CHAPTER 3

ELECTRIC UTILITY INDUSTRY IN THE PHILIPPINES

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3.1 Present State of Electric Utility Industry in the Philippines

3.1.1 Outline of Domestic Energy Resources

(1) Coal

The estimated coal reserves of the Philippines are presently said to be approximately more than one billion tons. Of this amount, the proved or indicated coal reserves which can be operative and the recoverable coal reserves multiplying the estimated reserves by geological safety factor and recoverable ratio will be confirmed by future detailed geological investigations such as surface investigations and drilling.

According to the Ten-Year Energy Program, 1979-1988, it is looked forward to for coal resources to be made the mainstream of future energy supply through the production of indigenous coal and the installation of logistical networks and the development of markets. As a coal market, coal-fired thermal power plants which will be built by NAPOCOR are being considered in addition to the present consumers, and it is predicted that the present consumption of 265,000 metric tons will increase to 4,972,000 metric tons in 1988, and 87% of the coal consumption in 1988 will be used in the coal-fired thermal power plants.

New coal mines are being planned for Semirara Island, Naga and Cebu. Promising coal bed areas following the above are at Batan Island, Polillo Island, Surigao del Norte, Zamboanga del Sur and the Cagayan Valley. (Refer to Table 3-1)

Table 3-1 Coal Development Program

Year	Reserves (Million metric tons)			(10^3 metric production tons)
	Proved	Indicated	Potential	
1979	150	80	920	330
1983	300	310	540	2 430
1987	500	540	110	4 200
1988	550	600	—	5 400

Data Source: Ten-year Energy Program

(2) Oil and Natural Gas

The proportion of oil in the total energy supply in 1979 was approximately 91%, which was a decline of 4% from the approximately 95% in 1973, the time of the oil crisis. This was because of that development and utilization of alternative energy sources such as hydro and geothermal power were promoted. At present, a national policy to lower this heigh proportion on oil to about 68% by 1988 is being pursued. Of the total quantity of oil supply, 90% is imported, of which 90% comes from the Middle East countries which are partly in uncertain political situation. Consequently, development of indigenous oil resources has an extremely important meaning for improvement of the international balance of payments of the Philippines and development of the national economy.

The recent oil explorations offshore of Palawan Island have brought about expectations that this region is an rich oil filed area. The NIDO complex is zealously making his efforts to succeed in the first commercial crude oil production. The exploration activities concerning oil fields are aiming for 203 exploratory wells to be drilled during the next 10 years, of which 133 wells are to be offshore and the remainder onshore. It is expected that the share of domestically produced oil will be gradually increased, towards the future, and in 1988, 36% of the total domestic demand of oil will be furnished with the indigenous oil production. (Refer to Table 3-2)

Table 3-2 Oil and Gas Development Plan

Year	No. of wells			No. of contracts	Seismic lines (10^3 km)	Footage (10^3 ft.)
	On-shore	Off-shore	Total			
1979	11	12	23	3	10	173
1983	37	66	103	13	36	787
1987	63	122	185	23	61	1 417
1988	70	133	203	26	66	1 554

Data Source: Ten-year Energy Program

(3) Geothermal Energy

Based on Presidential Decree No. 1442 of the Geothermal Act of 1978, it has been decided that both government and private sectors will cooperate in geothermal development. By adding another 56.6 MW of steam equivalent in 1978, the total steam availability reached 305 MW as of the end of that year.

According to the Ten-Year Energy Program, the cumulative steam availability and generating facilities to be installed at the end of 1988 after 10 years will respectively be 1,895 MW and 892 MW. The target number of the fields for development is eight in total, with three presently being developed:

Tiwi (Albay), Makaling-Banahaw (Laguna) and Tongonan (Leyte). In addition to these three, the five new ones of Manito (Albay), Palimpinon (Southern Negros), Mambucal (Negros Occidental), Manat (Davao) and Kalinga (Mountain Province) are being planned.

Geothermal energy is one of the most promising alternatives to oil in the Philippines. (Refer to Table 3-3)

Table 3-3 Geothermal Development Program

Year	No. of fields	No. of wells	Geothermal steam availability (MW)	Installed generating capacity (MW)
1978*	3	30	305	3
1979	4	89	470	278
1983	7	301	1125	562
1987	8	481	1675	782
1988	8	528	1895	892

Data Source: Ten-year Energy Program

Note: * figures are actual

(4) Uranium

The exploration for uranium has brought the total holes drilled to 81 and its cumulative footage to 45,231 for the six-year period 1973 to 1978, and during the next 10 years, radiometric and geochemical surveys will be carried out on a nationwide scale to delineate prospective sites for extensive exploration. As a result of this preliminary exploratory activities, outlooks for uranium mineralization at delineated sites will become manifested.

The areas which are expecting to bear uranium deposits will be Ilocos Norte, Isabela, Tarlac, Bulacan, Camarines Norte, Mindro, Masbate and Palawan in the Luzon Region, Samar, Panay, Leyte, Cebu and Negros in the Visayas Region, and Zamboanga, Davao and Cotabato in the Mindanao Region.

(5) Hydro Energy

Hydro energy generation which tames gravitational flow of water a main rivers and allied tributaries is one of the regenerative energy sources. In the Philippines, as topographical conditions, precipitation and meteorological patterns differ by region, hydroelectric power generating systems have differing features depending on the region.

In the Luzon Region for instance, has seen a preponderance of reservoir type and multi-purpose hydroelectric power generation. This is due to the fact that Luzon Island has the distinct wet and dry seasons and necessitates the

construction of dams for securing irrigation water in the dry season and controlling floods in the wet season. Also, pumped-storage power generation system is being contemplated to cope with the increasing acute peak loads of the Luzon power system.

There exist no significant watersheds in the Visayas Region, and only decentralized small hydro power projects are main.

In the Mindanao Region, on the other hand, precipitation is more or less even throughout the year so that the necessity for management of water for irrigation and flood control are less critical, and consequently, the abundant water is utilized principally for large-scale hydroelectric power generation.

A total potential capacity for large-scale hydroelectric power of the entire Philippines is estimated to be about 8,000 MW, and as of 1978, about 9% of this potential had already been developed. According to the electric power expansion program of NAPOCOR, it is scheduled for approximately 20% of the hydroelectric potential to be developed by 1983, approximately 37% by 1987 and approximately 57% by 1990. (Refer to Table 3-4 and 3-5)

Table 3-4 Installed Capacity by Plant Type

End of 1978

Type	MW	%
Hydro	746	23.6
Oil thermal	1 880	59.4
Diesel	536	16.9
Geothermal	3	0.1
Total	3 165	100

Data Source: Ten-year Energy Program

Table 3-5 Major Hydroelectric Plants Operated by NAPOCOR

End of 1978

Plant	Location	Date of operation	Capacity (MW)	Annual energy availability (GWh)
Ambuklao	Bokod, Benguet	Dec. 1956	75	398
Angat	Norzagaroy, Bulacan	Sep. 1967	212	552
Binga	Itogon, Benguet	May 1960	100	437
Caliraya	Lumban, Laguna	Feb. 1950	32	188
Maria Cristina	Iligan, Lanao del Norte (AgusVl)	Jul. 1953	200	1 066
Pantabangan	Nueva Ecija	Apr. 1977	100	450

Data Source: Ten-year Energy Program

In addition, based on the standpoint of further effective utilization of water power which is regenerative domestic energy source, it is looked forward to for development to be promoted of mini-hydro potentials, a total capacity of 887 MW at 773 sites, indicated with preliminary hydrologic data throughout the country. (Refer to Table 3-6)

Table 3-6 Mini-Hydro Potentials

Region	No. of sites with data	No. of sites without data	Total No. of sites	Estimated potential of sites with data (MW)
Luzon	478	1 248	1 726	564
Visayas	207	1 327	1 534	194
Mindanao	88	1 191	1 279	129
Total	773	3 766	4 539	887

Data Source: Ten-year Energy Program

(6) Nonconventional Energy

Since 1977, the development activities for nonconventional types of energy, for example, solar energy, wind power, biomass conversion, and other new types of energy and supportive promotions have been vivified. The basic policy for development of these new energy sources is summarized as follows. Firstly, the near-term goal of the nonconventional energy program is to bring widespread utilization of these readily available energy forms to the rural areas isolated from a grid. The program places emphasis on adapting simple and available technologies to practical applications for rural conditions. Hand in hand with the introduction of these low capacity but numerous utilization ends, is a simultaneous effort to develop and demonstrate higher level technologies that have potential for large-scale displacement of conventional fuel. Among the nonconventional energy sources presently under serious consideration are managed energy crops like ipil-ipil for power generation and sugar cane for power alcohol. These renewable resources offer the heighest potential for contribution to the national-commercial energy mix.

Secondary, in a long run, it is necessary to develop high-level new-energy technologies to replace petroleum in the future on a large scale. This new energy technology development program would include study on total energy systems for urban or provincial areas, utilization of biomass and hot springs energy and development of solar energy, wind power, fuel alcohol, and other new types of energy. In order to back up the successful development of this field, it will be necessary to make intimate international relations on the technical nature between the related organizations, and also enthusiastic activities for collecting data and information and for accelerating research and investigation works will be required.

3.1.2 Electric Utility

(1) Electric Utility's Constitution

The electric utility industry in the Philippines consists of the National Power Corporation (NAPOCOR), the country's largest single power producing utility which is responsible for planning, construction, maintenance and operation of its own power generation transmission and transformation facilities and for supplying electricity to all customers including rural electric cooperatives and utility on a nationwide scale, and more than 800 small-scale public and private electric utility which is responsible for supply to specific and limited local customers.

The basic policy of the Philippine Government toward the electric utility industry are as follows:

(a) In order to attain nationwide electrification, to establish island transmission networks with which link load centers to generation facilities, and to set up electric cooperatives for power distribution.

(b) In areas not embraced by NAPOCOR grid, to grant permission for electric cooperatives, private utility and local governments to own and operate isolated grids and generation facilities.

The primary function of the National Electrification Administration (NEA) is the area power distribution and electric cooperative management and not the installation of generation facilities. The power distribution systems presently owned by private and provincial public organizations will gradually be integrated in the future with the nationwide system of electric cooperatives.

According to the Ten-Year Energy Program, 1979-1988, the installed generation capacities for utilities at the end of 1978 are shown in Table 3-7.

Table 3-7 Installed Generation Capacities (End of 1978)

Utilities	Installed capacity	Share
NAPOCOR	2,196 MW	69.4 %
MECO	522 MW	16.5 %
Cooperatives	133 MW	4.2 %
Others	314 MW	9.9 %
Total	3,165 MW	100 %

Data Source: Ten-year Energy Program 1979 - 1988
Note: MECO — Manila Electric Power Co.

At the end of the same year, the composition of the power generation facilities by plant type was made up of 23.6% hydro, 59.4% oil-fired thermal, 16.9% diesel, and 0.1% geothermal. The residential electrification ratios were 29.1% for the entire country.

The utilities generation records from 1973 to 1978 were as indicated below.

Utilities Power Generation Profile

Year	Generation	Annual increase ratio
1973	10,910 GWh	—
1974	11,108 GWh	1.8 %
1975	12,221 GWh	10.0 %
1976	13,252 GWh	8.4 %
1977	13,833 GWh	4.4 %
1978	14,961 GWh	8.2 %

1973 to 1978 annual average increase ratio 6.5%

The energy production in 1978 by fuel type is composed of 62.8% oil, 20.4% diesel oil, 0.6% coal, 16.2% hydro, and 0.01% geothermal.

(2) NAPOCOR

NAPOCOR was established in 1936 with the purpose of investigating and developing water power resources of the Philippines. The scope of activities of NAPOCOR was afterwards greatly expanded to include hydro and thermal electric power development. The present basic corporate objectives is distinctly defined by National Power Corporation Charter of September 1971 and Presidential Decree No. 40 of September 1972. The outline is as described below.

The objectives of NAPOCOR are to harness and develop, produce and transmit, on a nationwide basis, electric power from all energy sources, and to ensure a continuing reliable supply of electricity at minimum cost within the framework of national economic and social policy. In order to achieve these objectives, NAPOCOR, as the implementing agency of the State, possesses the authority to set up transmission grids and to construct associated generation and related facilities in Luzon, Visayas and Mindanao, and as the ultimate objective of the State, for NAPOCOR to own and operate as a single integrated system all generating facilities supplying electricity to the entire area embraced by and grid it has set up is required. The basic conceptions in formulation of power expansion program executed by NAPOCOR will be summarized as follows:

(a) Attainment of the objectives and implementation of State policies on the electric utility industry under Presidential Decree No. 40.

(b) Attainment of total electrification on a nationwide scale including barrios.

(c) Completion of the country's backbone power systems.

(d) Diversification of energy sources.

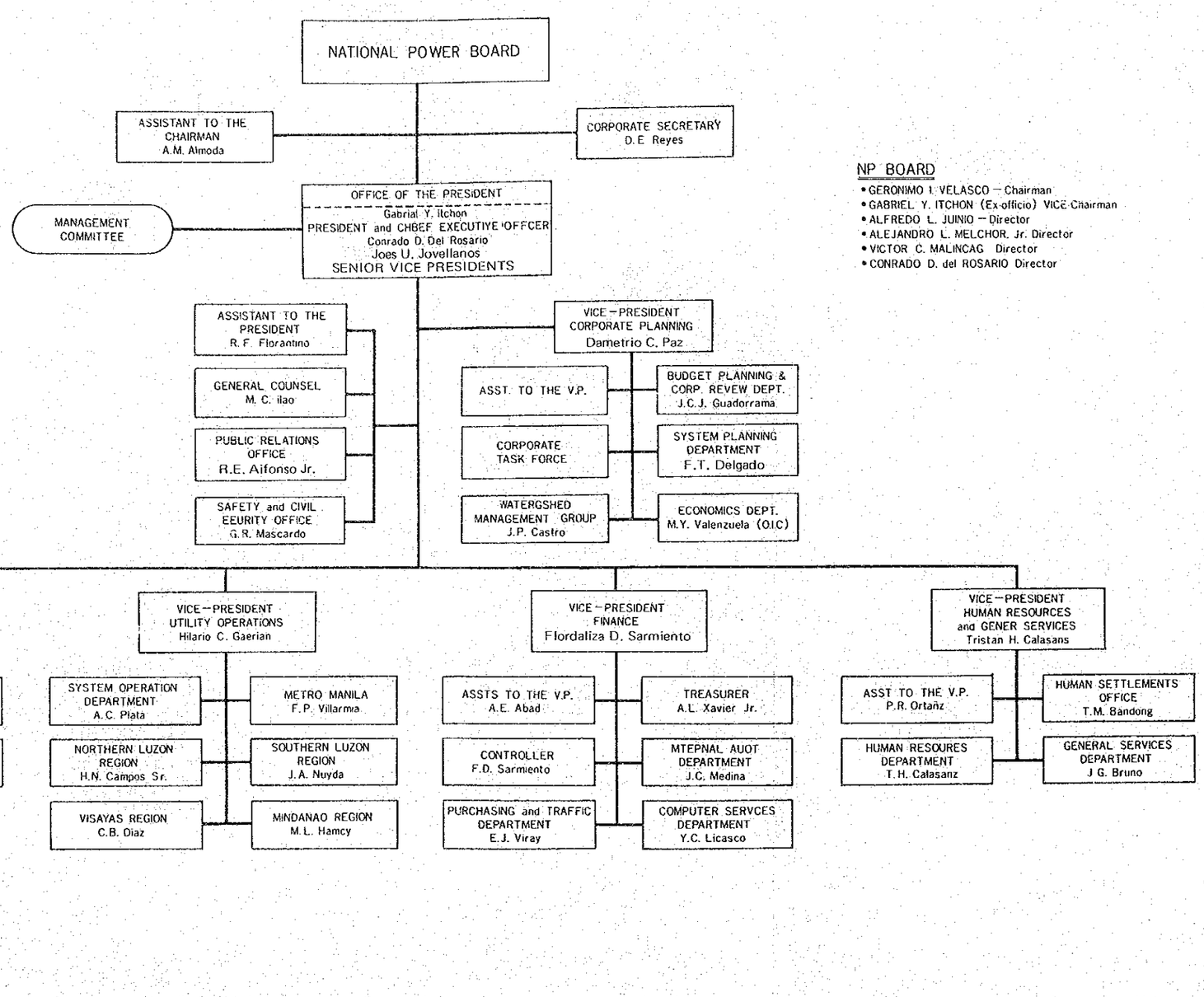
(e) As a result of the oil crisis, accelerated development and utilization of indigenous sources of power.

The organization chart of NAPOCOR made up in order to strive to achieve these objectives is as shown in Fig. 3-1.

Customers supplied electricity by NAPOCOR are electric cooperatives, large industrial consumers and public and private electric utilities having distribution networks. The outline of the electric rates schedule applied in energy sales are as given in Table 3-8. The electric rates schedules of NAPOCOR has a schedule for each grid since there are no island-to-island interconnections, caused by the archipelagic nature of the Philippines, and the unit prices are varied depending on the power source composition of each grid.

The total installed generating capacity of NAPOCOR at the end of November 1979 is 3,599 MW, of which 26% is hydro, 6% geothermal, and 68% thermal. The energy consumption by type of in 1978 is 10,525 GWh, of which 23.5% is residential, 24.1% commercial, 46.8% industrial and 5.6% others, as shown in Table 3-9.

Fig. 3-1 NATIONAL POWER CORPORATION ORGANIZATION CHART



NP BOARD

- GERONIMO I. VELASCO – Chairman
- GABRIEL Y. ITCHON (Ex-officio) VICE Chairman
- ALFREDO L. JUINIO – Director
- ALEJANDRO L. MELCHOR, Jr. Director
- VICTOR C. MALINCAG Director
- CONRADO D. del ROSARIO Director

Table 3-8 NAPOCOR's Electric Rates Schedules for The Different Grids as of Feb. 1980

Item	SCHEDULE I LUZON GRID	SCHEDULE II CEBU and PANAY GRIDS	SCHEDULE III BOHOL and NEGROS GRIDS	SCHEDULE IV MINDANAO GRIDS	SCHEDULE V GENERAL SANTOS SUB-GRID
UTILITIES					
Demand charge					
1st.	500 kW P.12.00/kW/mon.	100 kW P.14.00/kW/mon.	200 kW P.12.00/kW/mon.	500 kW P.10.00/kW/mon.	
Next	19,500 P.16.00/kW/mon.	900 kW P.17.00/kW/mon.		4,500 kW P.14.50/kW/mon.	
Next					
Over	20,000 kW P.22.00/kW/mon.	1,000 kW P.20.00/kW/mon.	200 kW P.10.00/kW/mon.	5,000 kW P.18.00/kW/mon.	
Energy charge					
1st	200 kWh/kW P.0.2900/kWh	100 kWh/kW P.0.3160/kWh	100 kWh/kW P.0.2400/kWh	100 kWh/kW P.0.0900/kWh	P.0.4000/kWh
Next	200 kWh/kW P.0.3100/kWh	150 kWh/kW P.0.3476/kWh	150 kWh/kW P.0.2600/kWh	200 kWh/kW P.0.1200/kWh	
Next					
Over	400 kWh/kW P.0.3320/kWh	250 kWh/kW P.0.3822/kWh	250 kWh/kW P.0.3000/kWh	300 kWh/kW P.0.1400/kWh	
INDUSTRIES and NON-UTILITIES					
Demand charge					
1st.	1,000 kW P.18.00/kW/mon.	100 kW P.23.00/kW/mon.	200 kW P.12.00/kW/mon.	1,000 kW P.18.00/kW/mon.	
Next	9,000 kW P.19.00/kW/mon.			4,000 kW P.19.00/kW/mon.	
Next				10,000 kW P.21.00/kW/mon.	
Over	10,000 kW P.20.10/kW/mon.	100 kW P.20.00/kW/mon.	200 kW P.10.00/kW/mon.	15,000 kW P.23.00/kW/mon.	
Energy charge					
1st.	200 kWh/kW P.0.3650/kWh	300 kWh/kW P.0.4000/kWh	100 kWh/kW P.0.2400/kWh	100 kWh/kW P.0.1500/kWh	P.0.4000/kWh
Next	250 kWh/kW P.0.3300/kWh		150 kWh/kW P.0.2600/kWh	150 kWh/kW P.0.1400/kWh	
Next				200 kWh/kW P.0.1300/kWh	
Over	450 kWh/kW P.0.3000/kWh	300 kWh/kW P.0.3896/kWh	250 kWh/kW P.0.3000/kWh	450 kWh/kW P.0.1200/kWh	

FUEL COST ADJUSTMENT CLAUSE

Adjustment charge per kwh $= \frac{A \times B}{C}$

A : Weighted average price increase above (or decrease below) the base price of fuel oil per liter actually burned during the billing period.
B : Liters of fuel oil actually burned in the grid during the billing period.
C : Kilowatt-hour sales of NAPOCOR in the grid during the billing period.

Where the base price of fuel is :

Luzon	P.30.290 per MMBTU	
Cebu	P. 1.204 per liter	
Panay	P. 1.218 per liter	
Negros	P. 1.213 per liter	
Bohol	P. 1.230 per liter	
G. Santos	P. 1.227 per liter	
Mindanao	P. 1.220 per liter	(Agus Grid)

Table 3-9 Energy Consumption at User End
Total-Philippines

Unit: GWh

	Residential	Commercial	Industrial	Others	Total
1969	1,518	1,372	2,361	134	5,385
1970	1,581	1,350	2,609	134	5,673
1971	1,642	1,520	2,897	259	6,319
1972	1,747	1,618	2,987	384	6,736
1973	1,885	1,760	3,349	444	7,437
1974	1,749	1,747	3,544	505	7,545
1975	1,944	1,949	3,830	586	8,309
1976	2,043	2,112	4,291	619	9,065
1977	2,241	2,350	4,546	524	9,661
1978	2,477	2,533	4,927	588	10,525

Data Source : NAPOCOR

Note : Based on NAPOCOR and MECO only

3.1.3 Power Market

(1) Present State

The installed generating capacity of NAPOCOR at the end of November 1979 was 3,599 MW, and the annual energy production in 1979 was estimated to have been 13,712 GWh. The electricity requirements in agriculture, mining, commerce and other services fields are filled with this energy produced, while approximately 30% of the households throughout the nation benefits from the energy for residential use.

There are qualitative and quantitative differentials in the power supply situation and in the generating costs between the three regions of Luzon, Visayas and Mindanao. This makes the circumstances in the improvement of the power supply availability serious. In particular, the level of electric power supply situation in the Visayas is considerablely low. The necessity to accelerate the development and expansion of electric power supply capability in the regions has been a matter of special concern for the Philippine Government. Although the power development and expansion programs have energetically been implemented on a nationwide scale by the Government and NAPOCOR, the rapid growth in energy demand which has ensued from remarkable increase of population and expansion of economic activities, and diversification of energy sources which is a focal point in the National Energy Plan will require greater capital investments for both expansion of electric power facilities and activities of energy resources exploration. It means that difficulty of electric power development has been doubly increased.

(2) Load Forecast

The electric power systems of the Philippines can be broadly divided into the 3 regional grids, Luzon Grid, Visayas Grids and Mindanao Grid. The long-range demand forecasts for the grids are made by NAPOCOR. On looking at the long-range load forecast incorporated in the electric power expansion program recently set up by NAPOCOR, the peak load recorded in the Philippines as a whole in 1978 was 2,129 MW, which is estimated to grow to 3,464 MW in 1983 five years later, and 6,021 MW in 1990. The peak load performance was an annual average of 8% during the period 1974 to 1978, while the estimated annual average growth rates are 11.8% for 1977 to 1983, and 7.8% for 1984 to 1990. The energy demand recorded for the entire country in 1978 was 13,529 GWh which is forecasted to reach 21,005 GWh in 1983 and 37,510 GWh in 1990, the forecast annual average growth rates are 11.7% for 1979 to 1983 and 8.3% for 1984 to 1990. Table 3-10 is referred to in this regard.

(3) Power Expansion Program

The target in the electric power expansion program of the Philippines is to achieve complete electrification of the whole country by 1990.

According to the long-range electric power expansion program up to 1990 formulated by NAPOCOR, as shown in Table 3-11, the total installed power generating capacity should be 4,946 MW in 1983, 7,311 MW in 1987, and 9,204 MW in 1990. This pace of development means new installation of approximately

500 MW of generating facilities in each year. Especially, for the Visayas Region, the regional development policy of the state is reflected with new installation of approximately 100 MW annually projected, on the other hand for the Mindanao Region, emphasis is placed on development and utilization of the abundant water resources.

Through realization of this program, it will be possible that the non-oil-burning proportion in the generating facilities by plant type of the Philippines becomes from the 30% at present to 78% in 1987. However, in areas and provinces where energy resources are lacking, there will still be construction partially of oil-fired facilities.

(4) Demand and Supply Balance

The future balance in demand and supply of electricity in the Philippines as a whole projected can be seen on the long-range power expansion program and the long-range load forecast made by NAPOCOR. The results are as shown in Table 3-12.

Table 3-10 Peak Load and Energy Requirement Forecast
Total-Philippines

Generation Level

	Peak Load (MW)	Energy Requirement (GWh)	Lead Factor (%)
Actual			
1974	1,567	9,338	68
1975	1,738	10,209	67
1976	1,908	11,110	66
1977	2,021	11,989	68
1978	2,129	13,259	71
'74 to '78	(8.0%)	(9.2%)	
Forecast			
1979	2,234	13,712	70
1980	2,515	15,374	70
1981	2,749	16,714	69
1982	3,109	18,778	69
1983	3,464	21,005	69
'79 to '83	(11.8%)	(11.7%)	
1984	3,844	23,250	69
1985	4,184	25,505	69
1986	4,551	27,909	70
1987	4,902	30,175	70
1988	5,272	32,617	70
1989	5,640	35,116	71
1990	6,021	37,510	71
'84 to '90	(7.8%)	(8.3%)	

Data Source : NAPOCOR's Power Expansion Program

Note : (%) indicates compound annual average increase ratio during the period

Table 3-11 Power Expansion Program - Total Philippines
Installed Capacity at the End of Year

Unit: MW

	Hydro	Geoth.	Coal Th.	Nuclear	Conv. Th.	Total
1979	928	223			2,448	3,599
1980	928	443	10		2,574	3,955
1981	940	446	65		2,720	4,171
1982	1,074	631	65		2,810	4,580
1983	1,609	781	65		2,491	4,946
1984	1,939	856	420		2,132	5,347
1985	2,194	1,114	475		2,073	5,856
1986	2,374	1,151	980	620	1,573	6,698
1987	2,949	1,189	980	620	1,573	7,311
1988	3,367	1,336	1,035	620	1,558	7,916
1989	4,053	1,411	1,035	620	1,358	8,477
1990	4,563	1,486	1,185	620	1,350	9,204

Data Source: NAPOCOR's Power Expansion Program

Table 3-12 Demand and Supply of Electricity Forecast
Total-Philippines

	Peak Demand (MW)	Dependable Capacity (MW)	Reserve (MW)	Energy Requirement (GWh)	Energy Capacity (GWh)	Surplus (GWh)
1979	2,234	3,199	965	13,712	19,470	5,758
1980	2,515	3,483	968	15,374	22,544	7,170
1981	2,749	3,783	1,034	16,714	25,634	8,920
1982	3,109	4,155	1,046	18,778	27,451	8,673
1983	3,464	4,642	1,178	21,005	24,195	3,190
1984	3,844	5,024	1,180	23,250	30,989	7,739
1985	4,184	5,856	1,672	25,505	33,997	8,492
1986	4,551	6,698	2,147	27,909	36,775	8,866
1987	4,902	7,311	2,409	30,175	39,783	9,608
1988	5,272	7,916	2,644	32,617	43,808	11,191
1989	5,640	8,477	2,837	35,116	44,277	9,161
1990	6,021	9,204	3,183	37,510	46,559	9,049

Data Source : NAPOCOR's Power Expansion Program

Note : GWh is based on generation level

3.1.4 Necessity for System Interconnection

The electric power system of the Philippines, because of the archipelagic restrictions of the land, consists of independent power systems on the respective islands. In effect, the composition is that of the Luzon Grid, Mindanao Grid, and the Visayas Region Grids of the 6 grids on the islands of Cebu, Panay, Negros, Samar, Layte and Bohol. Each grid is held responsible for supplying electricity with high reliability and stable both qualitatively and quantitatively, for instance constant voltages and frequencies, for the fluctuating power demands of the grids. Because of government requirements, each grid must have reserve capacity of 15% to 25% of the system capacity or capacity corresponding to the largest unit in the grid, whichever is larger. This reserve capacity ordinarily has the nature of supplementing a shortage in supply capacity in case of i) unscheduled outage of generating units, ii) sudden load increases because of errors in power demand forecast, iii) unexpected delays in the power expansion program, and iv) scheduled outage for periodic inspections of generating units.

In order for interconnections of the independent grids to be realized using submarine cables, there are many items to be investigated and problems to be studied. Of these, the principal ones are as cited below.

(1) The precondition is that the power demand of the grids to be the objects of the interconnection project will have grown above a given level.

(2) It is necessary for on-land trunk transmission lines in the grids to have been thoroughly planned or already constructed.

(3) The locations of submarine cable to be installed are at sites where interconnections with on-land trunk transmission lines are possible, and in addition, routes of the submarine cables are where the conditions for laying submarine cables such as meteorological conditions, current flows, sea-bed geological and topographical conditions of landing points, watercraft navigation conditions, etc. are satisfied.

(4) In case of interconnections of grids, the system analysis such as of power current flows, stabilities, short circuits, etc. which will be predicted, and simultaneously, various studies for determining the dimensions and specifications of submarine cables are necessary, and collection and arrangement of basic data for this purpose are also important factors.

(5) While making examinations and studies regarding to technical feasibilities, it is also necessary to do formulation of submarine cable system interconnection construction schedule, calculations of construction costs, and studies from aspects of the financial analysis.

(6) Finally, including technical aspects, comparison studies of merits and demerits in the cases of system interconnection and non-interconnection and economic evaluations related to it are to be made.

As described above, the investigations and studies to be made from various aspects for realization of system interconnection and its financing plan are also required.

To qualitatively describe the merits for system interconnection, they would be summarized as follows:

(1) Hot and cold reserve capacity can be saved for the system operation as a whole.

(2) It will become possible for large-scale generating units to be constructed for pursuance of economy of scale.

(3) It will become possible to make power interchanges by tanking advantage of the peak diversity of independent systems.

(4) There is effective in improvement of system reliability.

(5) An effective utilization of domestic energy sources such as hydro and geothermal energy, and comprehensive operation of the power system which consists of grids with different power sources becomes possible, accordingly, a reduction of power generation costs as a total can be expected.

(6) This will contribute for execution of the duties of NAPOCOR having the responsibilities for electric power supply on a nationwide scale, and consequently for promotion of electrification and incentive of industrial development.

3.2 Power Facilities in Visayas Region

3.2.1 Outlines of Power Generation, Transmission and Transformation Facilities

(1) NAPOCOR

The power generation facilities of NAPOCOR at the end of 1979 amounted to a total installed capacity of 92,700 kW, the installed capacities by island are as listed below.

Installed Capacity

	Installed capacity
Cebu	51,100 kW
Bohol	12,200 kW
Negros	11,800 kW
Panay	14,600 kW
Leyte	3,000 kW
Total	92,700 kW

The greater part of the above generating equipment consists of diesel generating facilities, with the exception of the geothermal power plant (3,000 kW) on Leyte Island, Amlan Hydroelectric Power Plant (800 kW) on Negros Island and Loboc Hydroelectric Power Plant (1,200 kW) on Bohol Island. As for Samar Island, power generating facilities of NAPOCOR do not now exist. Power plants now under construction are Naga Coal-Fired Thermal Power Plant (55,000 kW) and Talavera Diesel Power Plant (54,000 kW) adopting large-size of unit (18,000 kW) on Cebu Island and geothermal power plant (112,500 kW) under construction at Tongonan on Leyte Island. The power plants which are scheduled to start their construction works during 1980 are pilot plant (3,000 kW) at the Palimpinon geothermal site on Negros Island and following this, a total capacity of 112,500 kW generating facilities. Besides the above, two power plant barges with each capacity of 32,000-kW are scheduled to be moored and in operation at Naga on Cebu Island and Bacolod on Negros Island at the beginning of 1981.

At the end of 1979, NAPOCOR possessed 428 km of transmission lines with 60-kV voltage or higher, and 5 substations with total capacity of 127.7 MVA.

(2) Electric Cooperatives and Other Electric Utility

The installed capacities of electric cooperatives and other electric utility as of the end of 1979 were as indicated below.

Installed Capacity

	Electric cooperative	Other utilities	Total
Cebu	1,782 kW	62,450 kW	64,232 kW
Bohol	2,000 kW	0	2,000 kW
Negros	51,727 kW	2,526 kW	54,253 kW
Panay	17,810 kW	23,404 kW	41,214 kW
Leyte	15,260 kW	1,432 kW	16,692 kW
Samar	5,680 kW	83 kW	5,763 kW
Total	94,259 kW	89,895 kW	184,154 kW

Among other electric utility, the installed capacity of VECO on Cebu is 59,530 kW, and that of PECO on Panay is 23,140 kW, and the both capacity corresponds to 92% of the total generating capacity of the other electric utility. The most other utility except the both is operated by local governments and municipalities.

Of the power generating facilities described in the above table, with the exception of steam power plants, capacity of 10,500 kW owned and operated by VECO on Cebu Island, all power plants install diesel plants. These diesel power plants are capable of supplying only about 80% of the total installed capacity due to antiquation of plants and lack of spare parts.

(3) Private Power Generation Facilities

The greater part of the privately-owned power generating facilities in the Visayas Region are antiquated and there are very few facilities which can produce the energy with rated capacities. The installed capacity and the present capability by island are as tabulated below:

	Installed capacity	Present capability
Cebu	158,300 kW	142,112 kW
Negros		
Occidental	145,359 kW	120,280 kW
Oriental	22,410 kW	20,170 kW
Panay	20,122 kW	17,610 kW
Leyte	16,180 kW	15,290 kW
Samar	5,040 kW	4,500 kW
Total	367,411 kW	319,962 kW

Of the power generating facilities listed above, the facilities (103,050 kW) owned by Atlas Copper Mine on Cebu Island and the facilities (130,035 kW) owned by the sugar refining plants in the Visayas Region comprise 63% of the whole.

3.2.2 Electricity Rates

Generally speaking, the electricity rates of the Visayas Region are relatively high compared with the incomes of the consumers, and especially in rural areas there is a considerable number of cases where electricity supply has been cut off because many households have been unable to pay the costly electricity bills after having had electricity led in. The reason for the high electricity rates lies in the successive raises in oil prices since the oil crisis of 1973 up to 1979. Hereafter, therefore, supplying cheap electricity through power generating systems (coal, geothermal energy, water power, etc.) not relaying on oil will stimulate demand, and this will result in a favorable cycle where generating costs can be lowered.

In fact, the electric cooperative, LEYECO V, supplying power centered at the city of Ormoc Leyte Island, is purchasing power from the pilot Tongonan Geothermal Power Plant (3,000 kW) of NAPOCOR at a rate of US$0.04/kWh (P0.30/kWh) and selling it to consumers at an average unit rate of US$0.105/kWh (P0.79/kWh), and there is no problem of non-payment by consumers. Electrification of the surroundings is being aggressively promoted and it is scheduled for the number of customers to be increased from 2,380 to 7,380 by the end of 1980. As seen in such an example, it is extremely desirable for cheap electricity to be available.

The electricity rates in the Visayas Region differ greatly between the cities of Cebu and Iloilo having high load densities and other districts (mainly supplied power through electric cooperatives). Meanwhile, the electricity rates of NAPOCOR which is principally a wholesaler differs according to region. These electricity rates are shown in Table 3-13 and Table 3-14.

Table 3-13 Tariff Rate of NAPOCOR by Region

Unit : Pesos/kWh

	Utility			Industry and Non-utility		
	100 kWh	300 kWh	500 kWh	500 kWh	1 000 kWh	2 000 kWh
Luzon	0.410	0.376	0.378	0.413	0.363	0.358
Cebu & Panay	0.456	0.436	0.443	0.488	0.484	0.472
Bohol & Negros	0.360	0.340	0.348	0.324	0.336	0.336
Mindanao	0.190	0.137	0.182	0.208	0.200	0.187

Note: Industrial demands were estimated by 50% load factor.
This tariff rate was applied from February 27, 1980.

The electricity rates of NAPOCOR, affected by the second oil crisis, have been raised an average of 31%, the 32.6% raise on Luzon Island being the greatest, with 11.8% in the Visayas Region and on Mindanao Island, the rate schedules of Table 3-13 having become applicable from February 27, 1980.

On the other hand, the electricity rates indicated for VECO, PECO and electric cooperatives directly selling electricity to consumers were calculated based on prices of fuel for power generation prior to the raises implemented by the Philippine Government in February 1980. Consequently, it would be reasonable to think that the present electricity rates are 15 to 20% higher than those given in Table 3-14.

Table 3-14 Tariff Rate of Visayas Region

Unit : Pesos/kWh

	Residential		Commercial			Industrial		
	100 kWh	200 kWh	200 kWh	500 kWh	1 000 kWh	50 kW	100 kW	200 kW
LEYECO V	0.883	0.836	0.855	0.851	0.850	0.684	0.679	0.676
VECO	0.714	0.717	0.765	0.747	0.723	0.613	0.530	0.530
PECO	0.835	0.717	0.838	0.788	0.771	0.667	0.633	0.616
SAMERCO II	1.090	1.090	1.090	1.090	1.090	1.090	1.090	1.090
LEYECO II	1.020	1.020	1.020	1.020	1.020	1.020	1.020	1.020

As will be described in the economic analysis in Chapter 9, the fuel cost per kWh in diesel power generation is P0.416, and as long as the electric cooperative or VECO and PECO generate power depending on diesel generating facilities, it is thought it will be difficult to lower the present electricity rates. Therefore, the object hereafter would be to aim for reduction in generating costs through construction of the coal-fired thermal and geothermal power plants presently being built by NAPOCOR, and it is desirable for wholesaling to electric utility be done at the electricity rates being applied by NAPOCOR to the islands of Bohol and Negros.

3.2.3 NEA and Electric Cooperatives

(1) NEA

As of the end of September 1979, NEA had organized 116 electric cooperatives in the 72 provinces of the Philippines and was giving aid to these cooperatives. The situation where in 1970 23% of the nation had been enjoying the benefits of electricity had been changed to a point where through establishment of the cooperatives 33% of the nation is now supplied with electricity.

The authorized capital of NEA is 1 billion pesos with capital paid in 500 million pesos. Borrowings from the World Bank, the Overseas Economic Cooperation Fund of Japan and the West German Government presently total US$219.7 million. NEA lends these funds to electric cooperatives at low interest rates over long terms, and provides guidance in management and technical matters to the cooperatives. Also, to cope with the rises in oil prices, NEA has been making efforts for construction of mini-hydro and dendro thermal power plants of low power generating costs. It is estimated that the generating cost of a dendro thermal plant will be US$0.041/kWh (P0.30/kWh). As for the generating cost for diesel as a result of the second oil crisis, it is estimated to be US$0.066/kWh (P0.48/kWh).

(2) Electric Cooperatives

NEA has organized 27 electric cooperatives in the Visayas Region and is making efforts to complete rural electrification by the end of 1987. According to NEA data, a minimum of 3 years is required for establishment of an electric cooperative, and the electrification ratio at the time of start of power transmission is usually 40 to 50%. According to the results of feasibility studies of the major electric cooperatives of the Visayas Region, the energy demand of ordinary residential consumers per month at the time of start of power supply is 30 to 40 kWh, which is estimated to become 70 to 90 kWh 10 years later. The specific energy consumption by consumer and electrification ratios of major electric cooperatives are given in Table 3-15.

Table 3-15 Electrification Ratio and Energy Consumption by Sector

Cooperatives	Unit	Residential		Commercial		Irrigation		Pub. Building	
		1st year	10th year	1st year	10th year	1st year	10th year	1st year	10th year
CEBECO II									
Electrification	%	50	86	86	95	10	75	80	89
Consumption	kWh/mon.	38	91	40	114	2 000	2 000	25	70
ILECO II									
Electrification	%	50	86	86	95	10	75	80	89
Consumption	kWh/mon.	38	91	40	114	2 000	2 000	25	70
CENECO									
Electrification	%	50	86	86	95	10	75	80	89
Consumption	kWh/mon.	35	90	40	105	2 000	2 000	25	70

3.2.4 Geothermal Power Generation

Investigations of geothermal energy in the Visayas Region were started in the early 1970s, and at present there is a total of 8 sites on the island of Leyte, Negros and Cebu where either investigations are being made or steam wells are being dug. Of these sites, the one at which investigations have gone forward the most is the Tongonan geothermal site where 12 production steam wells have been completed with the average electric power output per well being close to 10 MW, and this is the most promising of all sites for geothermal power generation. At present, there is a 3,000 kW pilot plant at the Tongonan site which has been in operation since 1978, while a full-scale 112.5 MW geothermal power plant is now under construction with commercial start-up scheduled for 1982.

Following the Tongonan geothermal site, there are the Palimpinon and Mambucal sites on Negros Island. Exploitation wells have already been dug at both sites and it is scheduled for a 3,000 kW pilot plant to be completed at the Palimpinon site in 1980.

There is much expectation that the three geothermal energy sites above will become major power sources of the Visayas Region providing power plants capable of supplying cheap electric power to the region.

With regard to the Tonganan site, it has been confirmed that the potential of the steam wells already evaluated amounts to 3,000 MW-yr, and construction of a power plant of more than 400 MW is being considered for this site for the future.

This power is far more than needed to satisfy the power demands of the islands of Leyte and Samar under present circumstances, and it will be necessary to transmit this power to Luzon or Mindanao by extra-high-voltage transmission line.

CHAPTER 4

LOAD FORECAST

CHAPTER 4 LOAD FORECAST

4.1 Principles of Load Forecasing

Huge expenditures and long periods of 3 to 5 years are required when constructing new power generating, transmitting and transforming facilities. It is necessary for future power demand to be properly grasped in order to utilize limited funds with maximum effectiveness. In a country which is at the stage of development, economic activities are generally extremely fluid with changes severe, and since electric power demand is closely related, it is a fairly difficult matter to forecast it with accuracy.

The object areas of the Project do not have power distribution networks established except for urban districts, and the electrification ratio of this region is estimated to be about 18% at present. Since this is the situation, the forecasting method based on past power demand performance will be inadequate, and it is necessary to consider also the power distribution network expansion program being implemented for rural electrification by electric cooperatives and the trends of new industrial demand expected in the near future according to the industrial decentralization plans of the Philippine Government.

Meanwhile, NAPOCOR made a detailed power demand forecast for the Visayas Region in September 1979, and in this case, not only the power demand of urban areas, but also power demands of rural areas in accordance with the rural electrification program of NEA were included, while power demands of consumers possessing private power generating facilities (installed capacity 367.2 MW) in the Visayas Region considered as being possible to incorporate in the NAPOCOR power system as a result of individual questionnaires sent out to such consumers were also added.

Therefore, in the sense of making a cross-check of the above-mentioned forecast figures of NAPOCOR, the Survey Team focused on the correlation between population and power demand which is one of the fundamental of load forecasting, and a forecast was made by a method differing from the forecast method used by NAPOCOR. The Project is a power transmission and transformation project, and in evaluation of the Project, cross-checks were made only for the two cross sections of 1985 and 1990 respectively. The load forecast of NAPOCOR has been made for a 17 year period from 1979 through 1995.

4.2 Preconditions for Load Forecast

Firstly, the electrification of the Visayas Region is being aggressively pushed forward with NAPOCOR and NEA supplementing each other, and the electrification program of NEA is to be completed by the end of 1987 as scheduled to eliminate unelectrified villages, and the electrification ratio in 1990 is to be raised to about the same degree (57.7%) as that in the Cebu capital area in 1979. Secondly, the electricity charge is to be maintained at a low level as much as possible and be attractive to consumers. For example, the geothermal energy

development programs on Negros and Leyte are to make possible supply of cheap electric power, while interconnections between islands by 138 kV trunk transmission lines and submarine cables are to be realized so that the area enjoying the benefits of economy of scale of the large-scale coal-fired thermal power generating facilities on Cebu and Negros Islands will not be limited. Thirdly, as projected in the Five-Year Development Plan from 1978 through 1982, the economic growth rate of about 7.4% in real terms is to continue. The economic growth rates for 1978 and 1979 are said to be 5.8% and 6.0%, respectively, and the increase in income of consumers in general will be the greatest factor for changing potential demand for electricity into effective demand.

4.3 Load Forecasting Method

The fundamentals in load forecasting are obtaining of basic data (past power demand records, population, per-customer electric energy consumption in major cities and electric cooperatives, etc.), comparison studies of the above, and with the above, investigations of the true conditions in the related demand area, thereby basing load forecasts on actual conditions as much as possible. Accordingly, the Survey Team carried out field investigations of the actual conditions as described below.

(1) The electric utility enterprises carrying out power supply to the principal communities of the various islands -- PECO supplying power to Iloilo City on Panay Island, CENECO supplying power to Bacolod City on Negros Island, VECO supplying power to Cebu City on Cebu Island, and LEYECO II supplying power to Tacloban City on Leyte Island -- were visited, and electric power demand records were obtained and investigations of the actual situations in the present states of electrification, facilities expansion programs, power demand predictions, and power generating facilities were carried out.

(2) Representative electric cooperatives of the Visayas Region were visited and investigations were made of the present states of electrification, future distribution network expansion plans, and present conditions in power demand performance. The electric cooperatives visited were 11 out of the 24 in the Visayas Region.

(3) The principal power plants and substations of NAPOCOR in the Visayas Region were visited and investigations of the actual conditions were made regarding power supply performances such as load curves, scheduled outage of power generating facilities and shutdowns due to faulting. Namely, Dingle Diesel Power Plant (29.2 MW), Santa Barbara Substation (50 MVA) and Panitan Substation (30 MVA) on Panay Island, Amlan Diesel Power Plant (11 MW) on Negros Island, Naga Diesel Power Plant (51.1 MW) on Cebu Island, and Tongonan Geothermal Power Plant on Leyte Island were visited, and efforts were made to collect data.

(4) Comparison studies were made of the major areas through observations. That is, the Survey Team carried out investigations of the actual state of electrification in the Visayas Region by making comparative observations of the major communities and rural areas of the various islands.

(5) Power demands were grasped through investigations of the states of construction of power generation, transmission and transformation facilities of NAPOCOR, and the present states of operation and maintenance, etc.

(6) Investigations of the actual states of large electric power consumers possessing private power generating facilities were carried out. In effect, the Survey Team visited the largest sugar refining plant (Victorias Milling Company, Inc.) on Negros Island and Atlas Consolidated Mining and Development Corporation on Cebu Island, one of the largest copper mines in the world, and investigations were made of the present states of power demand and the possibilities of receiving power from the NAPOCOR System on antiquation of power generating facilities.

Power demand forecasts were made by the methods below based on the above-mentioned state of investigations and the fundamental data obtained from NAPOCOR.

4.3.1 Analysis of Present State of Power Demand

Electric power, as is widely known, has come to be increasingly used with time, and it plays an extremely important role as an energy source in the various activities of society in general, such as daily life, culture and industry. In effect, in the major cities of the Philippines, especially, Manila, Cebu, etc., there has been a shift from the past of lighting being central to diversification in use of electric power for washing machines, televisions, coolers, and further, electronic cooking appliances, resulting in penetration into family life to a point that it is an energy source which cannot be done without for a moment, and thus it supports daily life and production activities in these cities from their very foundations. However, in rural areas on the other hand, there are many households which do not enjoy the benefits of electricity. As described in Chapter 3, "Electric Utility Industry in the Philippines," the Government of the Republic of the Philippines has placed first priority on rural electrification, and that this is completed by 1987 as planned will clearly be an important factor in making a load forecast.

In forecasting future power demand, it is absolutely necessary to first grasp the present situation in the subject region of a project. In this sense, analysis are to be made for the Visayas Region of the electrification ratio, electric energy consumption, outlook for new industrial demand, and the trend in population which has a close relation with power demand. Such analysis are to be made individually for the islands of Panay, Negros, Cebu, Leyte and Samar which comprise the subject area of the Project.

(1) Panay Island

The load center of Panay Island is Iloilo City and its surroundings. Supply of electricity to this area is being carried out by Panay Electric Company, Inc. (PECO). The maximum demand in 1979 was 16.4 MW, there were 21,440 customers, and the growth rate in power demand for the most recent 5 year period was an annual 8.3%.

The power generation performance and energy sales by type of customer for PECO in 1979 are indicated in Table 4-1. PECO has no plans for additional power generating facilities, the policy being to meet future increases in demand by receiving power from La Paz Substation which is already interconnected with Dingle Diesel Power Plant of NAPOCOR.

Panay Island produces 45% of the rice of the entire Visayas Region, with the rice-growing area centered at Iloilo Province, while sugar plantations are spread out in the northern part of the island. The greater part of existing private power generating facilities is at sugar refining plants and installed capacity is approximately 20 MW. The power generating facilities of these sugar refining plants are antiquated and these plants wish to receive power supply from the NAPOCOR system, but it is thought the supply from NAPOCOR will increase only gradually in view of comparisons of power costs.

Power supply to areas other than Iloilo City, with the exception of Iloilo Electric Cooperative, Inc. III (ILECO III), is being done by five electric cooperatives. The electrification ratio of these areas is estimated to be about 20% while the energy consumption per customer is estimated to be 52 kWh/mo.

The total population of Panay Island as of 1979 is estimated to have been 2,053,000 with 271,000 (13.2%) living in the city of Iloilo. According to the censuses conducted in 1970 and 1975, the population growth rate of Iloilo City is 2.7% with that of the remainder 2.0%.

(2) Negros Island

The load center of Negros Island is Bacolod City and its surroundings. Supply of electricity to this area is being carried out by Central Negros Electric Cooperative, Inc. (CENECO) which is an electric cooperative. In 1979 the maximum demand was 18.6 MW, the number of customers was 25,020, and it is estimated the growth rate in power demand during the most recent 5-year period was 6.0% annually.

The power generation performance and energy sales by type of customer for CENECO in 1979 are indicated in Table 4-2. Increases in power demand at Bacold City and its surroundings are scheduled to be met by a power barge (32 MW) of NAPOCOR to be moored there at the end of 1980, and there is no other plan in special to increase power generating facilities.

Negros Island is divided into Negros Occidental Province and Negros Oriental Province, and whereas the former shows signs of brisk activity around the sugar industry, hardly anything can be seen in the latter because there is little flat land, with an exception being a sugar plantation near Bais. The greater part of existing private power generating facilities is at sugar refining plants, the installed capacity being approximately 117 MW. Most of power generating facilities at these sugar refining plant is fairly old, but increase in power supply from NAPOCOR will only proceed gradually in view of the power costs.

Table 4-1 Power Demand of Panay Island in 1979

	Unit	PECO	CAPELCO
Installed capacity	kW	23,174	14,750
Maximum demand	kW	16,400	9,300
Energy production	MWh	85,027	* 28,145
(1) Energy sold	MWh	68,707	11,120
Residential	MWh	22,673	5,847
Commercial	MWh	15,802	2,700
Industrial	MWh	26,795	1,073
Others	MWh	3,435	1,500
(2) No. of customers		21,440	17,968
Residential		18,542	15,792
Commercial		2,670	1,200
Industrial		177	24
Others		51	952
(3) Consumption per customer	kWh	3,205	619
Residential	kWh	1,223	370
Commercial	kWh	5,918	2,250
Industrial	kWh	151,384	44,708
Others	kWh	67,353	1,576

Note : * The figures involve energy demands of 6,281 MWh and 4,554 MWh at Aklan and Iloilo Electric Cooperatives, respectively.

Negros Island is divided into 5 districts, the customers in the respective districts supplied with power by electric cooperatives. That is, privately-owned electric power companies such as PECO on Panay Island and VECO on Cebu Island do not exist. There are Amlan Hydro (0.8 MW) and Amlan Diesel (11.0 MW) owned by NAPOCOR on Negros Island, and the power generated at these power plants are sold wholesale to the electric cooperatives of Negros Oriental Electric Cooperative, Inc. I (NORECO I) and Negros Oriental Cooperative, Inc. II (NORECO II).

It is estimated that the electrification ratio of areas of Negros Island other than Bacolod City and its surroundings is about 10%, while the energy consumption per customer is estimated at 115 kWh/mo. It is estimated that the total population of Negros Island was 2,324,000 as of 1979, of which 427,000 (18.4%) were living in Bacolod City and its surroundings. According to the results of censuses conducted in 1970 and 1975, the population growth rate of Bacolod City is 3.8% and that of other areas 3.4%.

(3) Cebu Island

The load center of Cebu Island is Cebu City and its surroundings. Power supply to this area is being carried out by Visayan Electric Company Inc. (VECO). The maximum demand in 1979 was 70.8 MW, the number of customers 73,570, and the growth rate in power demand during the most recent 5-year period 8.9%.

The power generation performance and energy sales by type of customer for VECO in 1979 are indicated in Table 4-3. Future increases in power demand will be met by VECO receiving power from Banilad Substation which is already interconnected with Naga Diesel Power Plant of NAPOCOR. (VECO is planning construction of a 55 MW coal-fired thermal at Argao at the southern part of Cebu Island, but the realization of this is questioned by many people in view of Presidential Decree No. 40. There is no other plan for expansion of power generation facilities.)

Cebu Island is the center of the Visayas Region, and besides being a collection and distribution point for commodities, it is a processing center of copra, dried coconut, coconut oil and coconut meal which are secondary products of coconut, one of the major products of this region. At the western part of Cebu Island, that is, the area facing the Negros Island side, there is one of the largest copper mines in the world. Existing private power generating facilities total an installed capacity of approximately 158 MW, the greater part consisting of the thermal power generating facilities (103 MW) owned by Atlas, the above-mentioned copper mine. Other than the above, Apo Cement, San Miguel Beer, a General Milling flour factory and a Ludo & Luym factory own private power generating facilities. These private power generating facilities are all thermal (diesel or steam), and if cheap power were to be supplied by NAPOCOR, it would be possible to include the power demands of these consumers in the demand of NAPOCOR, but it would be reasonable for them to be introduced gradually in the NAPOCOR system in view of the comparisons of power generation costs and the present conditions of the private power generating facilities.

Table 4-2 Power Demand of Negros Island in 1979

	Unit	CENECO	NORECO II
Installed capacity	kW	29,750	-
Maximum demand	kW	18,550	2,660
Energy production	MWh	*1 94,792	13,310
(1) Energy sold	MWh	70,655	*2 (12,204)
Residential	MWh	33,876	(5,244)
Commercial	MWh	12,266	(4,932)
Industrial	MWh	20,832	(840)
Others	MWh	3,681	(1,188)
(2) No. of customers		25,022	8,842
Residential		22,009	7,075
Commercial		2,607	1,607
Industrial		146	7
Others		260	153
(3) Consumption per customers	kWh	2,824	1,380
Residential	kWh	1,539	741
Commercial	kWh	4,705	3,069
Industrial	kWh	142,685	120,000
Others	kWh	14,158	7,675

Note : *1 The figures involve energy demands of 6,178 MWh for VRESCO Electric Cooperative.

*2 The figures in parenthesis indicate energy demands estimated based on Dec. '79 billing of NORECO II.

Table 4-3 Power Demand of Cebu Island in 1979

	Unit	VECO	CEBECO I
Installed capacity	kW	59,250	1,000
Maximum demand	kW	*70,800	*1,300
Energy production	MWh	*337,208	*3,264
(1) Energy sold	MWh	282,338	2,448
Residential	MWh	70,937	1,320
Commercial	MWh	47,801	408
Industrial	MWh	152,170	-
Others	MWh	11,430	720
(2) No. of customer		73,578	4,358
Residential		64,511	4,121
Commercial		6,585	166
Industrial		662	-
Others		1,820	71
(3) Consumption per customers	kWh	3,837	562
Residential	kWh	1,100	320
Commercial	kWh	7,259	2,457
Industrial	kWh	229,864	-
Others	kWh	6,280	10,141

Note : * The figures involve demands provided by NPC's Naga Diesel Power Plant.

Power supply to areas other than Cebu City and its surroundings is done by electric cooperatives dividing these areas into three parts. Under the present conditions only Cebu Electric Cooperative, Inc.I (CEBECO I) connected with the power system of NAPOCOR is carrying out power supply. The electrification ratio of the area being supplied by CEBECO I is 10%, and the energy consumption per customer is 47 kWh/mo.

The total population of Cebu Island as of 1979 was estimated to be 1,580,000, of which 778,000 (49.2%) were living in the city of Cebu and its surroundings. According to the censuses conducted in 1970 and 1975, the population growth rate of Cebu City is 2.5% with that of other areas 1.7%.

(4) Leyte Island

The load center of Leyte Island is Tacloban City and its surroundings. An electric cooperative, Leyte Electric Cooperative, Inc. II (LEYECO II), is responsible for power supply to this area, but the greater part of the demand is being met with the power from the diesel generating plant owned by the electric cooperative Don Orestes Romualdes Electric Cooperative, Inc. (DORELCO: formerly LEYECO I). The maximum demand in 1979 was 4.1 MW, the number of customers 12,350, and the estimated growth rate in power demand for the most recent 5 year period was 7.0% annually.

The power generation performance (mostly power purchased from DORELCO) and energy sales by type of customer for LEYECO II in 1979 are indicated in Table 4-4. LEYECO II has no plan to expand generating facilities for coping with future increases in power demand, relaying on power received from DORELCO and Tongonan Geothermal Power Plant (112.5 MW) to be completed in 1983.

Leyte Island has the two provinces of Leyte and Southern Leyte with development of Southern Leyte comparatively backward. The economic activities of Leyte Island, unlike the previously-described three islands, do not include anything prominent such as production and processing of rice and sugar, or collection and distribution of commodities. However, sugar plantations spread out on the plain around Ormoc City may be seen as exceptions. The total installed capacity of existing private power generating facilities is approximately 16.2 MW, and these are owned by sugar refining plants such as those of BIOPHIL, FILMAG and Ormoc. These private power generating facilities are all thermal (diesel or steam), and if cheap electricity were to be supplied by NAPOCOR, it will be possible for the power demands of these consumers to be gradually incorporated into the NAPOCOR power system in the future.

Electrification of Leyte Island is being pushed forward dividing the entire island into 7 electrification districts. Although the electrification ratio of the franchise of LEYECO II, which is the largest power demand area, is as much as 58%, the electrification ratios of other areas are estimated to be about 9%, while the energy consumption per customer is estimated to be 61 kWh/mo.

Table 4-4 Power Demand of Leyte and Samar Islands in 1979

	Unit	Leyte Island		Samar Island
		LEYECO II	LEYECO V	SAMELCO II
Installed capacity	kW	4,760	1,000	5,000
Maximum demand	kW	*4,035	*1,200	1,130
Energy production	MWh	*20,755	*2,386	2,358
(1) Energy Sold	MWh	15,878	2,052	1,869
Residential	MWh	5,508	695	892
Commercial	MWh	4,864	464	588
Industrial	MWh	3,521	724	89
Others	MWh	1,985	169	300
(2) No. of customers		12,347	2,784	4,153
Residential		9,769	2,329	3,526
Commercial		1,409	329	335
Industrial		125	35	1
Others		1,044	91	291
(3) Consumption per customer	kWh	1,286	737	450
Residential	kWh	564	298	253
Commercial	kWh	3,452	1,410	1,755
Industrial	kWh	28,168	20,685	89,000
Others	kWh	1,901	1,857	1,031

Note : * The figures involve demands provided by DORELCO's Power Plant

The total population of Leyte Island as of 1979 was estimated to be 1,456,000, of which 127,000 (8.7%) were living in Tacloban City and its surroundings. According to the results of censuses conducted in 1970 and 1975, the population growth rate of Tacloban City is 2.0% with that of other areas 1.4%.

(5) Samar Island

The area of this island is roughly the same as that of Negros Island, but there are few plains while the island is frequently hit by typhoons, and economic activities tend to be hampered by the natural environment.

There is nothing special to be seen in the power demand of Samar Island, and even in Catabalogan estimated to have a population of 15,000 to be the largest municipality on Samar Island, the maximum demand is estimated to be about 900 kW. Power supply to the district including Catabalogan is being carried out by Samar Electric Cooperative, Inc. II (SAMELCO II). The maximum demand in 1979 was 1.1 MW, the number of customers was 4,150, and the growth rate in power demand from 1978 to 1979 is estimated to have been 7.0%.

SAMELCO II is presently constructing a 69 kV transmission line to Calbayog City of adjacent SAMELCO I and Taft in Eastern Samar, and power supply to these areas will become possible in the middle 1980s.

The electrification program for Samar Island is centered on the power generating facilities owned by SAMELCO II, two 2,500 kW diesel power generating facilities, a total of 5,000 kW, and there is a plan for expansion of the 69 kV transmission lines, but there is nothing planned in the way of expansion of power generating facilities.

Electrification of Samar Island is being carried out by four electric cooperatives, but whereas the electrification ratio of SAMELCO II is estimated to be 13.7%, that of the island as a whole is thought to be only 4.5%. The per capita electric energy consumption of SAMELCO II is 38 kWh/mo. The total population of Samar Island in 1979 is estimated to have been 1,084,000, and according to the censuses of 1970 and 1975, the population growth rate was 1.8%.

4.3.2 Load Forecast

The load forecast described below was made based on the electrification ratios of the various islands, the trends of increase in population, the number of customers, energy consumption per customer, the existing consumers possessing private power generating facilities, and new industrial consumers to be incorporated in the NAPOCOR system.

(1) Electrification Ratio

The electrification ratios of the various islands in 1979 reflected well the economic activities and regional conditions of the individual islands. As previously described, the greater part of the electrification program for the Visayas Region has been pushed ahead by electric cooperatives, and

Table 4-5 Estimated Electrification Ratio in %

	1979 (Actual)	1985	1990	Annual increase
Panay				
Urban	47.8	55.0	60.0	2.1
Rural	19.9	30.0	40.0	6.6
Total	23.6	33.5	42.9	5.6
Negros				
Urban	35.1	60.0	80.0	3.3
Rural	10.0	55.0	70.0	19.4
Total	14.6	55.9	71.8	15.6
Cebu				
Urban	56.8	70.0	85.0	3.7
Rural	4.4	45.0	70.0	28.6
Total	30.2	57.4	77.7	9.0
Leyte				
Urban	58.0	65.0	70.0	1.7
Rural	8.5	40.0	60.0	19.4
Total	12.0	42.2	61.1	15.9
Samar				
Urban	13.7	25.0	30.0	7.4
Rural	2.8	15.0	20.0	19.6
Total	4.5	16.7	21.7	15.4

accordingly, the electrification ratios of the urban and rural areas of the various islands in 1985 and 1990 were estimated as shown in Table 4-5. Considerable differences may be seen in the electrification ratios of the various islands, but these have been estimated from the timings of establishment of the electric cooperatives being promoted by NEA and the distributions of consumers in the areas to be electrified (based on 1/50,000 scale topographic maps). Further, the influence on the entire power demand of a difference of 5% in the electrification ratio of a rural area will differ depending on the island, but in the case of Cebu Island it will be 1.0% and in the case of Samar Island 4.1%.

The electrification ratio of all of the five islands in 1990 will become 57.5%, roughly the same as the electrification ratio of 56.8% of the urban area of Cebu Island in 1979.

(2) Population Increase

NAPOCOR, based on the censuses of 1970 and 1975, estimated the population growth rates of the rural and urban districts, and further, carried out estimations of the future population according to the scopes of supply of electric cooperatives along with private electric power companies such as PECO and VECO. Details are given in Appendix A-2. The population growth rates of the various islands are indicated in Table 4-6.

Table 4-6 Projection of Population by Franchise Area

Unit : 10^3

	Estimated population			Annual increase (%)
	1979	1985	1990	
a) Panay				
PECO	271	314	347	2.27
Other cooperatives	1,782	1,910	2,007	1.09
Total	2,053	2,224	2,354	1.25
b) Negros				
CENECO	427	453	471	0.90
Other cooperatives	1,897	2,031	2,132	1.06
Total	2,324	2,484	2,603	1.03
c) Cebu				
VECO	778	883	952	1.85
Other cooperatives	802	890	921	1.26
Total	1,580	1,773	1,873	1.56
d) Leyte				
LEYECO II	127	134	139	0.82
Other cooperatives	1,329	1,400	1,454	0.82
Total	1,456	1,534	1,593	0.82
e) Samar				
SAMELCO II	255	273	292	1.24
Other cooperatives	829	878	937	1.12
Total	1,084	1,151	1,229	1.15
f) Grand total	8,497	9,166	9,652	1.16

The population growth rate in the entire Republic of the Philippines from 1970 to 1975 was 2.7% annually, while that of the Visayas Region excepting Bohol Island was 2.1% annually, but NAPOCOR is predicting the growth rates will decline slightly hereafter.

(3) Number of Customers and Specific Energy Consumption

The numbers of persons comprising households calculated from the census data of 1970 and 1975 were the following:

Central Visayas Region :	5.71 capita/household
Western Visayas Region :	6.28 capita/household
Eastern Visayas Region :	5.57 capita/household

In effect, it may be considered that the average for the Visayas Region is roughly 6 persons to a household. Although there is some difference according to area as seen above, in calculating the number of customers for load forecasting, it was assumed that the number per household would be 6 persons, and the number of customers in 1985 and 1990 were calculated from the before-mentioned population estimates and electrification ratios.

It might be added that according to the above population statistics data, the number per household for the whole of the Philippines is 5.74 persons so that the Visayas Region has a slightly larger number than the average for the Philippines.

Details of the number of customers by island are given in Appendix A-2. The populations, electrification ratios and numbers of customers of the various islands in various years are as shown in Table 4-7.

Table 4-7 Number of Customers by Island

		1979 (Actual)	1985	1990	Annual increase (%)
Panay					
Population	(10^3)	2,053	2,224	2,354	1.25
Elec. ratio	(%)	23.6	33.5	42.9	5.6
No. of customers	(10^3)	80.7	124.3	168.5	6.9
Negros					
Population	(10^3)	2,324	2,484	2,603	1.03
Elec. ratio	(%)	14.6	55.9	71.8	15.6
No. of customers	(10^3)	56.5	231.5	311.5	16.8
Cebu					
Population	(10^3)	1,580	1,773	1,873	1.85
Elec. ratio	(%)	30.2	57.4	77.7	9.0
No. of customers	(10^3)	79.5	169.7	242.4	10.7
Leyte					
Population	(10^3)	1,456	1,534	1,593	0.82
Elec. ratio	(%)	12.0	42.2	61.1	15.9
No. of customers	(10^3)	29.2	107.8	162.1	16.9
Samar					
Population	(10^3)	1,084	1,151	1,229	1.15
Elec. ratio	(%)	4.5	16.7	21.7	15.4
No. of customers	(10^3)	8.4	32.1	44.4	16.3
Total					
Population	(10^3)	8,497	9,166	9,652	1.16
Elec. ratio	(%)	18.0	43.6	57.7	11.2
No. of customers	(10^3)	259.3	665.4	928.9	12.5

As seen in Table 4-1 through Table 4-4, a considerable difference may be seen in energy consumption between urban and rural areas. This is because there are more large industrial users and commercial users consuming more than ordinary customers existing in urban areas compared with rural areas. The Survey Team calculated the energy consumptions per customer of electric power companies or electric cooperatives supplying electricity to representative urban and rural areas of the respective islands, and the energy consumptions at consumer ends were computed multiplying by the above-mentioned estimated number of customers (separated into customers in urban and rural areas). Appendix A-2 should be referred to for details.

The energy consumption per customer by island and by urban and rural areas are indicated in Table 4-8.

Table 4-8 Energy Consumption per Customer

Unit : kWh/year

	1979 (Actual)	1985	1990	Annual increase (%)
Panay				
Urban	3,205	3,310	4,220	2.5
Rural	619	890	1,170	5.9
Negros				
Urban	2,824	3,780	4,820	4.9
Rural	1,380	1,850	2,360	5.0
Cebu				
Urban	3,837	5,140	6,560	5.0
Rural	562	830	1,090	6.2
Leyte				
Urban	1,286	1,720	2,190	4.9
Rural	737	990	1,260	5.0
Samar				
Urban	450	800	1,150	8.9
Rural	--	710	1,090	8.9

Past performances were referred to regarding the growth rates in specific consumption (electric energy consumption per customer) in urban areas, while for rural areas, as stated in Chapter 3, "Electric Utility Industry in the Philippines," calculations were made assuming that the energy consumption per customer in one month during the initial year of start of operation of an electric cooperative of 38 kWh (408 kWh in 1 year) would increase to 91 kWh (1,092 kWh in 1 year) 10 years later. As for the specific consumption of the rural area of Negros Island, it is high compared with the other islands and this is thought to be because Negros has a longer history of rural electrification compared with the other islands, and moreover, because the average income of customers is higher.

(4) New Industrial Customers

With respect to industrial consumers to be newly incorporated into the NAPOCOR system, NAPOCOR has made investigations by year and by island. The details are indicated in Appendix A-2, but it is expected that there will be delays of 2 to 3 years partially (especially, the copper refining plant scheduled to move into the Pasar Industrial Area on Leyte Island, and the power demand arising in step with copper mine development on Negros Island). In any event, it was judged possible for all of the power demand of new industrial customers to be incorporated in the NAPOCOR system as of 1985.

Further, part of these industrial demands is made up of existing industrial users (sugar refining plants, etc.) who can gradually be added to the power demand of NAPOCOR as their power generating facilities become antiquated. The new industrial demands by island are shown in Table 4-9.

Table 4-9 New Industrial Demand by Island

	1985		1990	
	MW	GWh	MW	GWh
Panay	9.6	49.9	—	55.7
Negros	60.5	251.3	—	282.1
Cebu	34.0	138.7	—	156.5
Leyte	29.4	77.4	—	97.6
Samar	3.9	23.1	—	26.4
Total	137.4	540.4	—	618.3

It may be expected that there will be increases in the new industrial demand incorporated into the NAPOCOR system in 1985 resulting from increased rates of operation, and that there will be industrial demand after 1985 now unknown, but it is difficult for these to be estimated under present circumstances since concrete data are lacking. However, it will be reasonable for the new industrial demand incorporated in the NAPOCOR system to grow at a rate of 2 to 3%.