: improve CEPE's financial situation, correct economic distortions caused by the current price structure, and correct the distribution of gross petroleum revenues and the investment program.

Price of Refined Products at Replacement Cost (Recommended Option)

4.32 A change in refined product prices, in line with replacement costs, would result in an additional revenue of US$ 6.3/Bl on average, compared to the Hydrocarbons Law price (low option). This would bring the government an additional annual revenue of $250 and $296 million, based respectively on INE and CEPE projections of domestic consumption. The alternative (high option), based on the international oil price, would generate approximately twice as much additional revenue as the recommended option.

Change in Relative Price Structure

4.33 The new price structure would eliminate existing distortions in consumption among different refined products and (eliminate) part of the subsidies for consumption of diesel and LPG. This could increase the efficient use of refined products.

Reform of Oil Revenue Distribution System

4.34 Chapter III analyzed the quantitative analysis of the different alternatives for solving CEPE's financial problems, the level of its budget deficit, and the degree of self-financing of its investments.

4.35 With regards to the impact of the different alternatives on the distribution of oil revenues, it can be noted that an adjustment in the price of refined products implies an increase of $1,974 million for the General Budget of the Government and $104 million for CEPE, whereas the other recipients would continue to receive their same allotment.

4.36 The proposal of recovering costs plus a percentage of profit (5%) would affect primarily the Government Budget and CEPE. As Table No. 4.9 shows, instead of the total increase which results from the higher prices of hydrocarbons going into the Government Budget (US$1,974 million), only US$1,159 million would go into the budget. The difference, US$815 million, would be channeled to CEPE. Under this alternative, there is practically no change in the revenue of other recipients.

4.37 The short-term, immediate alternative implies changes only in the revenue of the Government Budget and of CEPE, totaling US$1,967 million. Contrary to general belief, in-depth restructuring of the oil revenue distribution system would imply redistributing revenue only between two

recipients: the General Budget of the Government and CEPE. The different alternatives and their effect on the revenue of the GBG, CEPE, the Armed Forces, and other recipients are shown in the following table.

Table No. 4.9

IMPACT OF ALTERNATIVEPRICE POLICIES ON DISTRIBUTION OF OIL REVENUE
(Period 1988-1992)
(Millions of 1987 US$)

ALTERNATIVE	GBG	CEPE	ARMED FORCES	COM-PANIES	TAXES	OTHER	INZCEL	TOTAL
Base case, No Fuel Price Adjustment	3668	541	823	759	278	194	52	6315
Base case, Fuel Price Adjustment	5642	645	823	759	278	194	52	8395
Elimination of Exchange Rate Ceilings	3208	1931	969	759	278	857	343	8395
Recovery, Costs +5% Petroleum Profits	4827	1725	802	759	278	251	52	8395
Recovery of Costs on Sale of By-products +20% Profits	4675	1613	823	759	278	194	52	8395

Source: Work Group.

Investment Rationalization

4.38 Rationalization of the investment program for the period 1988-1992, in accordance with the proposal made in this study, implies a reduction of $455 million (1987 dollars) in investments. CEPE's financial deficit in that period would consequently be reduced from $1,790 million to $1,340 dollars, which would be a positive complement to the other proposed measures.

4.39 As Table No. 4.10 shows, the proposed rationalization of investments would lead to greater exploratory and production activity that would aim to discover new reserves and bring them into production.

Table No. 4.10

CEPE: INVESTMENT PROGRAM 1988-1992
(Millions of 1987 US$)

	CEPE PLAN	PROPOSAL	DIFFERENCE
Exploration	81	114.4	+ 30.4
Production	259	340.1	+ 81.1
Processing	411	45.3	-365.7
Transport and Storage	296	101.6	-194.4
Marketing and Other Services	55	48.8	- 6.2
TOTAL	1102	647.2	-454.8

Source: CEPE and Work Group.

Impact of Recommended Measures on the Electricity Subsector

4.40 As mentioned earlier in this study, under the Master Electrification Plan, which calls for monthly tariff increases (2% for block sales and 3% for final consumers), the estimated deficit for 1988-1992 is $734 million at June 1987 prices, with disbursements of $414 million of on external credit. An analysis of the economic impact of the measures suggested in this study follows.

Tariff Adjustments

4.41 Tariff increases of 100% have been recommended for block sales of energy and of 40% for sales to final consumers. A real increase (that is, higher than the rate of inflation) of 1% per month could be an alternative option.

Reduction of Losses, Reduction of Investments, Renegotiation of Debt, Elimination (or Revision) of Exchange Rate Ceilings

4.42 All these measures, which affect mainly INECEL and, to a lesser degree, the electricity companies, have been analyzed. In brief, these measures could possibly eliminate INECEL's operational deficit by 1991. Results of these measures, including results of the application of corrective tariffs, which reduce annual deficits, are shown in Table No. 4.11.

Table No. 4.11

ELECTRICITY SUBSECTOR

FINAL BALANCE WITH ADDITIONAL REVENUES
(Millions of June 1987 dollars)

YEAR	BALANCE 1 With Corrective Tariff	ADDITIONAL REVENUE 2 Loss Reduction	3 Reassign. of Royalties	4 Renegot. of Debt	5 Subtotal 2, 3 and 4		FINAL BALANCE Accumulated Annual
1988	- 79.2			42.7	42.7	- 36.2	- 36.2
1989	-180.8	3.2	14.7	50.8	68.7	-112.1	-148.6
1990	-106.9	6.5	20.3	47.2	74.0	- 32.9	-181.5
1991	- 42.2	11.5	20.3	41.3	77.7	35.5	-146.0
1992	13.4	14.6	24.9	37.0	80.7	94.1	- 51.9
1993	85.8	13.5	33.1	19.5	66.1	151.9	100.0

Note: The results are evaluated for the alternative plan using a steam plant at San Francisco, which helps reduce investments.

Source: INECEL, Work Group.

4.43 The financial rehabilitation proposed through the analyzed measures will mean that annual deficits would disappear after 1991, and the accumulated deficit would be covered by the year 1993, when there would be a positive balance. It should be noted that these results are merely theoretical and that a more important reordering of the entire sector, for example, the reorganization of the oil revenue distribution system, would render certain measures obsolete (for example, the elimination of exchange rate ceilings). It is also probable that in five years INECEL will no longer receive any petroleum funds. The only effect of these measures outside the electric subsector would be that, to the extent that the subsector covers its costs, government subsidies would be reduced.