(3) Current issues in sea transport

In general, sea transport in the Philippines is characterized by high inter-island shipping costs and poor safety record. In addition, PPA's monopolistic function and scope brings about distorted port charges, causes further deterioration of public ports and results in less developed private ports.

Port of Manila

Low efficiency of cargo handling at the South and North harbors is due to lack of cargo handling space such as open storage area and parking area, and not due to cargo handling operation capability. A considerable part of port area has been occupied by unauthorized settlers for a long time. Heavy traffic congestion is seen around the Manila port due to insufficient road network.

Port of Subic

The port of Subic needs improvements and addition of facilities to convert it for civilian use. For instance, addition of container handling facilities such as shore/transfer cranes is needed. In addition to the improvement of port facilities, improvement of road network is crucial for development of the port and surrounding area, since there is low accessibility between Subic and Metro Manila. Several roadway links connecting Olongapo City are still threatened by natural disasters as follows:

- threat of lahar and flooding along the San Fernando - Olongapo road,
- high risk of lahar flow along the Olongapo - Bugallon Road, and
- flooding along Dinalupihan - Olongapo road stretch.

2.3 Transport Development Strategy and Development Plan

2.3.1 Transportation system development strategy and plan

(1) Basic strategy

Based on the goals set by the Medium Term Plan (subsection 2.1.1) and the current conditions (Section 2.2), transport development in Central Luzon should aim at the following:

- to concentrate on maintenance and rehabilitation of existing transportation facilities and make it all-weather use,
- to concentrate on transportation network development for supporting the planned/committed mega projects such as Clark international airport and Subic port,
- to protect the critical road sections by flood control measures, and
- to provide access links to resettlement areas.

From the long-term network development viewpoint, alternate links should be provided since Central Luzon is a natural calamity prone area.

(2) Short term development (1994-1996)

The short term plan for transportation development in Central Luzon should aim at the following:

1) to concentrate on maintenance and rehabilitation of roadway facilities,

2) to limit road developments for supporting planned major developments such as Clark international airport and the Subic Special Economic Zone,

3) to protect critical sections by flood control and lahar control (urgent),

4) to suspend road development projects until a flood control master plan is established,

5) to provide access to resettlement areas (urgent), and

6) to convert Subic Port into a commercial port.

(3) Medium term development (upto the year 2000)

The medium term transport development should aim at the following:

1) to develop the Clark international airport,

2) to construct bypasses in major urban centers,

3) to construct common bus terminals in the outskirt of the major cities,

4) to extend the North Luzon Expressway and access roads,

5) to construct the Manila-Bataan-Subic Coastal road,

6) to construct the Rainbow Highway(Dinalupihan-Angeles section), and

7) to rehabilitate the Main Line North of PNR(Metro Manila-Clark).

(4) Long term development (to the year 2010)

The transportation development in Central Luzon in the long run would realize the following:

1) to develop the Sierra Madre expressway, and

2) to upgrade roadway sections where necessary.

2.3.2 Transportation infrastructure investment plan

The infrastructure investment program prepared by NEDA includes the maintenance and improvement of national, arterial and secondary roads and flood control projects along the major river basins. Preventive works for lahar and pyroclastic flows are also included in this program. Most part of the funds are allocated for development and maintenance of roads and bridges in 1993 - 1998. Investment requirements for various transportation infrastructure are summarized below.

Investment Requirement in Transportation Infrastructure

(in million Pesos)

	1993	1994	1995	1996	1997	1998	Total
Roads and Bridges	1,528.31	1,993.05	2,098.83	3,551.40	3,607.61	3,962.28	16,741.48
Railways			15.00				15.00
Airports and Airways	50.00	80.00	25.00	50.00	250.00	250.00	705.00
Water Transport	35.00	10.00					45.00
Total	1,613.31	2,083.05	2,138.83	3,601.40	3,857.61	4,212.28	17,506.48

Source: Medium Term Central Luzon Regional Development Plan 1993-1998 prepared by NEDA

2.3.3 Road network development plan

(1) Government Medium Term Road Development Plan

In the Medium Term Development Program in Central Luzon, higher priority was given to improvement and maintenance of the following major arterial roads, which served inter-regional and inter-provincial traffic: Manila North road, Cagayan Valley road, North Luzon Expressway, Olongapo - Bugallon road, Gapan - San Fernando-Olongapo road, Nueva Ecija - Aurora road, and San Jose - Rosales road.

Furthermore, development of alternate routes to major trunk lines is also emphasized. The roads included in this category are:

- Tarlac - Pangasinan road:

  (either Camiling - Wawa Road, Guimba - Rosales Road, or Moncada - Anao - Nampicuan - Cuyapo - Rosales Road),

- Nueva Ecija - Nueva Vizcaya road:

  (Caranglaan in Nueva Ecija to Dupax Sur in Nueva Vizcaya as alternate to the CVR in going to Region II),

- Manila-Bataan Coastal road:

  as the faster alternative road in accessing western provinces in Central Luzon, and

- New North Luzon Expressway:

  as an alternate route to existing expressway and relatively far from lahar threat.

In pursuit of total integrated regional development, improvement and establishment of better linkages between industrial and economic zones, and for supporting agro-industrial development, the following roads are identified:

- San Fernando - Angeles - Mabalacat road (widening),
- Angeles - Dinalupihan road,
- Angeles - Magalang - Arayat - Sta. Ana - San Luis - San Simon road,
- Zambales - Tarlac - Nueva Ecija - Aurora road (East-West highway),
- Bagac - Mariveles road,
- Bagac - Morong - Olongapo road,
- Road support to Subic and Clark Conversion Programs,
- Tarlac roads,
- Nueva Ecija roads, and
- Bulacan roads.

(2) Existing road development programs

DPWH listed the following road construction and rehabilitation works in Central Luzon as the "flagship" projects for 1994 and 1995.

<u>North Luzon Expressway up to Subic/Clark</u>

1) Rehabilitation and widening of the existing expressway from Balintawak to Tabang and Santa Ines, Pampanga

   Asphalt overlay of the existing roadway and widening into three lanes per direction between Balintawak and Burol for about 56.0 km and into two lanes per direction and Dau for 22.0 km.
   Project Schedule: 1994-1996
   Total Cost: ₱ 1,946 million

2) Extension of NLT from Dau through Clark to Bamban, Tarlac

   Construction of about 10 km of two-lane expressway west of McArthur Highway to Bamban, Tarlac to provide direct access to Clark and across the Sacobia river.
   Project Schedule: 1994-1997
   Total Cost: ₱ 1,168 million

3) Construction of Pulilan - Calumpit - Lubao expressway

Rehabilitation of existing road from the Pulilan interchange along the NLT to Calumpit and construction of 26.0 km of two lane expressway from Pulilan to Lubao.
Project Schedule: 1994-1997
Total Cost: ₱ 2,272 million

4) Lubao - Dinalupihan - Subic expressway

Construction of 38.8 km of new road into two-lane expressway from Lubao through Dinalupihan to Subic.
Project Schedule: 1994-1997
Total Cost: ₱ 1,531 million

Pan - Philippine highway: Aritao, Nueva Vizcaya - Sta. Rita, Bulacan section
Rehabilitation works for 200.1 km of deteriorated pavement including construction of bridges and drainage with estimated length of 818.6 km.

Project Schedule: 1991-1995
Total Cost: ₱ 1,980 million

(3) Recommended road network development projects

A geographic information system (GIS) was used to project trip production growth from 1992 to 2010 and the traffic flows in 2010. Figures 2.4 and 2.5 depict the outcome. Based on these and existing conditions, policies, and on-going projects presented in earlier chapters and sections, road development plan in 2010 was determined for Central Luzon (Figure 2.6).

North-South inter-regional expressway
Since the extension of the North Luzon Expressway has been franchised to PNCC, the development of the New North Luzon Expressway is not necessary because both expressways go to the same destination and it will not get sufficient patronage in the northern part. Instead, development of the Sierra Madre expressway is more rational for the following reasons.

1) Parallel development of the North Luzon Expressway (NLE) and the Sierra Madre Expressway (SME) would achieve more balanced regional development by giving accessibility to provinces. NLE would encourage economic development in the provinces of Tarlac, Pangasinan, La Union and further northern provinces along the coastal lines. On the other hand, SME would open up Cagayan Valley and Aurora Province.

2) Another concern is insufficiency of roadway capacity in the vicinity of Metro Manila and ribbon type development along the corridor. Since urbanized areas have expanded along the two major roads NLE and the Manila North Road, and no alternative route has been provided, further development of urban expansion would occur along the existing roads and cause serious traffic congestion. Provision of the new expressway parallel to the existing one could induce land development between the two corridors and promote more efficient land use in the suburban area of Metro Manila.

The development of SMEs can be seen as a long term development project, if the extension of NLE is realized. However, the section between Metro Manila and San Miguel, Bulacan needs a feasibility study at an early date.

Linkage between Metro Manila and Subic Port , Clark International Airport

Currently three roads are proposed to connect Subic Port and Clark and Metro Manila:

- Pulilan - Calumpit - Lubao expressway,
- San Fernando - Dinalupihan road, and
- Angeles - Porac - Dinalupihan road (A part of Rainbow Highway proposed in the study).

The Pulilan - Calumpit - Lubao expressway was planned as a spur of NLE, but it runs through swamp area resulting in high construction costs. The San Fernando - Dinalupihan road is a toll road as an alternative route to the spur line. On the other hand, the proposed Rainbow Highway aims at direct linkage between Subic Port and the Clark international airport. Although combination of the Pulilan - Calumpit - Lubao expressway and the Rainbow Highway is desirable in order to achieve strong linkages among the National Triad Growth Centers, the San Fernando - Dinalupihan road would provide a moderate solution in the short term. In any case, the improvement of the section between Subic Port and Dinalupihan is required.

Bypass roads in urban centers

Construction of bypass roads for major urban centers, such as Cabanatuan City, Tarlac, and Angeles City is an effective way to divert inter-regional traffic flows from built up areas. Most highways in Central Luzon are two lane roads, but road capacity in rural areas is still sufficient for the traffic demand at present and in the near future. Traffic congestion is seen mostly in urbanized areas. Therefore, construction of bypasses is an economical way to provide reasonable traffic capacity in the short term. In order that bypasses function to divert traffic, cities should restrict land use along the bypasses; otherwise their original traffic function would not be attained. Thus, coordination with each city land use plan is of great importance.

Rural road network development plan

Even though rural roads are extensive in length, the quality of the roads should be upgraded. Priority should be given to rural roads near urban centers. Continuity is also important for the rural road improvement; short stretches of improper roads do not work. At the same time facilities such as warehouses and agriculture product distribution centers should be located along the proposed bypasses.

2.3.4 Railway development plan

(1) On-going railway development program

PNR currently undertakes the "Rehabilitation Project for the Main Line South" between Lucena and Naga, and the "Improvement and Modernization of Commuter Line(South) Project.

(2) Main North Line rehabilitation project

In Central Luzon, PNR pursues the feasibility for the rehabilitation of the Main North Line under a BOT scheme. They have prioritized the sections in the following order. The first priority is given to the section between Metro Manila and Angeles City. The second priority is set to the section between Bacnotan and Poro Point for transporting cement, followed by the section between Bacnotan and Dagupan, Dagupan and Tarlac.

In the first priority section, the railway will be rehabilitated between Paco Station and Clark including the branch line to Tutuban. The railway will serve air passengers and well-wishers to/from the airport, as well as local passengers along the Main Line North. Furthermore, it aims at transporting cargo to/from the airport.

The air passengers and well-wishers to/from Metro Manila and further locations will be served by special express trains, while those who have their origins along the line will be served by local trains.

Two alternatives for railway operation are proposed for the special express trains:

Alternative 1: Maximum running speed of special express trains is 160 km per hour, and

Alternative 2: Maximum running speed of special express trains is 120 km per hour.

Railway passenger demand was projected in accordance with the development of the Clark international airport.

Projected Daily Railway Passenger Demand

Type of Passengers	2005	2010
Air Passengers and Well-wishers	21,900	30,500
Airport Employees	6,200	8,400
Commuters	47,600	55,200

Source: Bases Conversion Development Authority and Mitsui & Co. Ltd., Clark International Airport Master Plan Study, Final Report, June 1994.

Project schedule is set such that the detailed design work will be done from 1995 to 1997, and the construction work will be completed by 2000.

(3) Necessity of integrated land and railway system development

Although the railway development project aims at serving air passengers to/from the Clark international airport, it is expected to serve commuters to/from Metro Manila. Since suburbs in the urbanized area have already expanded to the southern part of Bulacan province, enormous number of employees commute from this area to Metro Manila every day. People living in the suburbs use their own private passenger cars for commuting. This has brought about serious traffic congestion. To alleviate the traffic congestion problem in Metro Manila, the Main North Line commuter service would play a significant role if sufficient level of services is achieved.

However, as seen in many countries, urban rail companies cannot make train operation feasible if their revenue is limited only to those from transportation services. Subsidies to urban public transportation are justified by reducing external cost of traffic congestion imposed on the community. Governments in many developing countries, however, are not able to provide sufficient funds for urban transportation due to lack of funds. Therefore it is necessary to establish a system to internalize development benefits into railway operation. Without these considerations, it would be difficult to revitalize the railway operation in the region. Integrated railway system development coupled with commercial and residential land development along the corridor would be one way for revitalization of the Main North Line.

In order to make efficient use of railway system, railway station plaza and access roads to the stations should be planned. Also, land use planning should be coordinated with the railway system development plan. High density commercial land use such as shopping center or supermarket and high density residential land use such as multiple storied apartments are recommended within walking distance of the station.

2.3.5 Air transport development plan

Conversion of the two former U.S. airbases, Clark and Cubi Point, into international airports is of great importance for air transportation development in the region. DOTC has not made a final decision on the role of the Clark international airport in relation with development/expansion of the existing Ninoy Aquino International Airport. Swedish consultants have prepared the technical study for CIA and the Subic airport. Besides, the airport development plan for CIA is undertaken by BCDA.

(1) Clark international airport development plan

Traffic demand was projected on the conditions that all international flights will be handled at CIA and 3% of domestic flights in the region will be operated at CIA.

Projected Air Passenger Demand at CIA

(in thousand persons)

	1998	2005	2010
International	8,000	13,400	18,300
Domestic	170	300	410
Total	8,170	13,700	18,710

Projected Air Cargo Demand at CIA

(in thousand tons)

	1998	2005	2010
International	309	505	684

Source: Bases Conversion Development Authority and Mitsui & Co. Ltd., Clark International Airport Master Plan Study, Final Report, June 1994

The project implementation schedule is currently set as follows:

1) Detailed design: 1995-1996
2) Construction of passenger terminal building: 1996-1998
3) Initial opening: 1998

(2) Subic Bay international airport improvement plan

DOTC has conducted a feasibility study on upgrading of the Subic Bay international airport. Based on the investigation of existing airport facilities, it is recommended in the feasibility study to give priority to improving the airport facilities as follows.

First priority is given to the measures for maintaining safety and regularity of initial domestic and international civil aviation. This includes runway strip improvement, development of runway end safety areas, airport security development, and development of new passenger terminal area as well as other minor improvements. The total cost for these improvement was estimated at ₱216.1 million in 1993 price.

Second priority is given to the actions for future development of the airport and its facilities. They include construction of southeast parallel taxiway shoulders, hillside cut south of the runway, runway overlay pavement, southeast taxiway overlay pavement, and other improvements. Preparation of an airport master plan is also recommended. The total cost of actions in second priority group is estimated to be ₱54.1 million.

2.3.6 Sea transport development plan

(1) Subic Port development plan

The Subic Naval Base has been converted into an international commercial port by strengthening container handling facilities. SBMA plans to expand the port facilities by adding six berths, totaling in all eight berths and by expanding container stock yard. The port will increase the container handling capacity up to 500,000 T.E.U. by 1997. SBMA plans to develop the port as one of the hub container ports in the Southeast Asian countries. At the final stage, the port will be able to handle 1.5 million T.E.U.

(2) Perspective in advanced sea transport technology

A high-speed boat, "Techno Super Liner," is being developed in Japan and will be in practical use by 1998. This development of a high speed boat would expand one-day-travel area in the East Asia and would meet the potential cargo transportation demand which needs quick transport at cheaper cost than air cargo transport. Since this new type of boat needs a deep seaport, Subic Port could be utilized for the boat operation.

2.3.7 Phased development plan

According to the criteria set in the transportation development strategy, the projects are divided into three phases.

Phase I (1994-1998)

Clark International Airport Development Project (Phase I)
Subic Port Development Project (Phase I)
<North-South Backbone>
    North Luzon Expressway Improvement Project (Balintawak - C.I.A.)
<East-West Lateral Linkage>
    San Fernando - Dinalupihan Road Development Project
    Dinalupihan - Olongapo Road Development Project
Damaged Road and Bridge Rehabilitation Project
Access Roads to Resettlement Areas Development Project
Rural Road Development Project (Phase I)

Angeles Bypass Development Project
Cabanatuan Bypass Development Project
Cabanatuan Common Bus Terminal

Phase II (1999-2004)

Clark International Airport Development Project (Phase II)
Subic Port Development Project (Phase II)
PNR Main Line North Rehabilitation Project (Metro Manila-CIA)

<North-South Backbone>

North Luzon Expressway Extension Project (Mabalacat, Pampanga - Paniqui, Tarlac)
Sierra Madre Expressway Development Project (Quezon City, NCR - San Miguel)

<East-West Lateral Linkage>

Iba - Tarlac Road Development Project
Capas - La Paz - Cabanatuan Road Development Project

<Other Strategic Important Linkage>

Mariveles - Bagac - Morong - Olongapo Road Development Project

Rural Road Development Project (Phase II)
Tarlac Bypass Development Project
Olongapo Bypass Development Project

Phase III (2005-2010)

Clark International Airport Development Project (Phase III)
Subic Port Development Project (Phase III)

<North-South Backbone>

Sierra Madre Expressway Development Project (Sn. Miguel - San Jose City)

<East-West Lateral Linkage>

Dinalupihan - Angeles Road Development Project
Manila-Bataan-Subic Coastal Road Development Project

Rural Road Development Project (Phase III)

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TABLES

Table 2.1 Traffic Growth on the North Luzon Expressway

Section	Vehicle Type	1983	1985	1987	1989	1991	1993
Balintawak - Malinta	Light Veh.	40,206	32,700	41,764	49,422	47,264	63,957
	Trucks	9,242	5,343	7,436	12,301	11,464	11,051
	Buses	4,262	4,997	5,521	5,542	5,800	7,216
	Total	53,710	43,040	54,721	67,265	64,528	82,224
Malinta - Meycauayan	Light Veh.	29,099	25,367	28,680	40,662	38,258	
	Trucks	6,283	3,640	6,012	10,170	8,686	
	Buses	3,157	3,946	4,187	4,367	4,790	
	Total	38,539	32,953	38,879	55,199	51,734	
Meycauayan - Bocaue	Light Veh.	21,930	17,971	20,412	32,312	29,045	34,434
	Trucks	5,835	3,263	5,953	9,582	8,092	8,833
	Buses	3,240	3,838	4,175	4,360	4,784	5,995
	Total	31,005	25,072	30,540	46,254	41,921	49,262
Bocaue - Sta. Rita	Light Veh.	13,363	11,348	13,466	18,730	15,725	20,463
	Trucks	2,569	2,121	3,797	7,219	5,732	6,427
	Buses	1,550	1,865	2,119	3,130	3,124	2,953
	Total	17,482	15,334	19,382	29,079	24,581	29,843
Sta. Rita - Tibag	Light Veh.	-	8,404	8,516	15,867	13,315	
	Trucks	-	1,490	3,327	6,237	6,035	
	Buses	-	1,749	1,974	2,942	2,980	
	Total	-	11,643	13,817	25,046	22,330	
Tibag - Sta. Domingo	Light Veh.	10,204	7,763	8,758	13,003	10,904	16,625
	Trucks	1,091	1,425	3,277	5,362	5,168	6,073
	Buses	1,413	1,675	1,974	2,753	2,835	2,511
	Total	12,708	10,863	14,009	21,118	18,907	25,209
Sta. Domingo - San Fernando	Light Veh.	9,703	7,251	8,113	11,981	9,315	
	Trucks	509	1,306	3,179	5,085	4,707	
	Buses	1,219	1,536	1,873	2,680	2,753	
	Total	11,431	10,093	13,165	19,746	16,775	
San Fernando - Angeles	Light Veh.	6,418	4,814	5,631	6,778	4,163	8,197
	Trucks	423	623	1,685	2,451	1,570	3,094
	Buses	1,107	1,251	1,360	2,135	2,157	2,090
	Total	7,948	6,688	8,676	11,364	7,890	13,381

Source: PNCC

Table 2.2 Road Condition in the Selected Countries

Country	Road Length (kilometers)	Pavement Ratio (%)	All Roads: Length per 1000 persons (kilometers)	All Roads: Length per Automobile 1) (meters)	All Roads: Road Density 2) (km/sq. kms)
Philippine	157,448	14.2	2.68	178	0.52
Indonesia	219,009	62.3	1.30	107	0.11
Thailand	73,223	52.9	1.32	35	0.14
Malaysia	40,174	69.0	2.32	26	0.12
Korea	55,778	61.4	1.32	25	0.56
Japan	1,109,981	68.0	9.02	20	2.94
Former West Germany	496,652	99.0	8.08	16	1.98
Great Britain	354,315	100.0	6.19	14	1.54
Italy	301,846	100.0	5.27	13	1.00
U.S.A.	6,228,669	57.0	25.42	34	0.67

Country	Paved Road Length (kilometers)	Paved Road: Length per 1000 persons (kilometers)	Paved Road: Length per Automobile 1) (meters)	Paved Road: Road Density 2) (km/sq. kms)
Philippine	22,358	0.38	25	0.07
Indonesia	136,443	0.81	67	0.07
Thailand	38,735	0.70	19	0.07
Malaysia	27,720	1.60	18	0.08
Korea	34,248	0.81	15	0.34
Japan	754,787	6.13	14	2.00
Former West Germany	491,685	8.00	16	1.96
Great Britain	354,315	6.19	14	1.54
Italy	301,846	5.27	13	1.00
U.S.A.	3,550,341	14.49	19	0.38

Note: Indecies for paved roads are calculated based on the statistics of International Road Federation;
1) Road length / registered number of vehicles
2) Road length / area

Table 2.3 Motor Vehicle Registration in Central Luzon: 1986 - 93

Province/City	1986	1987	1988	1989	1990	1991	1992	1993	Average Annual Growth Rate(%) 86 - 93
Bataan	8,103	8,712	9,381	10,217	9,935	9,608	10,102	11,550	5.2
Bulacan	39,549	40,272	41,995	46,661	50,328	53,818	59,065	66,601	7.7
Nueva Ecija	22,340	22,955	24,387	28,305	29,716	31,051	33,914	40,967	9.0
Pampanga [1)]	17,041	17,914	18,787	21,709	24,050	26,490	33,861	37,825	12.1
Tarlac	16,876	17,011	19,146	23,495	27,094	27,508	30,489	32,247	9.7
Zambales [2)]	2,043	2,391	2,559	2,911	2,968	2,987	7,919	4,145	10.6
Angeles City	33,987	34,669	36,674	34,173	32,985	27,758	19,916	22,055	-6.0
Olongapo City	17,081	17,585	18,608	19,224	20,237	20,253	12,208	13,465	-3.3
Total	157,020	161,509	171,537	186,695	197,313	199,473	207,474	228,855	5.5

[1)] Angeles City is excluded in Pampanga.
[2)] Olongapo is excluded in Zambales.
Source: Land Transportation Office, Region III

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F I G U R E S

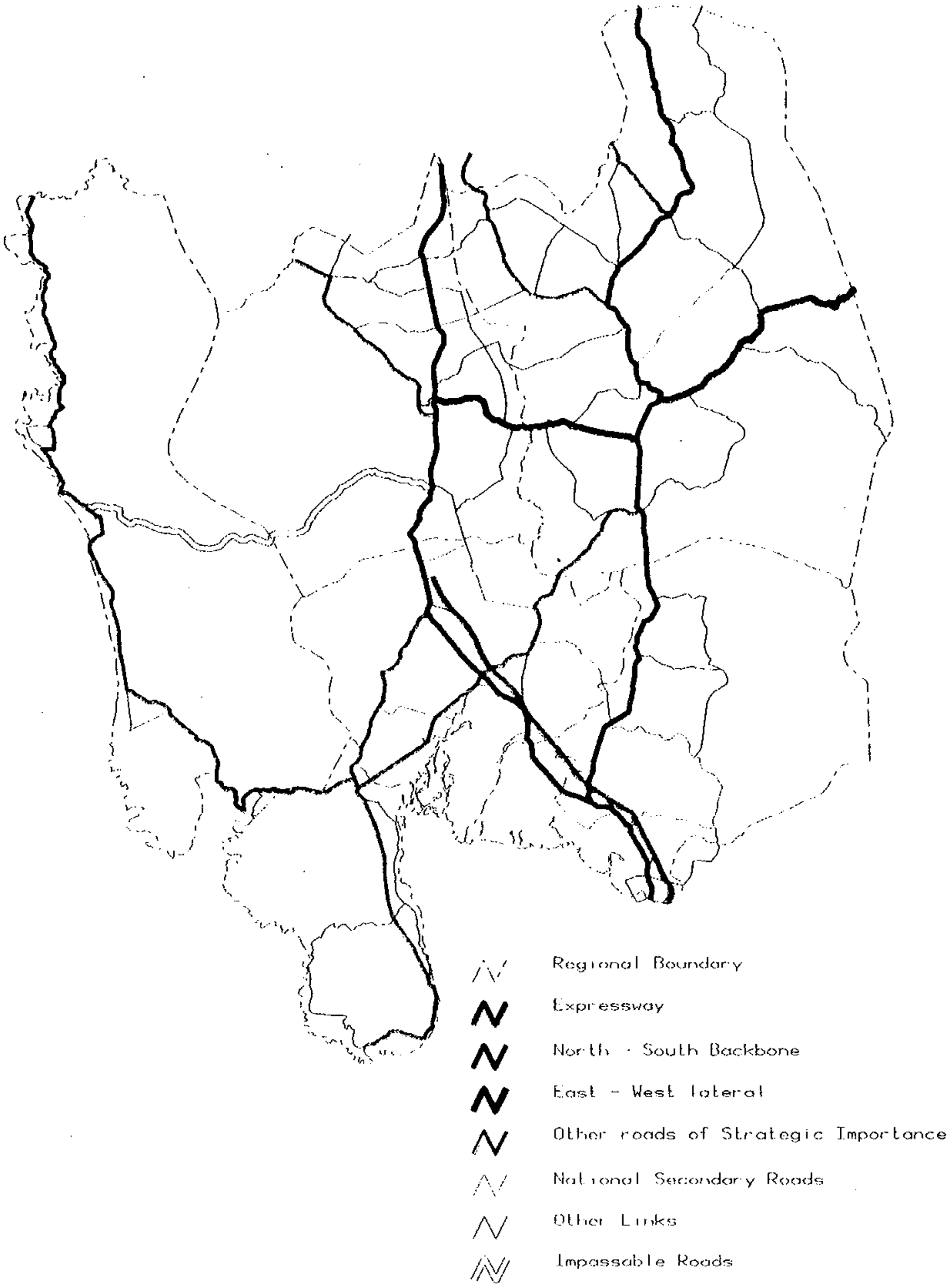


Figure 2.1 DPWH Road Classification in Central Luzon

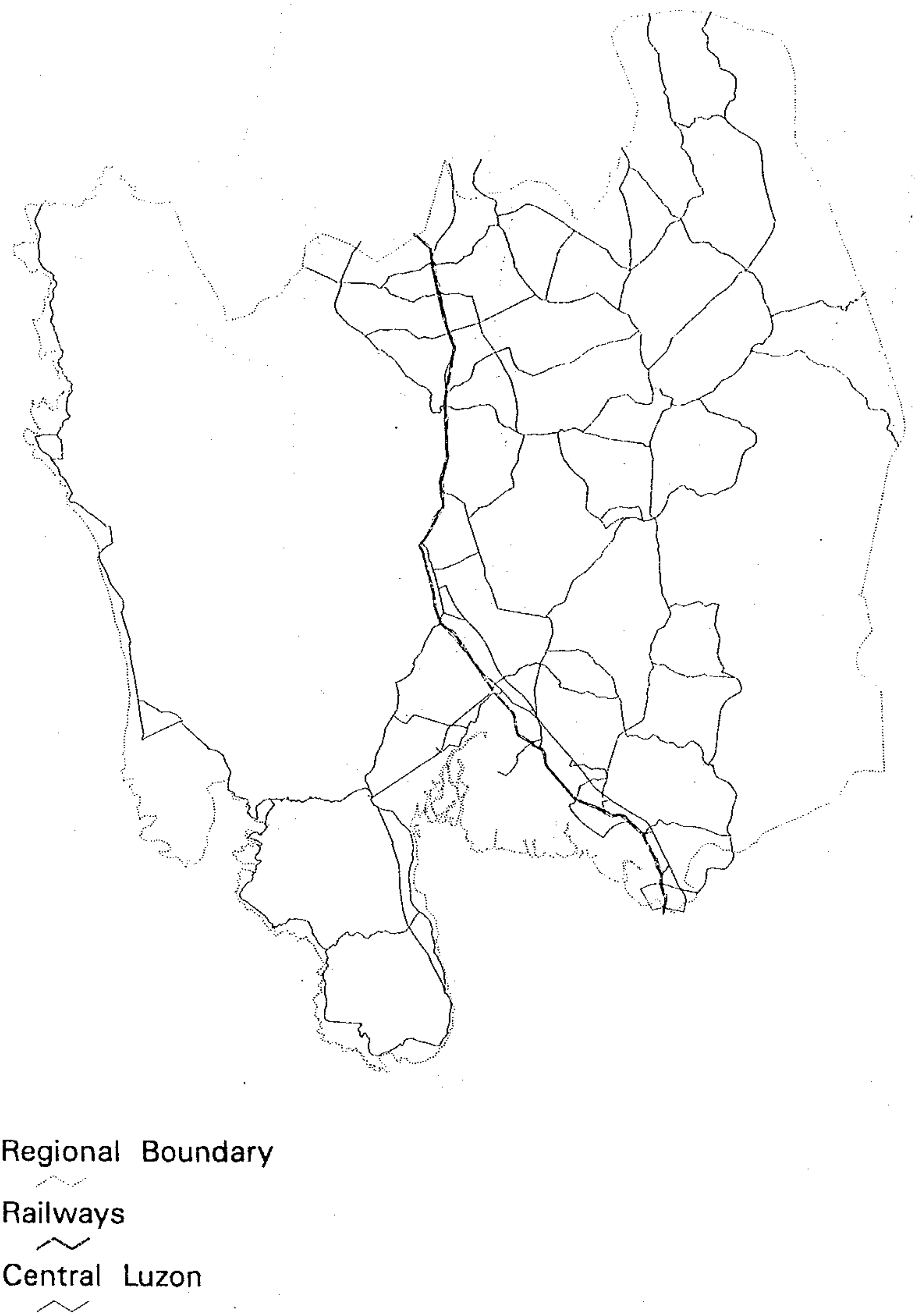
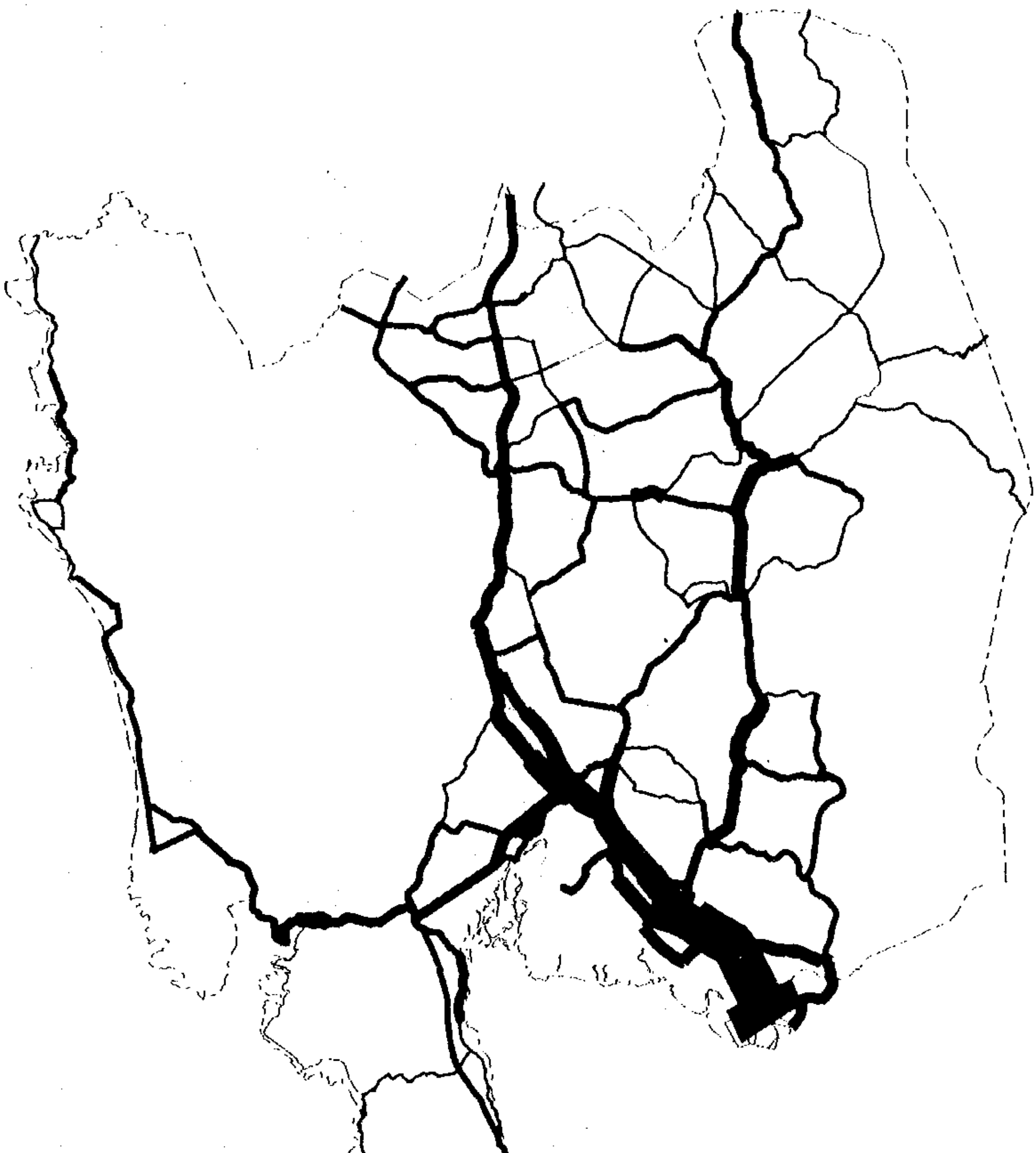


Figure 2.2 Railway Network in Central Luzon



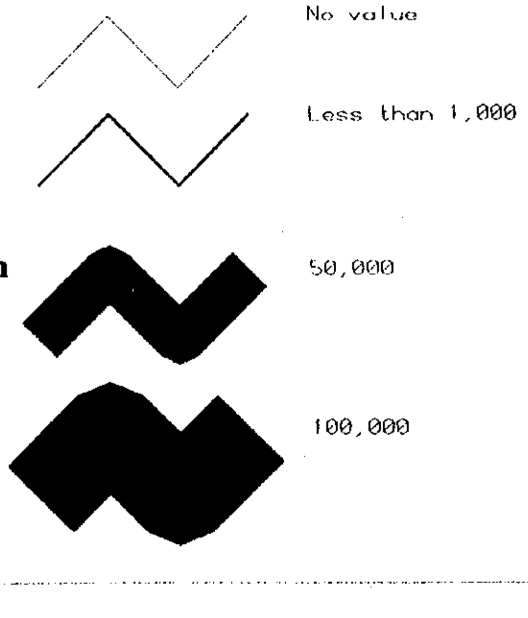
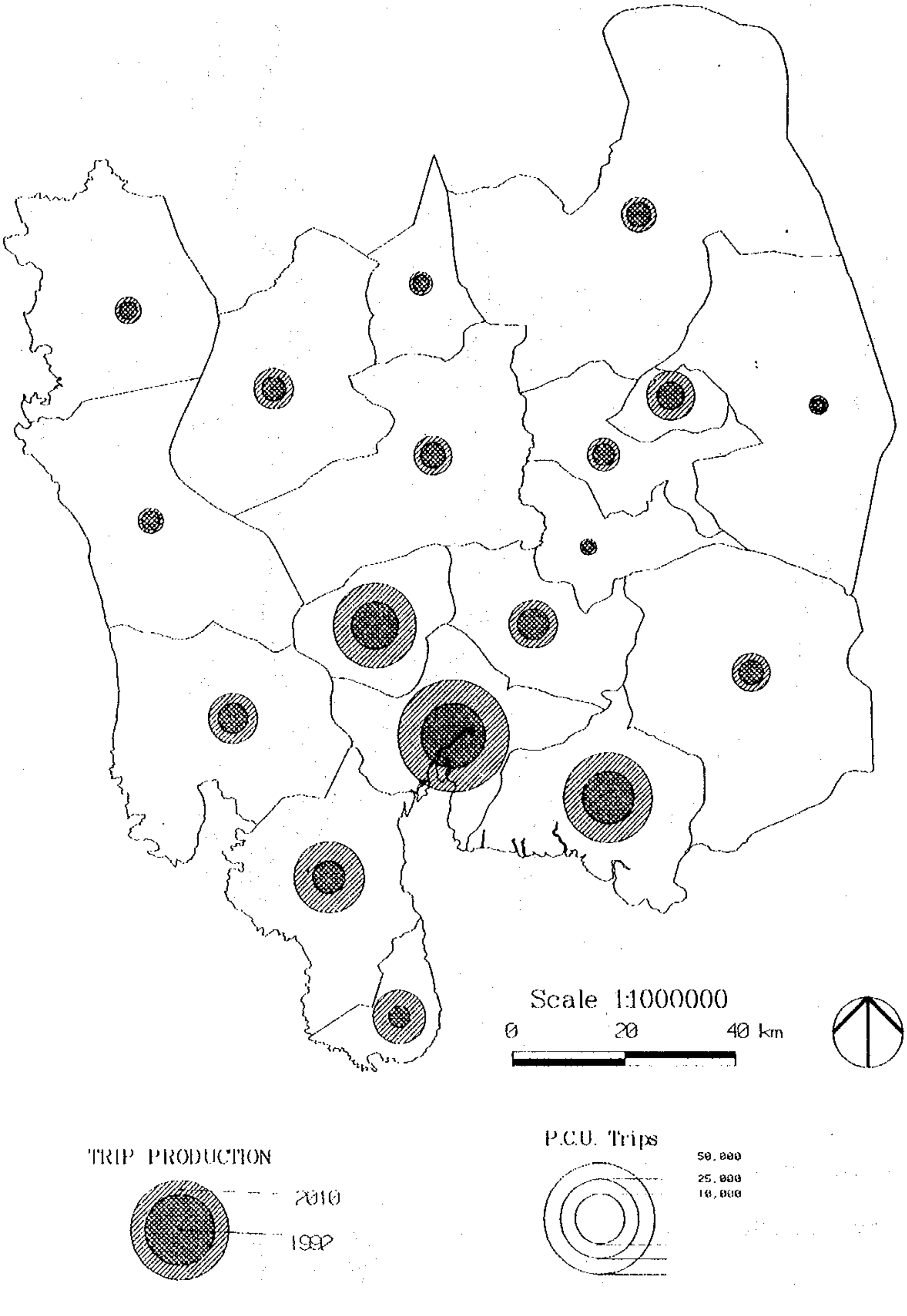


Figure 2.3

1993 Traffic Flow in Central Luzon

Figure 2.4 Trip Production Growth 1992 - 2010



Note: Trip production is the number of trips produced in traffic zone excluding intra-zonal trips.

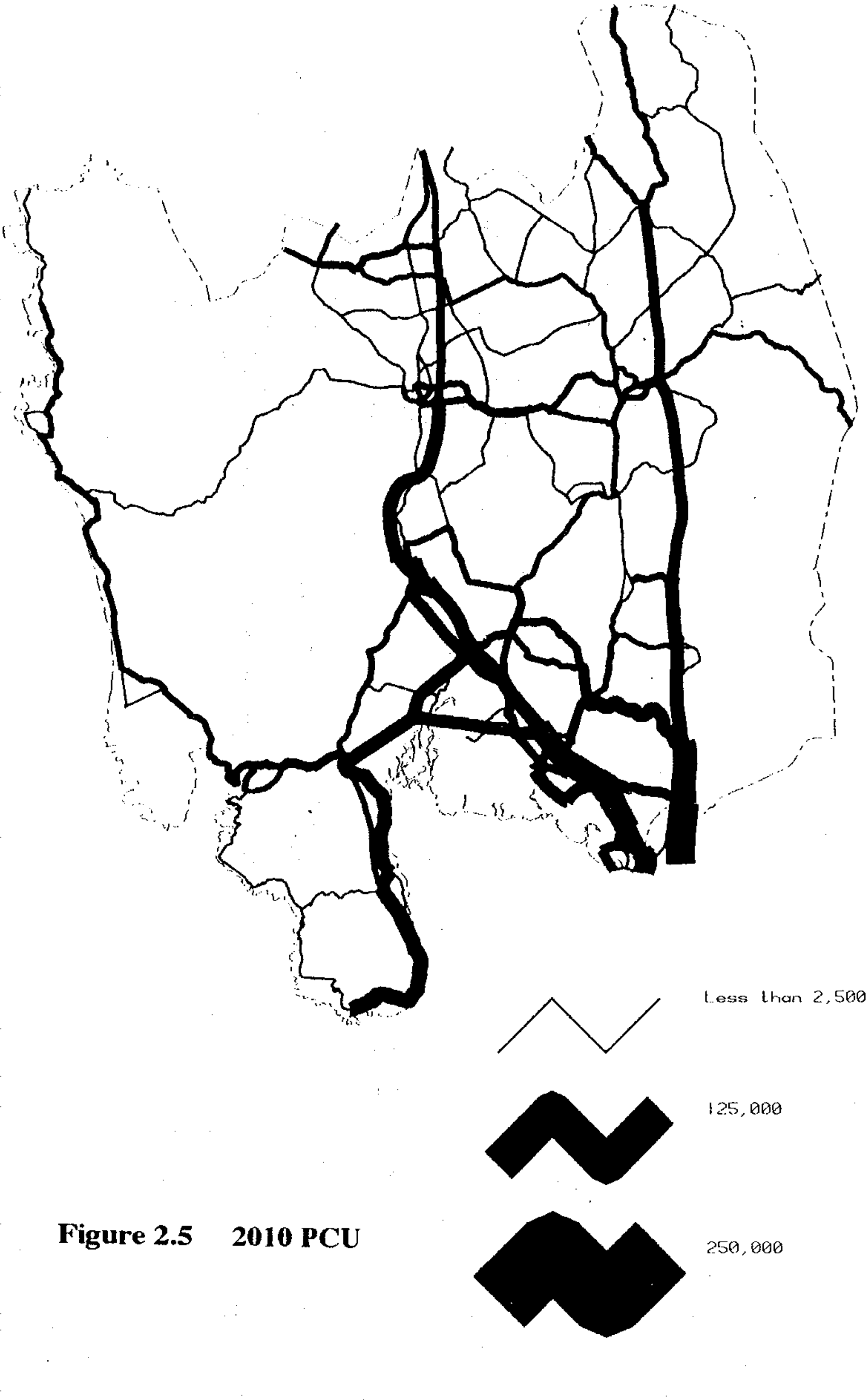


Figure 2.5   2010 PCU

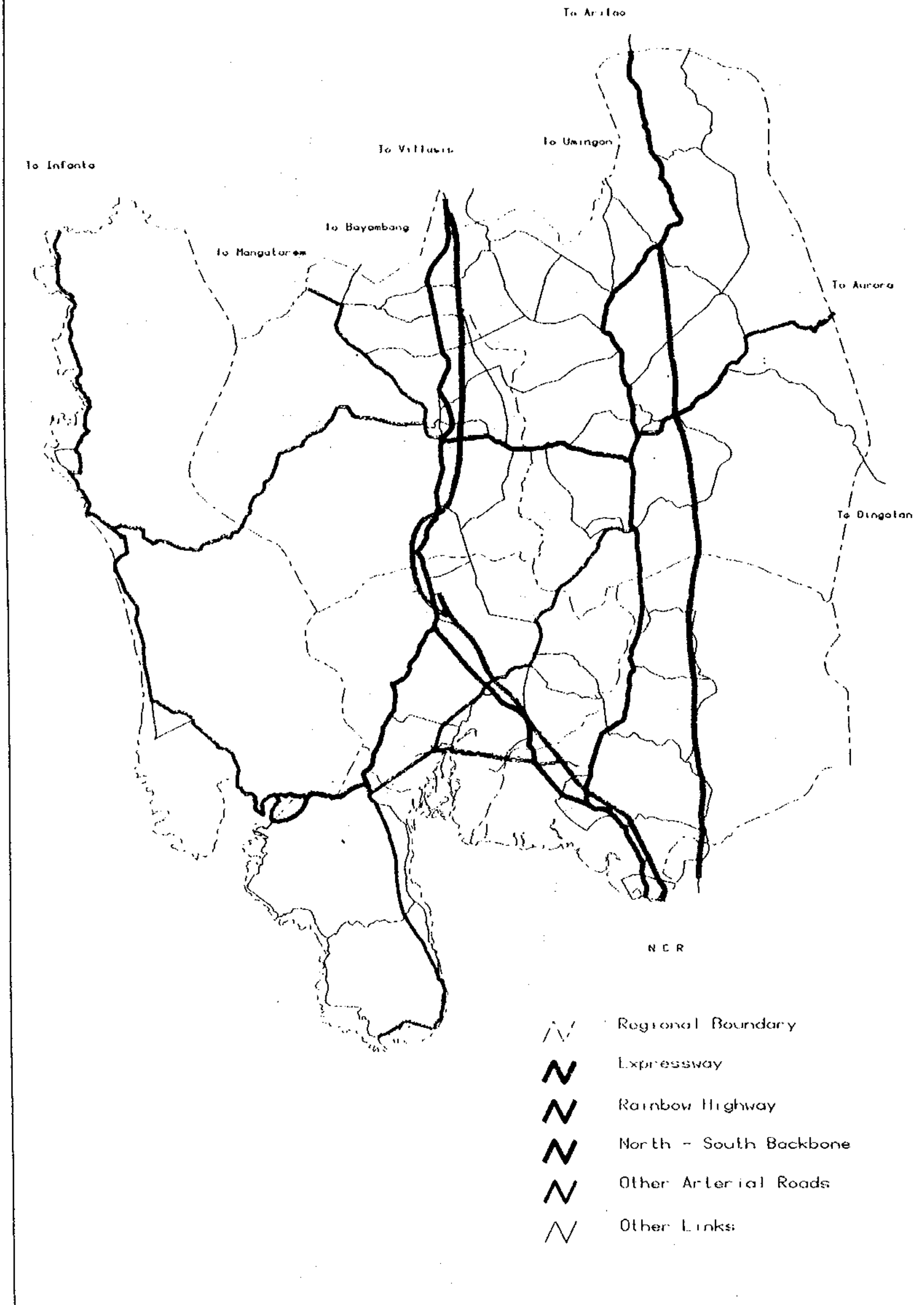


Figure 2.6 2010 Road Network Plan

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3. POWER AND ENERGY

3.1 Present Conditions of Power and Energy in the Philippines

3.1.1 National energy goals and policies

The current Philippine Development Plan has set forth as a main thrust the improvement of the life quality of the peoples through the economic activation. To support this, the goal of energy sector is to accomplish the energy security for sustaining stable productivity by enhancing the Country's reliance on indigenous, environment-friendly and cost-effective sources of energy.

(1) National energy goals and objectives

The government has been pursuing an active energy program with the following primary objectives:

1) to provide adequate, timely and reasonably priced energy forms and equitably distribute them to the market in support of productivity goals;

2) to promote the judicious and efficient use of energy resources within techno-economic bounds; and

3) to achieve the above objectives without ecological concerns.

(2) National policies and strategy

To attain these objectives, the Government has adopted the following policies and strategy:

1) to sustain momentum in the exploration and development of indigenous resources,

2) to diversify sources of energy imports while ensuring a balance between cost and stability,

3) to promote fuel substitution and diversification in power generation,

4) to formulate and strictly implement comprehensive operation and maintenance and rehabilitation programs for existing power plant,

5) to enhance private sector participation in energy projects,

6) to rationalize subsidies for rural electrification,

7) to move towards downstream oil industry deregulation,

8) to promote energy research and development and commercialization of proven technologies,

9) to intensify promotion of energy conservation and energy efficient technologies;

10) to restructure electricity tariffs to encourage efficient use of electricity,

11) to integrate environmental concerns in the planning and implementation of energy programs and projects,

12) to enhance assessment of and planning for the energy needs of countryside development, and

13) to rationalize operation of energy institutions to promote efficiency and competition.

3.1.2 Energy administration

(1) Governmental institutions

Department of Energy (DOE)
The Department of Energy was created in December 1992 and took over the regulatory functions of the former Office of Energy Affairs (OEA). Functions of DOE are (a) to assure that the Country shall have a proper and continuous supply of crude oil and petroleum products using the most economic and competitive terms possible considering all available sources of supply, (b) to assure the public of reasonable prices for petroleum products considering international price levels of crude oil and petroleum products, and (c) to protect petroleum dealers and distributors and remove unfair and onerous trade conditions.

Energy Regulatory Board (REB)
The Energy Regulatory Board was created in 1987 and followed the function of Board of Energy including Bureau of Energy Utilization (BOU) which was tasked with licensing of crude and product importation as well as the regulation of petroleum refining and marketing operations. However, non-price regulatory functions were transferred to DOE with its creation. The authority to set specific prices for all petroleum products at each level of distribution remained with ERB. Likewise, it has jurisdiction over the operations of and tariff setting for all electric utilities but so far it has performed this function only for private utilities.

Department of Environment and Natural Resources (DENR)
DENR is the Country's lead agency for environmental concerns. Policies and planning for environmental management are vested in the Secretary of DENR, and largely exercised through its staff bureau, the Environmental Management Bureau (EMB), and DENR's

Regional Offices share responsibilities for development implementation and enforcement of environmental regulations.

National Economic and Development Authority (NEDA)

As the central economic planning agency of the Government, NEDA is the source of macroeconomics parameters which line energy agency use in the formulation of their respective program target. The objectives of energy plan and sectoral program are also in the line with the overall economic thrusts set forth by NEDA. NEDA also exercises some form of regulatory authority over the energy sector.

National Electrification Administration (NEA)

NEA was established in 1969 to organize Rural Electric Cooperatives (RECs) and set out to undertake rural electrification on an area coverage basis. In the operation of the RECs, NEA's role ranged from administrative supervision to provision of technical and finical assistance. With the creation of DOE the responsibility for setting of tariffs charged by the RECs to its customers was taken over by REB to ensure the consistent application of electric utility tariff regulations.

Rural Electric Cooperatives (REC)

An REC is organized to thrust rural electrification under the jurisdiction of NEA. The total number of cooperatives is 199 and their investments and operation are financed by NEA.

(2) Power industry

National Power Corporation (NPC/NAPOCOR)

NPC is wholly-owned and controlled by the Government and tasked primarily to undertake the development of hydro-electric generation of power and production of electricity from geothermal and other sources, as well as the transmission of electric power on a nationwide basis. NPC sells by wholesales generated energy to private utilities and electric cooperatives.

In support of the privatization program of the Government, NPC allows private investors to participate in power generation through schemes such as co-generation, build-operate-transfer(BOT), and build-operate-own(BOO). To date, some 740MW of private sector capacity has been installed, and additional 2,350MW is programmed to be installed up to 2000 under the current power development program.

Private electric utilities

The Manila Electric Railroad and Light Company (MERALCO) is the largest private utilities in the Country, and holds the franchise for power distribution in the metropolitan area.

(3) Petroleum and coal industries

The upstream of oil industry is private-sector dominated, only with the Philippine National Oil Company (PNOC) being the Government entity. PNOC is initially created to stabilize the domestic oil market through crude procurement and participation in the downstream industry. Its role is expanded to catalyze development of the Country's indigenous resources including oil, gas, coal and geothermal. PNOC presently accounts for the largest share of the domestic petroleum market and also maintain largest refining and crude/product transport and storage facilities in the Country.

3.1.3 Primary energy consumption and sources

(1) Overview

Since the oil crisis in the early 1970s, the Philippines has invariably sought the enhancement of energy self-reliance in order to reduce the Country's dependence on import oil. The import oil dependence of the Country's energy mix declined from 92% in 1973 to 55% in 1985 through massive development and utilization of indigenous alternatives such as oil and gas, coal, geothermal and non-conventional energy resources. Since 1986, however, the Country's oil dependence started to increase to reach 70.7% in 1992. This is due to the increased dependence on oil-based power generation and the growth of transportation fuel demand and oil intensity of the economy continued.

Energy consumption in the Philippines and energy-economy relationships are shown in Table 3.1 and Table 3.2, respectively.

(2) Energy consumption

Total energy consumption

The total energy consumption in the Philippines reached 129.67 million barrels of fuel oil equivalent (MMBFOE) in 1992, a 5.9 % increase from 1991. This increase was due mainly to oil demand growth by industrial consumers including power generation. Indigenous energy production amounted to 38.0 MMBFOE in 1992, accounting for 29.3% of the total energy consumption, 2.8 MMBFOE smaller than the previous year. Oil production decreased remarkably to 0.54 MMBFOE from 1.06 MMBFOE in 1991 due to the shutdown of the Tana oil field. Of the total indigenous energy, geothermal power accounted for 7.6%, hydropower 5.7%, coal 3.9% and conventional energy 11.8 %.

Imported energy amounted to 91.7 MMBFOE in 1992 or 70.7 % of total energy consumption. Imported oil consumption increased by 4.5 % from the previous year to compensate for the decrease in indigenous oil production.

Per capita energy consumption

For ten-year period between 1980 and 1990, Philippine commercial energy consumption per capita of 1.55 barrels of fuel oil equivalent (BFOE) was one of the lowest in Asia. Per capita consumption in the same period was 2.42 BFOE in Thailand, 5.84 BFOE in Malaysia, 10.20 BFOE in South Korea, and 12.90 in Taiwan.

(3) Energy sources

Oil and gas

Crude oil supply in 1992 reached 92.0 million barrels, bulk of which or 89.0 million barrels were imported and only 3.2% of the total supply was produced from indigenous source (Table 3.3). Import crude oil recorded an increase of 16.1% from the previous year's level. The middle east countries supplied 72.9 million barrels, or 79.3% of total crude oil import. Imported petroleum products reached 15.8 million barrels (Table 3.4). The total amount of diesel and fuel oil accounted for 13.1 million barrels, or 82.8% of total import.

Consumption of petroleum products continued to rise since 1985 amounting to 92.9 million barrels in 1992, up by 8.5% over the previous year's level (Table 3.5). Diesel used mainly for power generation by gas turbine has the highest consumption of 33.7 million barrels or 36.2% of the total. Fuel oil followed with consumption share of 30.4% which is used for power generation and industrial heating purposes. The production of Country's oil refineries reached 82.8 million barrels, or equivalent to 237 thousand barrels per calendar day. Diesel oil and fuel oil, two major refinery products, shared 32.3% and 33.3% of the total oil production, respectively (Table 3.6).

Coal

Coal supply in 1992 reached 3.02 million tons shared by 55.0% domestic supply and 45.0% import to meet the domestic demand (Table 3.7). Domestic coal production amounted to 1.66 million tons, 20% higher than the previous year's level. Coal consumption in 1992 recorded 2.49 million tons, a decrease of 14.0% from the previous year's level attributable to reduced consumption in cement and industrial uses (Table 3.8).

Geothermal

The Country's total number of geothermal wells, as of 1992, was 459, covering at least 15 geothermal areas scattered throughout the archipelago. Installed generating capacity of these wells amounted to 888MW.

Hydroelectric power

The total hydropower capacity of existing plants as of 1992 was 2,189.5MW. Hydropower generation for 1992 reached 4,270 GWh which was 15.9% lower than the previous year's level due to extended drought condition.

Non-conventional energy

In 1992, non-conventional energy contributed to the equivalent of 15.3MMBFOE sharing 11.8% of the total energy consumption mix for the year. The present program of non-conventional energy development focuses on four systems: biomass, solar, wind and micro-hydro.

1) Biomass

Of the total contribution (15.3MMBFOE in 1992) of non-conventional energy to energy consumption mix, over 97.3% produced from biomass, consisting of bagasse (39.7 % in 1992) and agri-wastes (57.6 %). Biomass systems are used mainly as fuels for agri-industrial furnaces and boilers.

2) Solar energy

Over the last five years, some 1,500 domestic type of solar water heaters (SWH) have been installed, a high percentage of which is located in the Metro Manila areas. A large number of photvoltaic(PV) system development started with field experiments and a 13.3 kilo-Watt-peak(kWp) central pilot PV system in Bulacan. The system demonstrated its techno-economic viability for supplying the electricity needs of 70 rural households. The PV technology has been tested for small applications such as rural home lighting and small home appliances, telecommunications, poultry incubator, water pumping and others. Several demonstration units were installed in Regional Affiliated Non conventional Energy Centers (ANECs) to attract public interests.

3) Wind energy

Pilot wind generating power plants were installed in Tagaytay and Ilocos Norte for demonstration, but contrary to the expectation these plants could not be operated effectively because of low wind regimes and technical and maintenance problems. Windmills for water pumping have been disseminated and commercialized.

3.1.4 Electricity supply and consumption

The national power supply system is divided into three areas: 1) "Luzon area" covering Regions I to V including islands of Palawan, Oriental and Occidental Mindoro, Tablas, Busuanga, Marinduque, Masbate and Catunduanes, 2) "Visayas area" covering Regions VI to VIII including island of Bantayan, Camotes, Siquijor, western, eastern and northern Samar, and 3) "Mindanao area" covering Regions IX to XII including island of Basilan, Sulu, Tawi-tawi and Siargo. There is no interconnection among three areas as of 1992, but

NPC started the interconnection program to improve the future power system performance. Boundaries of these areas are shown in Figure 3.1.

(1) Power supply capacity

The total installed capacity for power generation in the Country (NPC grid) was 6,627.5 MW as of the end of 1992, consisting of 47.5 % oil-based thermal, 33.0 % hydro, 13.4 % geothermal and 6.1 % coal fired thermal plant. Of the total, 4,608.8 MW or 70 % is located in the Luzon island.

NPC Power Generation Capacity

(MW as of end 1992)

		Thermal			
	Hydro	Geothermal	Coal	Oil	Total
Philippines	2,189.5	888.0	405.0	3,145.0	6,627.5
Luzon	1,243.8	660.0	300.0	2,405.0	4,608.8
Visayas	2.0	228.0	105.0	268.2	621.2
Mindanao	943.7	-	-	453.8	1,397.5

Source: 1992 NPC Annual Report

Types and capacity of existing power plants in each grid are shown in Table 3.9.

The total energy production from these plants was 25,567 GWh in 1992 within the NPC grid, consisting of 52.6% oil-based, 22.3% geothermal, 16.7% hydro and 8.5 % coal-fired. The average annual growth rate of the power consumption was 2 % in the Country during 1990-92.

NPC Gross Energy Generation

(GWh as of end 1992)

		Thermal			
	Hydro	Geothermal	Coal	Oil	Total
Philippines	4,270	5,692	2,169	13,164	25,567
Luzon	1,925	4,426	1,658	11,927	19,936
Visayas	12	1,266	511	703	2,492
Mindanao	2,333	-	-	806	3,139

Source: 1992 NPC Annual Report (Table 3.10)

Actual production in the Luzon grid was composed of 59.8 % oil-fired, 22.7 % geothermal, 9.7 % hydro, and 8.3 % coal-fired.

The NPC facilities in the transmission system at the end of 1992 are classified into the following.

Transmission and Distribution Line Length

(circuit - km)

Voltage (kV)	Country	Luzon	Visayas	Mindanao
500	575	575	-	-
230	3,636	3,636	-	-
138	3,003	-	823	2,180
115	508	508	-	-
69	6,006	2,773	1,496	1,777
< 69	755	528	127	100
Total	14,483	7,980	2,446	4,057

Source: 1992 NPC Annual Report (Table 3.11)

Extra high voltage lines of 500 kV and 230 kV form the back-bone of power supply system in the Luzon grid. All facilities, except those in MERALCO franchise areas, are operated by NPC. Distribution lines and distribution transformers as well as the related switchgears in the region are mainly operated and maintained by rural electric cooperatives (Coops) or private power companies, especially for city areas.

The total installed capacity of all the sub-stations in the NPC grid was 14,788 MVA at the end of 1992, of which 72 % is located in the Luzon grid.

Substation Capacity

(MVA as of 1992)

Voltage (kV)	Country	Luzon	Visayas	Mindanao
230	7,640	7,640	-	-
138	3,519	-	1,418	2,101
115	2,147	2,147	-	-
69	1,252	666	242	344
< 69	230	200	22	8
Total	14,788	10,653	1,682	2,453

Source: 1992 NPC Annual Report (Table 3.12)

Power system network of Luzon grid is shown in Figure 3.2.

(2) Power consumption

The total consumption of energy in the Country was 23,838 GWh in 1992, an increase by 0.5 % over the previous year. This quite low growth is due to the unprecedented power crisis.

NPC Energy Sales by Customer

(GWh as of end 1992)

	Utilities	Industries	Misc. Load	Total
Philippines	20,952	2,884	2	23,838
Luzon	17,196	1,435	2	18,633
Visayas	1,877	359	0	2,336
Mindanao	1,897	1,090	0	2,969

Source: 1992 NPC Annual Report (Table 3.13)

Energy consumption by sector in 1992 was 35.3% for industrial, 24.7% for residential, 19.0% for commercial, 4.2% for others, 4.4 % for station use and 12.5 % losses.

Electric Energy Consumption by Sector

(GWH, % share in parentheses)

	1989	1990	1991	1992
Residential	5,161 (20.2)	5,950 (23.6)	6,244 (24.3)	6,336 (24.7)
Commercial	4,428 (17.3)	4,850 (19.2)	4,869 (19.0)	4,878 (19.0)
Industrial	9,763 (38.2)	8,982 (35.6)	9,339 (36.4)	9,060 (35.3)
Others	1,299 (5.1)	1,140 (4.5)	930 (3.6)	1,069 (4.2)
Utilities own use	1,125 (4.4)	1,097 (4.3)	1,086 (4.2)	1,128 (4.4)
Power loss	3,797 (14.8)	3,225 (12.8)	3,181 (12.4)	3,211 (12.5)
Total 1/	25,573 (100)	25,244 (100)	25,649 (100)	25,682 (100)

Note: 1/ Total sale energy includes the direct sales of private utilities, NEA, and self-generating industries.
Source: DOE data (Table 3.14)

The peak load in the Luzon grid reached 3,205 MW in 1992 (Table 3.15). It grew at an average annual rate of 4.57% during 1989-1991 with the load factor of 70% (Table 3.16).

(3) Per capita consumption

The per capita electricity consumption of the Country stood at 380kWh in 1990. This may be compared with 6,300kWh in Japan, 6,218kWh in Singapore, 2,206kWh in Korea, 1,216kWh in Malaysia, and 166kWh in Indonesia.

(4) Electrification

Electrification by electric cooperatives, MERALCO and private utilities in the Philippines is 70% as of the end of 1991.

Electrification Ratio

(as of end 1991)

	Rural Electric Cooperatives	Meralco	Other Private Utilities	Philippines
Households ('000)	3,318	2,553	604	6,475
Potential ('000)	5,880	2,725	702	9,307
% Electrified	56	94	86	70

Source : DOE data (Table 3.17)

(5) Electricity tariffs

The average tariff of NPC is summarized as bellow.

Average Tariff Rate

(P/kWh as of end 1992)

Gird	Luzon	Visayas	Mindanao
Tariffs	1.557	1.658	0.964

Source: 1992 NPC Annual Report (Table 3.18)

Table 3.19 shows the electricity tariff of NPC as of October 1993.

3.2 Prospects and Constraints for Power and Energy Development in the Philippines

3.2.1 Alternative energy scenarios

The Government has prepared alternative scenarios for national energy development to reflect different energy policy alternatives and to prepare a national energy development plan. The scenarios represent increasing levels of achievement of plan objectives: energy self-efficiency, usage efficiency, and environmental sustainability. The scenarios have been named "expected", " aggressive", and "ambitious". They are defined below. Energy mix programs corresponding to these scenarios are given in Tables 3.20, 3.21 and 3.22.

(1) Expected/baseline scenario

This is a baseline scenario largely on the assumption of the continuation of existing policies. Targets are based on firm programs of major entities involved in energy program implementation. Indigenous energy production targets are based on the commitment of major contractors. Oil substitution in power generation mainly by coal and geothermal is as scheduled in the current Power Development Program. Modest energy savings are expected from on-going energy efficiency programs.

In the expected or baseline scenario, Country's self-sufficiency level will increase from 31.5% in 1993 to 33% in 2000. In spite of the massive addition of geothermal power capacity, a large part of oil based generation will have to be replaced with imported coal-fired power plans.

(2) Aggressive scenario

This scenario simulates a modest impact of an enhancement of existing policies and programs. It assumes the development of natural gas and additional geothermal fields as a result of additional incentives. Local coal utilization is assumed to be increased by NPC displacement of some of its coal imports. Likewise, energy efficiency programs can have wider coverage and thus generate greater energy savings.

In the aggressive scenario, self-sufficiency level by 2000 can be increased to 58% as oil and natural gas substantially displace imported oil and coal. Aside from natural gas, additional capacity from marginal geothermal fields and small and mini hydroplants shall further bring down non-oil based generation to 4% to from 14% in the baseline scenario. Local coal will also displace part of the imported coal used for power generation.

(3) Ambitious scenario

This scenario projects a more optimistic result of policy and program enhancements. It assumes maximum production possibilities for major oil and geothermal discoveries and also the development of new fields. Availability of financing for large hydropower projects is assumed to boost utilization of existing potential. Likewise, increased financial assistance to renewable energy and energy efficiency programs is assumed to promote commercialization of these options.

With assumptions of higher oil, geothermal , and non-conventional energy contributions, self-efficiency level in the ambitious scenario can stand to 70%. Greater savings from energy conservation measures shall further reduce the oil import share.

3.2.2 Energy resource potentials and development

(1) Energy resource potentials

Hydropower

The hydropower potential in the Country has been estimated at 14,367 MW with energy production of 46,761GWh. Of the total, 2,214 MW or 18% has been developed by the end of 1992, and another 12,153MW will be developed in the future with annual energy of 36,520GWh.

Major potentials in the Luzon island are located in the Abulog and the Cagayan River basin in the north and Abra river basin in Pampanga province.

Oil and gas

In terms of hydrocarbon potential, the Country has estimated recoverable reserves of about 40 million barrels oil and 4.5 trillion standard cubic feet of natural gas. The Country has produced some 40 million barrels of oil since its first oil field, Nido, opened in 1979. Current production, mainly from West Linapacan which is the biggest oil field in the Country, is at an average rate of 10, 000 barrels of oil per day.

Coal

The total potential coal reserve is estimated at 1.55 billion metric tons in 1991, of which 370 million metric tons are proven. Domestic coal production reached 1.66 million MT in 1992, an increased by 25 % from the previous year.

According to the Philippine Energy Plan 1992-2000, the domestic production of coal is expected to increase at 13.6 % per annum. This will contribute to the displacement of 88.8 million barrels of fuel oil for the plan period.

Geothermal

Geothermal energy resources have been initially assessed in 25 sites to have a total potential capacity of around 4,000 MW. Of these geothermal potentials, 888 MW or 22.2 % is ready to be utilized for power generation with four plants at Tiwi in Albay, Mac-Ban in Laguna, Palimpion in South Negros and Tongonan in Leyte, and Mac-Man in Albay/Sorsogon is at development stage. NPC has a plan to develop the geothermal power in Luzon island with total capacity of 1,673 MW by 1998.

Non-conventional energy

The Department of Energy assessed the applicable non-conventional energy technology with three development priorities as shown below. It has prepared the Non Conventional Energy Programs (NEP) to develop the indigenous non-conventional energy source. The program consists of three sub programs ; i.e. Technology Program, Area-based Non-conventional Energy Program through Affiliated Non conventional Energy Centers (ANECs), and Promotion and Commercialization Program. The ANECs have been organized for disseminating the non-conventional energy technology including development and research of the indigenous energy source in respective regions.

Technology Assessment

	Non-conventional Energy System Source of Applications	Stage of Development
First Priority		
BIOMASS	Biogas System	Commercial
	Direct Combustion System	Commercial
	- CO-Generation	Commercial
	- Heat, Steam Generations	Commercial
	- Power Generation	Commercial
	- Improved stoves	Commercial
	- Others	Commercial
SOLAR	Photovoltaic system	Commercial
	Solar Water Heating System	Commercial
WIND	Wind Turbine system	Demonstration
	Windmills for water pumping	Commercial
MICRO-HYDRO	Electro-Mechanical Application	Demonstration
Second Priority		
BIOMASS	Densification (Briquetting)	Commercial
	Gasification	Pilot
	Pyrolysis	Pilot
SOLAR	Solar Drying system	Demonstration
OTHERS	Land Fill Gas From municipal	Pilot
	solid waste	Pilot
	Non-Power Geothermal system	
Third Priority		
BIOMASS	Alcohol-Based Fuel System	Pilot
	Coconut-Based Fuel System	Pilot
SOLAR	Other Solar Thermal System	Basic R & D
OCEAN	Ocean Thermal Energy Conversion	Pilot
	systems	Basic R & D
	Ocean current energy system	Basic R & D
	Wave energy system	
OTHERS	Hydrogen-Based Fuel Systems	Basic R & D

Source : DOE 1993-2000 National Non-Conventional Energy Program

(2) Energy resources development

Physical targets in respective energy sources have been set for the three scenarios.

Oil and gas

1) Expected/baseline scenario

Domestic oil production is calculated to reach 3.39 million barrels (MMBLS) in 1993 and it is projected to grow further to about 4.55MMBLS by 1994 and 12.8MMBLS by 1995 when the West Linapacan field production is in full swing. The Octon field is expected to produce 1.82 MMBLS during its first year of production in 1995.

2) Aggressive scenario

A substantial change in the base case projections can be materialized with the Comago-Malampaya gas project. In the aggressive scenario, indigenous oil and gas production can be expected to reach an aggregate of 51.1 million barrels of fuel oil equivalent (MMBFOE) by 2000, and thus, account for 20.5% share in the Country's primary energy mix. The Malampaya well is expected to produce oil at rate of 50,000 barrels per day and gas at the rate of 400 million cubic feet per day, beginning 1998. The Libertad field may produce gas at the rate of 3.5 million cubic feet per day by 1995.

3) Ambitious scenario

Indigenous oil and gas share in total primary energy consumption is expected to increase further to 62.48MMBFOE, or 25.2% of the Country's total energy needs by 2000. In this scenario, increased oil production at a rate of 10,000 barrels per day will come from new oil fields assuming discovery and delineation of additional recoverable reserves of 50 million barrels.

Breakdown of oil demand forecast for each scenario is shown in Table 3.23. Geological locations of oil fields are shown in Figure 3.3.

Geothermal

1) Expected/baseline scenario

The geothermal alternative remains as the Country's least cost option for power generation. Development projects will center on proven geothermal resources. Geothermal fields at Mac-Ban Mt.Apo, Maibarara, and Del Gallego will be the focus of development and construction of new geothermal power plants in the next five years. By the year 2000, total steam availability is expected to stand at 2,680MW, with total geothermal generating capacity reaching 2,561MW.

2) Ambition scenario

The share of geothermal energy in the Country's energy consumption mix can increase further to 13.3% by 2000. In addition to the baseline power plants, new geothermal fields will be required to develop in the Mabini, Tinoc-Hungaduan, Batong Buhay, Bulusan, Bato-Lunas, and Mt. Parker fields to produce 360MW geothermal power capacity. In this scenario, total geothermal energy production may reach 33.15 MMBFOE.

3) Aggressive scenario

In this scenario, geothermal energy contribution to the total energy requirement is expected to increase to 14.8% by the year 2000. A total of 2,253MW of new geothermal capacity will be commissioned during 1993-2000, increasing geothermal energy production from 30.35 MMBFOE in the baseline scenario, to 36.7 MMBFOE in the ambitious scenario.

Coal

1) Expected/baseline scenario

The coal production will increase from 1.5 million MT in 1993 to 4.0 million MT by the year 2000. The production increase rely on higher utilization of the local Semirara coal for the Calac II coal-fired power plant to be commissioned in 1995

2) Ambition scenario

In this scenario, domestic coal production can be expected to increase further to reach a production target of 5.4 million MT by 2000. The conditions of increase include setting of high coal tariff, displacement of import coal for power plants and introduction of new coal-fired power plants.

3) Aggressive scenario

In this scenario, the contribution of domestic coal production to the Country's energy requirement will reach the level of 8.8 million MT by the year 2000.

Coal demand and production forecasts are shown in Tables 3.24 and 3.25, respectively. Coal areas in Philippines are shown in Figure 3.4.

Hydropower

1) Expected/baseline scenario

Hydropower contribution to the Country's primary energy mix is expected to increase from 8.3 MMBFOE in 1993 to 9.0 MMBFOE by the year 2000. Aggregate hydropower capacity of 486.6MW is expected from eighteen mini, small and large hydropower projects. The total installed capacity is expected to reach 2,664MW by 2000.

2) Ambition scenario

An alternative scenario for hydropower development lines up the implementation of eleven additional mini-hydro and seven small-hydropower projects totaling 176.9MW. Implementation of these power projects will contribute to total hydro power capacity of 2,821MW by 2000.

3) Aggressive scenario

An extremely optimistic outlook for hydropower development looks at the implementation of 1,303.7MW of new hydropower projects for the period 1993-2000.

Non-conventional

1) Expected/baseline scenario

Renewable energy technologies are envisioned to reach 8% to 40% of the total potential market. Effective increase in total non-conventional energy consumption will be from 12.8 million barrels of fuel equivalent (MMBFOE) in 1993 to 20.6 MMBFOE by 2000. During the plan period, consumption will grow at an annual average rate of 7% .

2) Ambition scenario

In this scenario, both government and the private sector will make effort to disseminate the utilization of non conventional resources. It is envisioned that total consumption energy will increase from 12.9MMBFOE in 1993 to 31.9MMBFOE by 2000.

3) Aggressive scenario

Non conventional energy consumption from projected utilization of agro-industrial wastes mainly from large sugar centrals and wood processing industries is estimated to increase from 13.0MMBFOE in 1993 to 38.8MMBFOE by 2000.

(3) Capital investments

In the expected/baseline scenario, the capital investments required for the various programs and projects over the eight year period is estimated at ₱566.8 billion at constant 1993 price levels. Among the energy industrial sector, power development has the biggest share of 74.4% or ₱421.5 billion. Capital investment requirements for the respective scenarios of the National Energy Program 1993-2000 are shown in Table 3.26.

3.2.3 Environmental consideration

The growing concern on energy-environment relationships for sustainable development has added new dimensions to the formulation of national and international policies for energy security and efficient use of energy.

(1) Strategy and programs

To maintain and enhance environmental quality in the implementation of energy programs and projects, the following are to be adopted by DOE :

(a) Strict monitoring of compliance with environmental standards required ;

(b) Rehabilitation of degraded areas caused by energy -related activities ;

(c) Support for the Philippine Agenda 21 which includes the development and promotion of renewable energy sources such as biomass, wind, solar and energy efficient technologies ;

(d) Strengthening of technical capabilities in environmental management and in the analysis of environmental impact of competing technologies ;

(e) Strengthening of linkages with LGUs NGOs, POs, and the DENR; and

(f) Extension of benefits to communities hosting energy projects.

In line with the foregoing strategy, the following programs are to be undertaken:

(a) Streamlining of environmental regulatory policies, procedure and standards for energy projects in coordination with DENR, DOF, DOH, LWUA and other energy industries ;

(b) Conduct of environmental management of audit of selected power plants and energy industries ;

(c) Conduct of a national inventory of related emissions ;

(d) Optimization of open areas;

(e) Protection of groundwater qualities particularly related to geothermal development;

(f) Implementation of a community relations program; and

(g) Enhancement of watershed protection and management.

(2) Environmental implication of energy plan scenarios: CO_2 emissions

Carbon dioxide (CO_2) is one of the most significant greenhouse gases that accompanies development and industrialization. CO_2 emission is directly proportional to the amount of energy used. During a period of the development plan, CO_2 emission is estimated to increase by 50 % from 1993 (100 million tons) to year 2000 (152 million tons) in the expected scenario. The energy conversion sector (power generation and oil refining) will continue to be the biggest generator of CO_2 accounting for more than 60 % of the total emission by the end of the period. CO_2 emission targets for each scenario are shown in Table 3.27.

3.2.4 Power development program

The latest power development program was prepared by NPC for the period 1993-2005 for each of the Luzon, Visayas and Mindanao grids. In order to mitigate the power imbalance among these three power grids, NPC has planned to interconnect the Luzon and Visayas (Leyte-Luzon) grids in 1997 and Visayas and Mindanao grids (Leyte-Mindanao) in 1997/98.

(1) Power demand forecast

The historical power demand shows that for the last six years (1986-1991) the annual average growth rates of the power and energy consumption were 5.4 % and 6.3 %, respectively in the whole of the Philippines. The plan period of 1993 to 2005 was divided into three and different growth rates are applied for power and energy demand forecast in each grid as shown in Table 3.28. The power demand forecast is summarized below.

Power Demand Forecast

Grid	1993		1999		2005	
	MW	GWh	MW	GWh	MW	GWh
Luzon	3,463	19,874	6,613	37,400	11,724	65,360
Visayas	511	2,639	1,124	5,913	2,143	11,270
Mindanao	837	4,892	1,810	10,472	4,326	25,020
Philippine total	4,811	27,405	9,547	53,785	18,193	101,650

Source: NPC Power Development Program 1993-2005

(2) Energy resource assessment

In compliance with the Government policy for utilizing the indigenous energy in the country, the energy sector will identify and develop the energy potential as shown in the Table 3.29.

Hydropotentials

A total of 14,367 MW of hydropower potential has been identified in 293 sites throughout the Country. This includes the 2,214MW of the existing hydro power plants. In the main island of Luzon, 8,874MW out of 10,100MW of hydro potentials remain to be developed in the future.

Geothermal reserves

Geothermal energy resources have been initially assessed in thirty one sites having a total potential capacity of 2,205MW to 3,405MW. Of these geothermal potentials, 888MW are being operated.

Coal deposits

Coal deposits in the Country are estimated at 521 million tons of exploitable reserves. These reserves can support a maximum of 1,820MW of coal-based power generation.

Import energy options

NPC considers also the use of import energy to compensate for the shortages of indigenous energy resources for power development.

(3) Generation projects

The power development program calls for a total capacity addition of 20, 698 MW during the period of 1993-2005. This consists of coal at 2,800MW(14%), hydro at 1,872MW(9%), geothermal at 1,673MW(8%), oil-based capacity in the form of diesel, gas turbine, combined cycle units at 4,753MW and other base-load plants at 9,600MW(46%). Table 3.30 shows the summary of capacity additions by plant type and Table 3.31 presents the details of the power plants.

Geothermal

The development of indigenous sources of energy remains the main thrust of the power program. About 1,673 MW are targeted for completion during the period 1993-1998. Locations of the geothermal projects are shown in Figure 3.5.

Coal thermal

A total of 2,800MW coal power projects are identified in the program to enhance the base-load power supply capacity for the system. Figure 3.6 shows the geographical locations of the identified coal power plants.

Hydropower projects

The current program contemplates the additions of 1,870MW. Preparatory works of some of hydro projects will be required to be commenced as scheduled within the next two years. Figure 3.7 shows the geographical locations of the hydro power projects.

Oil base thermal

To improve the present power supply conditions, NPC has implemented about 1,841MW oil base power plants, of which 1,000MW will be completed in 1993, 741MW by 1994, and rest in 1995. Figure 3.8 shows the geographical locations of the base oil power projects.

Other base-load power projects

The program also requires an additional 9,600MW base-load capacity during the period 1999-2005. Power plant types will be selected from among oil, coal, liquefied natural gas or other types. The location of these base-load power plants are not decided yet.

(4) Power generation capacity

Generation capacity mix

With the implementation of the power program, the installed capacity of 6,700MW in 1992 will increase to 12,800MW in 1998 and 25,000MW in 1995. The projected installation capacity has been taking account for the retirement of existing power plants amounting to 2,200MW. Table 3.32 and Figure 3.9 present the build-up schedule of power plants during the plan period and Table 3.33 shows the retirement schedule of existing power plants. Power plant development is summarized below.

Power Plant Development Plan

	1993		1999		2005	
Power Plant	MW	%	MW	%	MW	%
Hydro	2,177	27.4	2,597	20.3	4,049	16.2
Geothermal	1,075	13.5	2,588	20.2	2,588	10.4
Coal-fired	405	5.1	3,205	25.0	3,205	12.8
Oil-fired	4,300	54.0	3,850	30.0	5,541	22.2
Other base-load	0	0	600	4.5	24,953	38.4
Total	7,957	100	12,814	100	24,953	100

Source: NPC Power Development Program 1993-2005

Energy generation mix

The energy generation consists of the indigenous and imported energy sources. The share of indigenous energy source will decrease from 41.2% in 1993 to 26.1% in 2005. The share of imported fuel will decrease from 59% in 1993 to 24% in 2005. Other base-load generation by imported fuel will be initiated in 1999 with a share of 6% in the total supply and it will share 50% of total supply in 2005. The energy generation mix is summarized below.

Energy Generation Mix

Power Plant	1993 GWH	1993 %	1999 GWH	1999 %	2005 GWH	2005 %
Hydro	4,953	17.8	5,419	9.2	10,809	9.7
Geothermal	6,577	23.4	18,211	31.6	18,211	16.4
Coal-fired	2,251	8.0	20,036	34.0	20,069	18.0
Oil-fired	14,246	50.8	11,449	19.4	7,035	6.3
Other base-load	0	0	3,440	5.8	56,814	49.6
Total	28,027	100	58,948	100	111,372	100

Source: NPC Power Development Program 1993-2005 (Table 3.34)

(5) Fuel requirements

The program will require about 3.1 million metric tons of coal annually for the period 1993-1998. In case other base-load plants use coal, a total of 19.5 million metric tons of coal will be required for the plan period. Table 3.35 presents projected coal and fuel oil requirements for the period 1993-2005.

(6) Transmission

With the development of generation projects, the existing network system is required to be strengthened for increased power transmission capacity. For Luzon, 2,700ckt-km of 500kV extra high voltage lines and 1,500MVA substation capacity are to be constructed during the planned period. In addition, 1,750ckt-km of 230kV transmission lines and 5,370MVA substation capacity will be constructed during the same period. Table 3.36 shows the summary of the transmission lines and substation equipment. The system expansion plan of Luzon grid is shown in Figure 3.2.

(7) Capital investment requirements

A total of ₱850 billion, equivalent to an annual average of ₱65 billion will be required to implement the planned power development. The amount does not include the further project implementation cost beyond 2005. Of this total, ₱645 billion is allocated for power generation projects, ₱110 billion for transmission facilities, and ₱95 billion for rehabilitation, improvement, development and technical studies.

3.2.5 Constraints to power and energy development

(1) Current issues of energy sector

High dependence on oil imports

Due to the rapid introduction of oil-fired power plants to solve the power shortages in the Country, fuel supply to these plants was forced to rely on the imported oil. This has caused the oil-import dependency to stand at 70% in 1992.

Low penetration of energy conservation

Energy-saving programs have not been effective. No systematic program nor campaign exists to let customers to understand that energy conservation will contribute to the decrease of the total national energy consumption.

Slow adoption of renewable, environment-friendly, and cost effective energy technology

In spite of the development and research of renewable energy technologies such as solar, wind, biogas etc. at various institutions, these technologies have not sufficiently realized in commercial scale.

Environmental opposition to energy projects

Many energy projects were delayed due to opposition from the environmental points of view. Another concern is to meet social requirements in areas to be affected by major energy projects.

(2) Constraints to energy development

Major constraints in non-conventional energy are as follows:

1) Weakness of institutional linkages among development and research, commercial and financial institutions,

2) Insufficient information of the development technologies and promotion program to local developers,

3) Shortages of experts for non-conventional energy in DOE and ANEC's,

4) Lack of strong strategy for commercialization (market assessment and market development), and

5) Shortages of funds for development and dissemination of non-conventional energy.

(3) Current issues in power sector

Main issues in the present power supply are energy supply shortage, high system loss, high power rate, transmission system and supply liability.

Supply shortages

In 1993, the Country faced the worst power crisis, particularly in the Luzon grid, attributable to inadequate generating capacity. The critical power conditions were caused by the breakdown of major power plants, Bataan 1, Sucat 2 and 3, Navotas power barge, Malaya 1 and 2 and continuous draw down of reservoir elevation of major hydropower plants. Highest brownout level was about 1,200 MW during the third week of May affecting customers with 10 hours curtailment of the supply. In addition to the rehabilitation of the broken facilities, the Government has been taking an urgent measure to relieve power shortages by import of short lead time gas turbine units and combined cycle power plants. Also the Government strongly promotes participation of the private sector to increasing generating capacity through BOT, BTO (built-transfer-operate) or BOO (built-own-operate).

System losses

Energy losses in the transmission system in the Luzon grid decreased to 6.5 % of the total grid generation in 1992 from 7.2 % of the previous year. In addition, MERALCO's average losses were recorded at 15.2 % in 1992. Average losses of electric cooperatives reached 20.8 % in 1992. Non-technical losses, primarily due to power pilferage of electricity, are also high.

High tariffs

The average tariffs of MERALCO and NPC are among the highest of the tariff structure in Asia and Pacific region. At present, the NPC board is responsible for setting its tariffs. NEA establishes tariffs of rural electric cooperatives. The Energy Regulatory Board is responsible for approving tariffs of MERALCO and other private utilities.

Transmission line network

A part of the existing high voltage power transmission lines in the Luzon grid has reached their maximum current capacity as a number of generating power plants were integrated with the system in 1993. As a result, the transmission lines sometimes experience excess power flow, which causes the thermal expansion of line joints. This results in line opening due to loss of tightness of joints.

Power supply reliability

Consumers suffered from frequent and long duration power brownouts. Some private utilities or similar associations have operated power plants for supply to limited areas/estates to minimize effects of the power brownouts or maintain their minimum productivity. As long as the supply reliability is not improved, the consumers will continue to take account for own alternative power supply.

(2) Constraints to power development

Fuel supply

As reported in the NPC power development plan, power plants have sufficient capacity to meet the system peak demand, but energy supply depends on the commissioning of the base-load power plants which will share 51.1% of the total energy generation in 2005. However, the types of plants and sites have not yet been determined in the program, while additional base-load power plants are expected to be introduced from 1999. Planning for the base-load development will affect operation and maintenance of the entire power system.

Future development of the power generating capacity depends on the coal-fired thermal plants. The total installation capacity of coal-thermal is planned to increase from 405 MW in 1992 to 3,440 MW in 1999.

The development of coal-fired thermal plant will require about 3.1 million metric tons of coal annually for the period of 1993 to 1998. The indigenous coal production can hardly meet the requirements for the development program. Consequently, the coal supply for the power generation will rely on the import coal estimated at 4.89 million metric tons in 1998.

Finance

Finance is a major constraint to realizing the power development programs.

Other constraints

Additional constraints are imposed by environmental quality. The implementation of any power project, particularly a large scale coal- or oil-fired thermal power project, calls for measures for environmental protection to observe standards for exhaust smoke and sulfur dioxide from the plant. The provisions for removal of the fine particles from the plant will increase the construction cost.

3.3 Energy Situation in Central Luzon

3.3.1 Overall energy situations

Central Luzon has been playing key roles for power and energy supply in the Philippines. In Limay, Bataan, there is the biggest oil refinery plant with petroleum production capacity of 155,000 barrels per stream day (BSD) sharing 52% of the total refinery capacities of 296 BSD in the Country. There also exist oil-fired and gas turbine combined-cycle power plants with total capacity of 825MW in Limay as of 1993. These power plants have been interconnected with the Luzon grid via 230kV transmission lines.

Power supply in Central Luzon is from the NPC Luzon grid through the 230 kV primary substations located in each province. As a result of the rural electrification project by rural electric cooperatives since early 1970's, all of the municipalities in Central Luzon were electrified as early as in 1985.

Central Luzon is endowed with various energy resources as summarized in Table 3.37. Hydro power potentials in Central Luzon are estimated at 358 MW in three small and one large hydro power potential sites and 93.7 MW in 114 mini hydro potential sites. Geothermal potential can be exploited in Mt. Pinatubo in Zambaless and Mt. Nabit in Bataan with the total potential output estimated at 20 MW.

Central Luzon has large among of agri-waste materials represented by rice husk and stud and bagasse. Other biomass energy available include animal wastes and wastes from the food processing industry.

3.3.2 Energy consumption

(1) Petroleum

Time-series data on petroleum production in Central Luzon are not available, but 1990 data on fuel consumption in the industrial sector except for NPC power generation are given below. Major consumers of petroleum products were gasoline for transportation and LPG and kerosene for fuel oil.

Industrial Petroleum Consumption

Province	LPG	Avg	Premium gasoline.	Regular gasoline	Kerosene	Avit.	Solv.	Diesel oil	Industrial fuel
Bataan	5,164	0	2,608	2,867	4,644	0	0	10,188	2,527
Bulacan	6,487	0	34,692	15,903	16,883	1	0	106,652	19,665
Nueva Ecija	1,727	0	12,847	21,335	11,097	0	0	56,654	4
Pampanga	48,517	0	41,686	7,067	7,851	292	0	52,341	1,493
Tarlac	1,813	0	7,474	6,182	4,914	0	0	28,673	0
Zambaless	3,683	0	10,564	6,084	3,334	0	0	21,463	108
Region III total	67,391	0	109,871	59,438	48,723	293	0	275,971	23,797
Philippine total	548,437	4,510	1,546,385	337,016	579,486	439,561	14,972	4,613,256	4,535,526

Note : Quantity in metric tons for LPG and in kilo-liter for others
Source : DOE data

The fuel prices as of July 1993 in Nueva Ecija were as follows.

Fuel price

Charcoal (₱/sack) Small	Big	Fuel wood (₱/bundle)	Kerosene (₱/li.)	LPG (₱/tank) (11.5kG)
30-50	60-80	2.5	7.21	120.0-160

(2) Coal

A major consumer of coal in the region is the cement industry. There are four cement factories in Central Luzon that used indigenous coal and bunker oil as fuel. Three factories used 128,900 metric ton (MT) coal in 1992, which account for 14.6% of the total consumption of the cement industry of 881,771MT in the Country.

3.3.3 Power supply system

(1) Power supply organizations

Organization for the power supply system in Central Luzon consists of NPC for power generation, twelve electric cooperatives and private power utilities for power distribution. NPC is responsible for power generation and sales to electric cooperatives, utilities and big industrial consumers. Franchisee areas of cooperatives and utilities in Central Luzon are as follows (Figure 3.10).

Provincial Jurisdiction of Power Supply in Central Luzon

Province	Electric Cooperatives	Private Utilities/Others
Bataan	PENINSULA	
Bulacan	-	MERALCO
Nueva Ecija	NEECO-I & II, SAJELCO, PRESCO	CELCOR(Cabanatuan)
Pampanga	PELCO-I,II & III	ANGELES ELEC., SFELAPCO MASON'S
Tarlac	TARELCO-I & II	TARLAC ELEC (Tarlac)
Zambaless	ZAMECO-I & II	OLONGAPO CITY GOV'T

(2) Energy sales

Energy sales in the Luzon gird amounted to 14,990 GWh in 1987 and 18,633 GWh in 1992, representing the average annual growth rate of 4.5%. The Luzon grid is the dominant market of electricity, consuming 78 % of the national consumption of 23,838GWh in 1992. Some 2,500 GWh or 13.4 % of the total energy sales in the Luzon grid was attributed to consumers in Central Luzon.

(3) Power supply facilities

Power supply facilities in Central Luzon was totally 703 MW accounting for 12.9% of Luzon grid capacity of 4,604.8MW as of 1992. Peak load was estimated at 520 MW in 1992 accounting for 16 % of Luzon grid peak at 3,250 MW.

Power Plant of NPC in Central Luzon

Plant	Capacity (MW)	Power Generation (GWH)	Commissioning year
Hydro			
Angat	200	345.94	1967-1968
Pantabangan	100	174.90	1977
Angat aux.	46		1978-86
Masiway	12	28.68	1981
Oil			
Bataan 1 & 2	225	823.02	1972-1977
Gas			
Bataan GT	120	619.87	1989
Total	703	1,989.41	

Note: Energy generation in Angat aux. P/S included in Angat P/S
Source : NPC data

Power generation in the Luzon grid was 16,030 GWh in 1987 and 19,942 GWh in 1992. The power plant in Central Luzon contributed 10.0 % of the power generation in Luzon grid. Table 3.38 shows the detailed power plant capacity and generated energy production in the Luzon grid as of 1992.

Primary substations in Central Luzon are located in respective provinces, with the total capacity of 850 MVA or 11.2% of the total in the Luzon grid of 7,640 MVA, where secondary transmission lines extend to demand centers. These substations are now interconnected through 230 kV backbone transmission lines. A single line diagram of the power supply system in Central Luzon is shown in Figure 3.11.

Primary Substations of NPC in Central Luzon

(As of 1992)

Province	Substations		
	Location	Capacity	Voltage
Bataan	Hermosa	1 x 50 MVA	230/69/13.8 kV
Bulacan	San Jose	1 x 300 MVA	230/115/13.8 kV
Nueva Ecija	Cabanatuan	2 x 50 MVA	230/69/13.8 kV
Pampanga	Mexico	2 x 100 MVA	230/69/13.8 kV
Tarlac	Concepcion	1 x 50 MVA	230/69/13.8 kV
Zambaless	Botolan	1 x 50 MVA	230/69/13.8kV
	Olongapo	2 x 50 MVA	230/69/13.8 kV

(4) Electrification

Electrification of barangays and households in Central Luzon is summarized below.

Electrification Ratio

(As of 1992)

Cooperatives utility	Barangay Coverage	Barangay Energized	(%)	Household connection Coverage	Household connection Energized	(%)
PENINSULA	230	221	96.1	72,000	59,883	83.2
MERALCO	24	24	100	307,131	284,464	92.6
NEECO-I	97	93	95.9	42,000	37,435	89.1
NEECO-II	511	330	64.6	123,000	78,846	64.1
SAJELCO	41	40	97.6	14,000	10,489	74.9
PRESCO	41	41	100	7,000	6,831	97.6
PELCO-I	113	113	100	40,659	31,045	73.6
PELCO-II	171	171	100	70,825	65,715	92.8
PELCO-III	99	99	100	41,863	33,936	81.8
TARELCO-I	412	342	83.0	81,000	47,435	58.6
TARELCO-II	119	118	99.2	42,000	32,233	76.7
ZAMECO-I	118	106	89.8	30,000	21,256	70.9
ZAMECO-II	112	111	99.1	35,000	27,536	78.7
TOTAL	2,061	1,778	86.3	605,000	458,394	75.8

Source : NEA and MERALCO data

The electrification ratio is relatively high in the region compared with the average of all cooperatives at 56 % in 1991.

(5) Cooperatives

Basic data of the cooperatives in Central Luzon are shown in Table 3.39 and summarized below.

Energy purchased	:	605,559	MWh
Energy sales	:	423,700	MWh
Peak load	:	122.2	MW
Loss	:	30	%
Nos. of total customers			
Residential	:	396,719	(93.0 %)
Commercial	:	18,459	(4.3 %)
Industrials	:	1,082	(0.3 %)
Others	:	10,192	(2.4 %)
Energy consumption			
Residential	:	246,719	MWh (58.2 %)
Commercial	:	44,530	MWh (10.5 %)
Industrials	:	107,657	MWh (25.4 %)
Others	:	24,749	MWh (5.9 %)
Consumption per household per month	:	51.8	kWh

(6) Utilities (MERALCO)

Basic data of MERALCO in Bulacan is summarized for 1992.

Energy sales	:	823,716	MWh

Peak load	:	167.7	MW
Loss (estimated)	:	14	%
Nos. of total customers	:	246,197	
Residential	:	222,633	(90.4 %)
Commercial	:	21,780	(8.8 %)
Industrials	:	1,302	(0.6 %)
Others	:	482	(0.2%)
Energy consumption			
Residential	:	280,209	MWh (34.0 %)
Commercial	:	103,678	MWh (12.6 %)
Industrials	:	431,584	MWh (52.4 %)
Others	:	8,245	MWh (1.0 %)
Consumption per household per month	:	125	kWh

(7) Electricity tariffs

Average electricity tariffs of MERALCO and cooperatives are summarized as bellow.

Tariff rate of MERALCO and Cooperatives

(P/kWh as of end 1992)

	MERALCO	Cooperatives
Residential	2.65	3.25
Commercial	2.63	3.29
Industrial	2.43	3.23
Others	1.59	3.15

Tariff rates of cooperatives are decided based on the current NPC sale price, operation and maintenance cost, amortization of loans, inspection and system loss factor by the respective cooperatives. Table 3.40 shows the tariff structure of MERALCO as of 1994.

3.3.4 Current power and energy related issues and constraints in Central Luzon

(1) Issues

High system losses

The average system loss of the cooperatives in Central Luzon was the highest among the cooperatives throughout the Country. This was due mainly to illegal connections of households without watt-hour meter reading by jumper. The average loss including technical loss recorded 30% in 1992 which was higher than that of all cooperatives of 20.8%.

Shortage of equipment and materials

Replacement and new installation of watt-hour meters cannot be made in time because of shortages of the stock. Sometimes defective watt-hour meters are used, resulting in incorrect meter reading. Supply of distribution materials is often not timely to cause delays in expansion of the line or rehabilitation.

Technical problems

Line voltage drop is significant , especially for remote areas. Primary tapping voltage at NPC substations dropped to 66 to 67 kV against the rated voltage of 69 kV. This is one of the reasons for the voltage drop in distribution lines. Proper measures of the load sharing of three-phase line are required to avoid excessive unbalance current conditions.

(2) Constraints

Expansion of distribution lines to large consumers is restricted by the line capacity, because cooperatives operate with 13.8 kV distribution lines which restrict the bulk power supply.

Rehabilitation of the distribution lines including secondary lines is required to improve the power supply conditions. Funds for rehabilitation of secondary distribution line are not enough to meet growing power demand. This means progress of distribution expansion program will be delayed in spite of power demand increase.

3.3.5 Power system expansion plan

(1) Power demand forecast in Central Luzon

Energy sales in the Luzon grid were recorded at 18,880GWh in 1992. As mentioned in the power development program, the energy sale for the Luzon grid was forecasted to become 42,022GWh in 2000 and 65,360GWh in 2005. If the same share of 13.4% in 1992 is applied for energy, 5,630GWh in 2000 and 8,758GWh in 2005 will be consumed in Central Luzon. Peak power demand in the Luzon grid was estimated at 7,430MW in 2000 and 11,724MW in 2005. Also, peak demand of Central Luzon will reach 1,188MW in 2000 and 1,875MW in 2005 with the share of 16% of total power demand in the Luzon grid.

(2) Power supply facilities

NPC has the following power development program in Central Luzon to cope with the power demand of the Luzon grid during the plan period of 1993 to 2001.

Power Development Plan in Central Luzon

Plant	Capacity (MW)	Commissioning year
Oil		
Subic (Enron I DSL)	105	1993/94
Bataan EPZA	58	1994
Subic (Enron II DSL)	100	1995
Combined cycle		
Bataan B	300	1993
Bataan A	300	1993/94
Limay, Bataan	600	2001
Coal		
Masinloc I & II	300/300	1996/97
Total	2,063	

Source : NPC Power Development Program 1993-2005

Likewise, during the plan period, NPC has planned the following power projects in Region I, of which generated power will be consumed in Central Luzon and Metro Manila transmitted by 500 kV transmission lines. If the construction of power plants will be pursued as scheduled, Central Luzon will have sufficient capacity to supply the required power demand.

Power Development Plan in Region I

Plant	Capacity (MW)	Commissioning year
Oil		
Fast Track FPPC	200	1994
Coal		
Sual I &II	500/500	1998/99
Import coal	1,200	2002
Import coal	1,500	2005
Hydro		
San Roque	390	1996/97
Total	4,290	

(3) Transmission projects

Transmission lines and substation facilities will be expanded to meet the power demand forecast. In Central Luzon, with the commissioning of power plants transmission projects will be implemented. Among them, three extra high voltage transmission line projects, (1)Labrador-San Manuel-San Jose line, (2)Labrador-Hermosa-San Jose line and (3)Hermosa-Dasmarinas line are indispensable for stable power supply to the Central Luzon and Metro Manila. Construction works for the Labrador-San Jose line has already started so as to be in time for commissioning of the Masinloc coal-fired power plant in Zambaless in

1996/97 and the Sual coal-fired power plant located at Pangasinan in 1998/98. The other two projects will not only support the power transmission from the imported coal power plants located in the north but also increase the reliability of power supply in the Luzon grid. The Labrador -Hermosa -San Jose line will form the loop power supply system with the Labrador -San Manuel -San Jose line which will allow more flexible power system operation in case of line failures or transmission line maintenance. The Hermosa -Dasmarinas line also forms loop system with the Dasmarinas-Tayabas-Kalayaan-San Jose line through a submarine cable crossing the Manila bay. This line will also enhance the power supply capability from the north to the south and vice-versa.

Transmission Projects in Central Luzon

Project	Start Date	Comm. date
A. Generation Associated T/L		
1. Subic Diesel T/L (Enron 2)	1993	1994
2. Limay Combined Cycle T/L	1993	1994
3. Subic Diesel T/L (Enron 2)	1994	1995
4. Masinloc Coal T/L	1993	1996
B. Grid Reinforcement		
1. San Jose-Kalayaan EHV Line	1990	1993
2. Balintawak-San Jose T/L	1993	1993
3. Mexico Capacitor Project	1993	1994
4. Labrador-San Manuel-San Jose EHV Line	1993	1996
5. Concepcion S/S Expansion	1997	1998
6. Hermosa S/S Expansion	1997	1998
7. San Jose S/S Expansion	1997	1998
8. Taya-Dasma-San Jose EHV Uprating	1995	1999
9. Labrador-S. Manuel-S. Jose EHV Uprating	1995	1999
10. Mexico S/S Expansion	1998	1999
11. Cabanatuan S/S Expansion	1998	1999
12. Labrador-Hermosa-San Jose EHV	1997	2001
13. Bataan S/S Expansion	2000	2001
14. Olongapo S/S Expansion	2001	2002
15. Botolan S/S Expansion	2002	2003
16. Mexico S/S Expansion	2003	2004
17. Hermosa-Dasmarinas EHV T/L	2001	2005
C. Distribution Projects		
1. Cabanatuan-San Isidro T/L	1993	1994
2. Cabanatuan-Talavera T/L	1993	1994

Source : NPC Power Development Program 1993-2000

Power development at the provincial level has been pursued by electric cooperatives and private utilities. Bulacan is the highest power consumption area in Central Luzon, where energy sales in 1992 were 824GWh with peak power demand of 173MW. Power demand was forecasted to increase to 978GWh energy in 1995 and 1,830GWh in 2000. In order to meet the growth of power demand in Bulacan, MERALCO has implemented the following transmission projects and distribution line projects as shown in Figure 3.12.

Transmission Projects in Bulacan

Project	Comm. date
A. Transmission program	
1. Construction of Malolos -Baliwag 69kV line	1996
B. Delivery point program	
1. Duhat 230kV substation	1994
2. CND 230kV substation	1995
3. Malolos 230kV substation Capacitor Project	1995
C. Substation Development program	
1. Tabang substation	1993
2. Meycauayan substation	1993
3. Tabang 69kV substation	1995
9. Bustos 34.5kV-13.8kV substation	1996
5. Norzagaray substation	1996
6. Expansion of San Miguel substation	1997
12. Expansion of Meycauayan substation	1997

Source: MERALCO data

3.4 Power and Energy Development Plan for Central Luzon

3.4.1 Objectives and strategy

(1) Objectives

Objectives for energy development in Central Luzon have been established in line with the national energy development policies as follows:

a) To improve the quality of life in rural areas,

b) To promote the energy-environment balance, and

c) To replace imported fuel to local indigenous energy sources.

(2) Strategy

Strategy for pursuing the objectives are as follows:

a) To establish technologies suitable for various energy sources,

b) To develop commercial base equipment for popularization,

c) To provide low interest funds and incentives to local manufacturers to encourage equipment research and development, and

d) To organize institutions with relevant government agencies, users and manufacturers.

3.4.2 Rural energy development

(1) Potentials for non-conventional resources of rural energy

A large amount of non-conventional resources are available in Central Luzon. Rice and sugarcane are major crops in Central Luzon, of which residues are expected to be useful biomass energy resources. Other promising non-conventional energy resources include solar, wind and mini-hydro power.

Biomass

Biomass has the highest potentials in Central Luzon. Possible uses in the region include the following.

a) Rice hull: power generation and fuel for cook stove for household

b) Cane trash and bagasse: steam and power generation

c) Animal wastes: biogas for fuel and power generation

Solar

Solar water heaters are already at commercial stage and widely used for hot water supply at hotels, hospitals, restaurants and offices. Other commercially proven solar applications include photovoltaic system for battery charging station, solar home system, solar water pumping system, power supply system, communication repeater station and street lighting. A pilot photovoltaic (PV) system was installed for rural power supply in Bulacan. The pilot system has proved the effectiveness for rural electrification. At present, for the purpose of the dissemination of the photovoltaic system, ANEC in Central Luzon State University has conducted the monitoring work of PV Solar Home System (PV-SHS) consisting of 50 Wp PV demonstration unit.

Wind

Wind mills for pumping water have well operated in the region, especially in Nueva Ecija. No wind power generation is installed at present.

Mini hydro

There are several hydropower potential sites, but none has been developed yet due to difficulty of fund arrangement.

(2) Development of non-conventional energy

Biomass

A large amount of agri-wastes are available in Central Luzon. Paddy production in Central Luzon was 1,815,936 tons in 1992. Rice hull production was 360,000 tons which can be converted to heat value of 1.2 million kcal at average heat value of 3,400 kcal/kg for hull. If half of rice hull produced in the region is used for power generation, 72 GWh electric energy can be generated, assuming 10% generating efficiency. This amount corresponds to 3% of the electric energy consumption (2,500 GWh) in Central Luzon or 10% of total purchased energy (430 GWh) of electric cooperatives in Central Luzon.

Heat Value of Rice Hull

(as of 1992)

Province	Palay (MT)	Rice Hull (MT)	Heat Values of Rice Hull (BKCAL)	Numbers of Rice Mills
Bataan	64,724	12,945	44,012	113
Bulacan	384,063	76,813	261,163	420
Nueva Ecija	865,804	173,161	588,747	423
Pampanga	165,113	33,023	112,277	113
Tarlac	300,533	60,107	204,362	220
Zambaless	35,699	7,140	24,275	138
Total Region III	1,815,936	363,187	1,234,836	1,128

Note : Production rate of rice hull is assumed at 20 % of total palay input.
Heat values of rice hull is assumed at 3,400 kcal/kg

Source ; National Food Authority (NFA)

Sugarcane is also a major crop in the region, produced in Tarlac and Pampanga, and its total production was 2,040,701 tons in 1992. Bagasse production was 500,000 tons which can be converted to heat value of 1.17 million kcal at heat value of 2,300 kcal/kg for bagasse. At present, the bagasse is utilized as fuel for milling processing, drying and own use electric power generation. During off-cropping season, the power plant in sugar mills can supply surplus electric power to the network, but duration time of supply is about three months. Energy potential derived from the bagasse in the Central Luzon is as follow.

Heat Value of Bagasse

(as of 1992)

Province	Sugarcane (MT)	Bagasse (MT)	Heat Values of Bagasse (BKCAL)	Numbers of Sugar Mills
Pampanga	831,122	207,781	477,896	2
Tarlac	1,209,579	302,395	695,509	2
Total Region III	2,040,701	510,176	1,173,405	4

Note : Production rate of bagasse is assumed at 25 % of total sugar cane input.
Heat values of rice hull is assumed at 2,300 kcal/kg.
Source ; National Food Authority (NFA)

1) Universal type boiler power generation

The universal type boiler power generation system is suitable for utilizing biomass energy sources. The system consists of boiler system power generation and steam for processing system. The boiler has been designed to adopt for various kind of fuels including low calorific value fuel.

This system is recommended for installation in rural areas for power supply including supply of surplus power to the grid. This system will relieve rural areas from critical power supply conditions due to long distance distribution lines. The system diagram is shown in the Figure 3.13.

The wasted heat from the turbine outlet can still be reused for other purposes such as drying processes in saw mill, wood industry, and food processing industry. Sites will be selected based on waste material availability.

2) Typical fuel application

Typical fuels for a universal boiler are shown below.

Applicable Fuel of Universal Boiler

Kind of fuel		Rated Steam Production (T/H) 15	20	30	40	50	Heat value (kcal/kWh)
Lignite	(ton)	3.784	5.160	7.740	10.463	13.186	3,000
Baggase	(ton)	6.306	8.600	12.900	17.438	21.977	1,800
Rice husk	(ton)	3.153	4.300	6.450	8.719	10.988	3,600
Waste wood	(ton)	4.366	5.954	8.930	12.073	15.215	2,500
Coconuts husk	(ton)	3.106	4.235	6.353	8.588	10.823	3,665
Generating output	(kW)	1.320	1.800	2.700	3.650	4.600	
Steam consumption rate	(kg/kWh)	11.4	11.1	11.1	11.0	10.9	

Note : Heat values of fuel are assumed.

Mixed fuel application is possible utilizing seasonal crops; e.g. four months for rice millers and six months for sugar millers. For effective and efficient operation of a plant, other fuels such as coal and waste wood can be used during changeover period.

3) Typical boiler and generation system

Specifications of a boiler generation system and cost are shown below.

Specification of Boiler Generation System

		Case-1	Case-2	Case-3	Case-4
Steam production (TH)		12	90	60	40
Steam pressure	(kg/cm^2)	22	20	67	24
Steam temperature	(°C)		360	445	350
Power output	(kW)	500	5,000	4,000	1,900
Fuel					
- Kind		Oil-palm	Coal	Waste Wood	Bagasse
- Consumption rate	(kg/hr)	2,600	14,600	13,100	12,700
- Heat value	(kcal/kg)	3,000	5,000	3,000	1,900
Cost (FOB Japan)	¥ $x10^6$	100	500	450	400
Commissioning year		1977	1985	1988	1989

Benefit of this system application is roughly estimated as follows. Energy flow is shown in Figure 3.13.

Boiler steam production	20,000 kg/hr
Maximum steam pressure	66 kg/cm^2
Normal steam pressure	61 kg/cm^2
Turbine inlet pressure	9 kg/cm^2
Turbine outlet pressure	6 kg/cm^2
Superheated steam temperature	425 °C
Generator output	1,800 kW
Electricity tariff	₱ 2.6/kWh (assumed average price)
Boiler feeding water temperature	140 °C (ejector outlet)
Boiler efficiency	92 %
Fuel cost	₱ 5,200/ton (assumed utilization of heavy oil)
Annual operation hours	7,200 hr

Enthalpy difference (A-steam)-(B+C steam) 1,540,000 kcal/hr (see Fig.5.3.1)

This difference of ethalpy is equivalent to 2.22 tons/hr (1,540,000/695) of steam consumption, or equivalent to 0.156 tons/hr (2.22/14.2) of heavy fuel consumption.

Generating energy	1,800 kWh
Incremental fuel cost	₱ 811 (=0.156 tons/hr x ₱ 5,200/ton)

Generating energy cost	₱ 0.45/kWh (=₱ 811/1,800 kWh)
Operation cost saving	₱ 2.15/kWh (=2.6-0.45/kWh)
Annual saving cost	₱ 27,864,000/year (=1,800x2.15x7,200)

Biogas

Livestock residues are most popular biogas energy sources. Economical operation of a biogas energy production system, however, depends on number and mixture of different types of livestock, particularly hog, poultry and cattle and carabao. In the Philippines, chicken manure with high gas productivity has more economic value as a feed stock and fertilizer. Application of cattle and carabao depends on effective collection of manure as they are normally raised in the backyard or open field. Consequently, the hog manure will be most preferable biogas energy source. Hog raising in Central Luzon accounted for 491,000 in backyard and 553,000 in commercial operation as of 1992. If hog manure produced from commercial operation is converted into energy, 3,069 million BTU can be available per year.

Biogas Potential from Hogs

Province	Head of Hog		Daily Biogas Potential ($\times 10^3$ cft)		Total for 200 days A year ($\times 10^3$ cft)	Calorific Value (Million BTU's) (commercial)
	Backyard	Commercial	Backyard	Commercial		
Bataan	14,651	4,009	18	19	3,857	23
Bulacan	137,724	432,043	165	2,069	413,966	2,484
Nueva Ecija	181,487	11,023	217	53	10,775	65
Pampanga	49,080	44,587	59	214	42,763	257
Tarlac	79,962	38,930	96	186	37,382	224
Zambaless	28,479	2,813	34	13	2,728	16
Region III Total	491,383	533,405	588	2,554	511,472	3,069

Assumptions: Only 25% of potential from backyard hogs is recoverable.
Biogas potential of 4.79 cubic feet per head/day.
Biogas production is 200 days per year.
Heating value is 6,000 BTU/lb

A methane gas generating plant is one of recommendable biogas systems to replace the conventional fuel. The methane gas generating plant using animal residue from 500 heads of hog is expected to generate 30 m^3/day of methane gas which can be used for cooking at households. This 30m^3/day gas can be supplied to 30 households assuming 1.0 m^3/day per household. The plant consists of feces press, pressed waste storage, gas generator, water separator, gasholder, booster pump and accumulator, and pressure reducer. Feces and urine driven from cattle house are separated from separated waste and pressed waste by the feces press, and pressed waste is fed to gas generator. In the gas generator, methane gas is generated derived from press waste by digester ferment effect, the methane gas sent into gasholder passing through water and separator. A piping system made by vinyl chloride is necessary to dispatch the gas to each household.

The system diagram is shown in Figure 3.14 and specifications are given below.

Specification of Gas Generating Plant

Items	Application	Numerical value
Head of hog	15kg/day/head	500
Process manure	1 x 3 %	750 kg
Necessary urine water	1+2	225 lit.
Total feces an urine water	3 x 30 %	975 kg
Quantity of separated water	(3-4)	292 kg
Pressed liquid	for one day	683 kg
Dressed liquid storage capacity		700 lit
Storage day of raw materials in generator		23 days
Gas generation		30 m^3/day
Water separator capacity		100 lit.
Sulfur elimination capacity		101 lit.
Gasholder capacity		14 m^3
Quantity of digested water		670 lit.
Equipment cost (¥ x10^6)		35.0

Solar energy

1) Solar hot water supply system

A solar water heater supply system consists of sunshine collectors, heat storage tank, booster tank, collector pump and auxiliary boiler. The solar heating system is classified into two types by heat collecting method: directional or unidirectional as depicted in Figure 3.15. This system is simple for construction and installation with low operation and maintenance costs. The system can respond to supply requirements easily by a combination of collector units as shown below.

Outline of Solar Water Supply System

Hot water supply per day (ton)(60degree C)		2	4	6	8	10	15	20
Nos. of Unit		17	34	51	68	85	127	169
	Hotel (person)	14	29	43	57	71	107	169
	Hospital(bed)	8	17	25	33	42	53	83
	Restaurant(Nos. of dishes)	250	500	750	1,000	1,250	1,875	2,500
	Sport Center (person)	87	174	261	348	435	652	870
	Apartment (household)	9	17	26	34	43	64	85
Served energy	10^6 kcal/year	25	50	80	100	130	190	260
	thousand Pesos/year *1	28.8	57.6	92	115.2	150.0	220.0	300.0
Installed space (sq.m.)		79	137	185	236	285	423	548
System cost (x 1,000 yen) *2		7,000	11,000	15,500	19,000	23,000	32,000	42,000

*1 Heat value and price (in 1991 Nov.) for kerosene is assumed as 8,250 kcal/liter and 9.5 pesos/liter.
*2 Equipment cost does not include installation cost.

2) Solar heat absorption liquid chiller

A solar heat absorption liquid chiller is a modern device used to produce chilled water that can be used for cooling rooms. Application can be extended to low temperature storage for preservation of farm products. The system consists of solar heat collectors, hot water tank auxiliary boiler and heat exchanger, absorption liquid chiller, chilled water tank, cooling water and fan unit as shown in Figure 3.16.

The absorption liquid chiller consists of evaporator, absorber, condenser regenerator, heat exchanger and cooling medium pump. The principle of the absorption liquid chiller is as follows:

- Cooling medium vapor generated in evaporator is absorbed and diluted by biomic lithium liquid in absorber.
- Temperature of the diluted liquid rises passing through heat exchanger by liquid pump and the liquid becomes heavy by heating in regenerator.
- This heavy liquid returns to absorber transferring heat exchanger.
- Then, the cooling medium vapor generated from the diluted liquid in regenerator returns to evaporator.

An example of specifications and performance of the typical chiller are summarized below.

Specification and Performance of Solar Absorption Liquid Chiller

Item		Unit	case-1	case-2	case-3
Refrigerating capacity		USRT	30	50	100
		MW	106	175	350
Chilled water	Temperature	°C		14/9	
	Flow rate	m^3/min.	0.30	0.55	0.96
Cooling water	Temperature	°C		31/36	
	Flow rate	m^3/min.	3.5	11.0	2.4
Hot water	Temperature	°C		85/80	
	Flow rate	m^3/min.	0.4	0.8	1.4
Electricity		kW	4.0	4.0	4.0
Solar collector	Unit size	m x m	1 x 2	1 x 2	1 x 2
	Nos. of Unit		490	820	1,640
	Total area	m^2	980	1,640	3,200
Applied room area		m^3	990	1,650	3,300
Annual served energy	Energy	kWh	90,000	150,000	300,000
	Benefit cost	Pesos	234,000	390,000	780,000
Equipment cost		¥x10^3	82,000	125,000	240,000

Note :Installation cost excluded
Electric tariff :Pesos 2.6/kWh

3) Photovoltaic electric power supply system for rural electrification

A photovoltaic power supply system will be applied in rural areas where extension of the distribution line is not economical for small power demand. The system consists of solar array, DC/AC invertor, battery charger, storage batteries, control and distribution panels and transformer. A case study for the system has been made assuming the power demand of 100 W for 9 hours supply per day.

Case-1	30 household	3kW
Case-2	50 household	5kW
Case-3	100 household	10kW

Specifications and equipment cost of the system are shown below.

Specification of Photo-Voltaic System

Items			Unit	Case-1	Case-2	Case-3
System output	Voltage		V	230	230	230
	Output		kW	3	5	10
	Frequency		Hz	60	60	60
Demand hour			Hr	9	9	9
Solar Array	Out put		WP	18,126	30,528	61,056
	Arrangement	Serial		18	18	18
		Parallel		19	32	64
	Nos.		PCs	342	576	1,152
	Total areas		m^2	136	227	455
Inverter output			kW	3	5	10
Battery	Voltage		V	310	310	310
	Arrangement	Serial		124	124	124
		Parallel		2	2	2
	Capacity		AH	2,200	3,700	7,300
Total installation areas			m^2	800	1,100	2,300
Equipment cost			¥ $x10^6$	110	170	300

4) Photovoltaic electric power supply for water supply system

This system is applied to drinking water supply system in remote areas or irrigation water supply. The system will be operated during day time only. The system for water supply consists of solar array, DC/AC inverter, deep well pump, piping and storage tank necessary only for drinking water supply. A case study for water supply system is summarized below

Specification of Water Supply System

Type		1/8	1/10	20/1	5/8	5/10	20/8	10/20	200/3
Pump volume	(m^3/day)	10	10	200	50	50	200	200	2000
Total head	(m)	80	100	10	80	100	80	100	30
Solar output	(KWp)	1.5	1.9	3.8	7.5	9.4	30	37.5	112.5
Array area	(m^2)	17.5	22.2	44.3	87.5	109.7	350	437.5	1312.6
Served									
- Population		200	200	-	1,000	1,000	4,000	4,000	-
- Household		40	40	-	200	200	800	800	-
Pump									
- H	(m)	88	100	10	80	100	80	100	30
- Q	(m^3/min.)	0.02	0.02	0.42	0.1	0.1	0.42	0.42	4.2
Cost									
- Solar		10.5	13.3	26.6	52.5	65.8	210	262.5	787.5
- Pump		1.4	1.4	0.6	1.8	1.8	3.8	3	5.2
Total cost	(¥ x 10^6)	11.9	14.7	27.2	54.3	67.6	213.8	265.5	792.7

5) Photovoltaic electric supply system for home electric power supply

This system has been applied for individual household power supply which is already commercialized in the Philippine. This system has a possibility to lead the promotion of rural electrification in individual households through further reduction of production cost as compared to large scale installation. Costs of the system in local market are roughly quoted as below.

Cost of Photovoltaic System in Local Market

Items		Unit	Case-1	Case-2	Case-3	Case-4	Case-5	Case-6
System output	Voltage	V	230	230	230	230	230	230
	Frequency	Hz	-	60	60	60	60	60
Solar Array	Out put	WP	64	64	128	256	512	1,024
	Nos.	PCs	1	1	2	4	8	16
Inverter output		W			200	800	1,500	2,600
Battery	Voltage	V	12	12	12	12	24	24
	Nos.		1	1	2	4	9	15
	Capacity	AH	100	100	100	100	100	100
Equipment cost		P x10^3	27	29.9	60	125	248	497

Wind power

Wind mills for pumping groundwater have been operated in the region, especially in Nueva Ecija. No wind power generator is installed at present. However it is worth monitoring meteorological conditions for developing the wind power generation along the western coastal areas of Bataan and Zambales and mountainous areas of Nueva Ecija.

Mini hydro

Five mini-hydro power projects have been identified in Central Luzon with a total capacity of 7,116 kW. Their locations are shown in Figure 3.17. Outline of the projects are as follows.

Mini-hydro Power Projects

Province	Location	Site	Head (m)	Capacity (kW)	Reference
Nueva Ecija	Rizal	Pris	4.7	1,040	NEA
	San Jose	Talavera	13.2	1,126	NEA
Zambaless	Botolan	Salaza	188	3,200	NEA
	Sta. Cruz	Cabaluan	40	1,000	TAP
Tarlac	Sn Clemente	Kanding	24	750	PHILT
Total				7,116	

3.4.3 Hydropower development

Two major water resources development projects have been planned with hydropower: the Balintingong reservoir multipurpose project and the Casecnan project (Phased transbasin scheme). The hydropower component of each projects is outlined below.

(1) Balintingon Reservoir Multipurpose Project

Two main objectives of the Balintingon project are to be provide irrigation water to about 22,000 ha and to generate electric power. The expected install capacity of the power plant is 22 MW x 2 units with energy output of 164 GWh per year. Its primary energy output with 90 % dependability is 134.2 GWh per year. The generated power at the Balintingon power plant is to be supplied to the NPC network through the Cabanatuan substation. One double circuit 69 kV transmission line is proposed to connect the power plant to the Cabanatuan substation where the receiving power will be distributed through a 69 kV local network or delivered to the NPC network by stepping up the voltage to 230 kV.

(2) Casecnan Project (Phased transbasin scheme)

The Casecnan Project has been planned to divert the water of the Casecnan catchment to the existing Pantabangan reservoir for power generation and irrigation purposes. A feasibility study was recently conducted for the phased transbasin scheme.

The first phase features for power generation are as follows:

(a) Manablon power plant

- Type of powerhouse	: underground (59m(L)x24m(W)x37.5m(H)
- Number and type of unit	: 3 Francis
- Total installed capacity	: 270 MW
- Average annual energy production	: 494.7 GWh
- Annual firm continuous energy	: 314.6 GWh
- Average annual secondary energy	: 180.1 GWh

(b) Pantabangan and Masiway power plant extension

		Pantabangan P/S	Masiway P/S
- Present number and type of unit		: 2 Francis	1 Kaplan
- Unit capacity		: 50 MW	12 MW
- Present total installed capacity		: 100 MW	
- Present annual energy prod.	Average	: 229.9 GWh	38.1 GWh
	Firm	: 122.4 GWh	
	Secondary	: 107.5 GWh	
- Additional unit and capacity		: 2 Francis 50 MW	1 Kaplan
- Total installed capacity		: 200 MW	24 MW
- Future annual energy prod.	Average	: 427.4 GWh	83.6 GWh
	Firm	: 337.2 GWh	
	Secondary	: 190.2 GWh	

The second phase features for power generation are as follows.

(a) Be-De Pumping plant

- Type of pump house	: underground (41.5m(L)x23m(W)x36m(H)
- Number and type of unit	: 2 Francis
- Total installed capacity	: 90 MW
- Average annual energy use	: 415.2 GWh
- Average annual discharge	: 38.0 m^3/s

(b) Additional power energy at Pantabangan and Masiway power plant

		Manablon	Pantabangan	Masiway
- Present number and type of unit		: 3 Francis	4 Francis	2 Kaplan
- Unit capacity		: 90 MW	50 MW	12 MW
- Total installed capacity		: 270 MW	200 MW	24 MW
- Addit. annual energy prod.	Average	: 616.5 GWh	210.7 GWh	30.4 GWh
	Firm	: 598.5 GWh	162.6 GWh	
	Secondary	: 18.0 GWh	48.1 GWh	

A new substation will be constructed at Rizal as the center substation for collecting the generated power at the respective power plant in the project area. The new substation will further be integrated with the Luzon grid at the nearest 230/500 kV substation. A new Manablon power plant will be linked to the new Rizal substation by a 230kV double circuit transmission line. The existing transmission line from the Pantabangan power plant will also be connected to new Rizal substation.

3.4.4 Comprehensive regional energy strategy formulation

Within the Luzon grid of power supply, Central Luzon is subsidizing the rest of Luzon, particularly Metro Manila. This situation will continue with the planned power development projects. A question from a regional development point of view is to what extent Central Luzon should continue to subsidize other regions and at what costs - social and environmental.

Central Luzon has advantages for certain non-conventional types of energy, which may provide a viable alternative especially in rural areas. However, it has not been established to what extent such forms of energy can support various economic activities.

A study is proposed to examine all the energy-related issues from the viewpoint of Central Luzon regional development and to formulate comprehensive regional energy strategy to support the new development paradigm pursued through the Central Luzon Development Program (CLDP).

Specific objectives of the study are the following.

(1) To formulate comprehensive energy strategy for Central Luzon to support both its globalization drive and community-based development;

(2) To assess priority of power development projects from economic, social and environmental as well as technical points of view;

(3) To prepare a comprehensive package of measures to encourage energy savings and to promote non-conventional types of energy; and

(4) To formulate a comprehensive rural energy program that can be implemented by community-based approach.

Specific issues to be addressed by the study may include the following:

(a) How to bear social costs of power development,

(b) Applicability of discriminating pricing,

(c) Applicable extent of community-based rural energy development,

(d) Viability of alternative/non-conventional energy sources, and

(e) Incentive measures for energy savings and use of alternative energy.

A typical social issue is related to power supply. A thermal power plant usually produces two kinds of output: electricity and environmental degradation or economic goods and externalities. The problems is that most users of electricity enjoy only the economic goods, while local people around the plant site suffer the economic externalities. That is, in terms of environmental costs, the local people, usually the rural poor, are in effect subsidizing the electricity users, including the urban rich and industrial users.

This situation needs to be corrected by the society as a whole. One way is to minimize the pollution at the source, but this would involve high costs. Another way is to charge higher tariffs to electricity users, especially those in high income categories, and compensate the local people in the form of resettlement with sufficient livelihood opportunities. However, the average electricity tariff in the Philippines is already on the high side as compared with other Asian countries, and higher tariffs would undermine international competitiveness of industrial activities.

If there is a general consensus in the society that industrial activities should be much promoted as they would benefit the society as a whole, there should be a proper institutional mechanism to balance the costs and the benefits of the economic goods and externalities within a broad regional framework.

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TABLES

Table 3.1 Histrical Energy Mix

(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

	1983		1984		1985		1986		1987		1988		1989		1990		1991		1992	
	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%
INDIGENOUS ENERGY	34.02	34.55	39.42	42.12	41.62	44.97	41.34	44.32	38.16	38.06	40.28	37.24	41.80	35.64	41.32	34.26	40.61	33.16	38.01	29.31
I. CONVENTIONAL	19.43	19.73	24.42	26.09	25.08	27.10	25.13	26.94	22.83	22.77	25.84	23.89	26.27	22.40	25.23	20.92	25.07	20.47	22.69	17.50
OIL	4.65	4.72	3.54	3.78	2.60	2.81	2.85	3.06	1.75	1.75	1.91	1.77	1.72	1.47	1.54	1.28	1.06	0.87	0.54	0.42
COAL	2.63	2.67	4.06	4.34	4.45	4.81	4.02	4.31	4.27	4.26	4.78	4.42	4.18	3.56	3.82	3.17	5.21	4.25	4.99	3.85
HYDRO	5.12	5.20	9.01	9.63	9.50	10.26	10.37	11.12	9.00	8.98	10.80	9.99	11.22	9.57	10.45	8.67	8.87	7.24	7.33	5.65
GEOTHERMAL	7.03	7.14	7.81	8.34	8.53	9.22	7.89	8.46	7.81	7.79	8.35	7.72	9.15	7.80	9.42	7.81	9.93	8.11	9.83	7.58
II. NONCONVENTIONAL	14.59	14.82	15.00	16.03	16.54	17.87	16.21	17.38	15.33	15.29	14.44	13.35	15.53	13.24	16.09	13.34	15.54	12.69	15.32	11.81
BAGASSE	5.47	5.55	6.57	7.02	4.36	4.71	4.09	4.39	3.54	3.53	4.59	4.24	6.14	5.24	5.42	4.49	6.15	5.02	6.08	4.69
AGRIWASTE	9.05	9.19	8.23	8.79	12.00	12.96	11.65	12.49	11.23	11.20	9.33	8.63	9.12	7.78	10.35	8.58	9.03	7.37	8.83	6.81
OTHERS	0.07	0.07	0.20	0.21	0.18	0.19	0.47	0.50	0.56	0.56	0.52	0.48	0.27	0.23	0.32	0.27	0.36	0.29	0.41	0.32
IMPORTED ENERGY	64.45	65.45	54.18	57.88	50.94	55.03	51.93	55.68	62.09	61.94	67.87	62.76	75.48	64.36	79.27	65.74	81.86	66.84	91.66	70.69
OIL	63.54	64.53	52.67	56.27	46.96	50.73	49.76	53.35	59.58	59.43	64.13	59.30	72.48	61.80	76.20	63.19	78.58	64.16	88.97	68.61
COAL	0.91	0.92	1.51	1.61	3.98	4.30	2.17	2.33	2.51	2.50	3.74	3.46	3.00	2.56	3.07	2.55	3.28	2.68	2.69	2.07
TOTAL ENERGY	98.47	100.00	93.60	100.00	92.56	100.00	93.27	100.00	100.25	100.00	108.15	100.00	117.28	100.00	120.59	100.00	122.47	100.00	129.67	100.00
GROWTHRATE, % P.A. VS. Previous yr. shown		3.03		-4.84		-1.22		0.78		7.47		7.87		8.44		2.83		1.55		5.89
OIL IMPORT BILL (CIF in Million U.S. Dollars)	2,199		1,563		1,453		795		1,257		1,127		1,397		1,930		1,720		1,999	

Source : Energy of Department

Table 3.2 Philippine Energy - Economy Integration

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Energy comsumption (MMBFOE)	98.47	93.70	92.54	93.28	100.25	108.14	117.27	120.59	122.46	129.67
Growth Rate (%)		-4.84	-1.24	0.80	7.47	7.87	8.44	2.83	1.55	5.89
Petroleum (MMBFOE)	68.19	56.21	49.56	52.61	61.33	66.04	74.21	77.74	79.64	89.51
Growth Rate (%)		-17.57	-11.83	6.15	16.57	7.68	12.37	4.76	2.44	12.39
Population (Millions)	52.46	53.35	54.67	56.00	57.40	59.07	60.84	61.50	63.40	64.26
Energy per capita (BFOE)	1.88	1.76	1.69	1.67	1.75	1.83	1.93	1.96	1.93	2.02
Real GDP (1985 prices, Billion Pesos)	66.57	61.70	57.19	59.17	61.97	65.85	69.84	71.53	70.82	71.33
Growth Rate (%) p.a.		-7.32	-7.31	3.46	4.73	6.26	6.06	2.42	-0.99	0.72
Energy to GDP ratio (BFOE/'000 GDP)	1.48	1.52	1.62	1.58	1.62	1.64	1.68	1.69	1.73	1.82
Petroleum to GDP ratio (BFOE/'1 GDP)	1.02	0.91	0.87	0.89	0.99	1.00	1.06	1.09	1.12	1.25
Peso-US Dollar Rate	11.12	16.70	18.61	20.41	20.60	21.39	21.74	24.31	27.48	25.52
Crude Oil Prices $/bbl, FOB	28.63	27.89	26.67	13.06	16.97	13.53	16.15	20.63	18.04	17.98
Imported Oil (MMBFOE)	63.54	52.67	46.96	49.76	59.18	64.13	72.48	76.20	78.58	88.97
Import Oil Share to Total Energy (%)	64.53	56.21	50.75	53.34	59.03	59.30	61.81	63.19	64.17	68.61
Oil Import Bill (CIF,MMS$)	2,199	1,563	1,453	795	1,257	1,127	1,397	1,930	1,720	1,999
Oil Fraction in Import Bill (%)	29.37	25.75	28.43	15.76	18.66	13.81	13.41	15.81	14.27	13.77
Oil Fraction in Export Proceed (%)	43.93	28.99	31.39	16.42	21.98	15.93	17.87	23.58	19.46	20.35
Trade Imbalance (MM$)	-2,481	-679	-482	-202	-1,017	-1,085	-2,598	-4,020	-3,211	-4,695
Oil Bill as fraction of Trade Deficit (%)	89	230	301	394	124	104	54	48	54	43

Source : DOE Philippine Energy Plan 1993 - 2000

Table 3.3 Crude Supply by Country of Origin

(In Thousand Barrels of Fuel Oil Equivalent, MTBFOE)

Region/Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Middle East										
Kuwait	5,676	11,270	8,068	7,642	16,010	9,966	10,024	6,748	0	4,997
Saudi Araabia	25,521	12,837	8,855	12,041	10,300	4,579	9,696	25,659	34,682	43,442
Iran	1,206	680	2,157	6,888	8,183	12,901	15,137	5,331	11,408	9,468
Oman	1,000	602	0	0	3,135	5,440	0	1,030	0	0
Dubai	7,123	1,825	2,850	2,949	2,013	9,181	9,929	17,777	10,045	0
Iraq	0	0	889	500	1,307	1,314	4,224	3,843	0	0
UAE	0	0	0	1,611	1,277	4,062	4,130	1,133	0	12,418
Qutar	0	0	0	1,855	994	2,752	2,273	4,009	4,247	2,568
Neutral zone	480	796	1,051	0	911	1,785	0	0	0	0
Abu Dhabi	1,815	0	0	0	0	0	0	0	0	0
Sub-total	42,821	28,010	23,870	33,486	44,130	51,980	55,413	65,530	60,382	72,893
Malaysia	2,596	8,025	10,498	9,838	7,702	9,244	7,859	7,474	7,130	9,194
China	4,074	6,337	8,088	3,329	6,551	4,208	3,875	1,154	2,989	761
Brunei	1,841	1,823	545	485	3,104	2,138	2,219	4,491	4,562	4,303
Indonesia	5,881	5,258	4,417	3,274	1,411	0	0	708	1,432	1,631
Australia	0	0	1,425	0	1,251	3,214	1,520	430	0	0
Pakistan	0	0	0	0	0	0	0	311	161	0
Mexico	2,614	0	0	0	0	0	0	0	0	0
Sub-total	17,006	21,443	24,973	16,926	20,019	18,804	15,473	14,568	16,274	16,120
Total Import	59,827	49,453	48,843	50,412	64,149	70,784	70,886	80,098	76,656	89,013
Domestic	5,147	3,920	2,671	3,147	1,939	2,105	1,906	1,720	1,164	2,954
Grand Total	64,974	53,373	51,514	53,559	66,088	72,889	72,792	81,818	77,820	91,967

Table 3.4 Petroleum Product Importation

(In Thousand Barrels of Fuel Oil Equivalent, MTBFOE)

Products	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Avitation Gasoline	47	29	36	36	71	32	25	38	40	23
Avitation Turbo	0	0	0	0	117	0	220	299	0	0
Premium Gasoline	0	0	0	0	0	0	41	51	0	0
Diesel	1,044	490	139	599	967	1,044	1,220	2,377	4,815	6,423
Fuel Oil	12,401	3,121	3,051	4,182	5,510	4,181	7,946	4,927	4,663	6,629
Kerosene	0	0	0	0	0	0	218	0	598	0
LPG	876	608	615	584	708	1,193	1,146	1,904	598	2,576
Solvents	0	0	0	0	0	17	0	17	2,028	30
Naphtha	0	211	0	0	0	0	0	0	0	0
Lubes/Additives	0	99	55	64	0	73	175	98	0	67
Heavy Vaccum Gas Oil	104	0	336	924	1,750	188	0	0	94	0
Slop Oil	0	0	38	29	133	155	147	139	0	13
Special Fuel Oil	0	0	39	0	136	0	0	0	132	0
Used Lube Oil	0	0	0	0	0	9	10	0	0	0
Feedstock	0	0	0	0	0	371	174	0	875	0
Total Products	14,472	4,558	4,309	6,418	9,392	7,263	11,322	9,850	13,843	15,761

Source : DOE data

Table 3.5 Petroleum Product Sale

(In Thousand Barrels of Fuel Oil Equivalent, MTBFOE)

Petroleum Products	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Avitation Gasoline	51	39	36	35	36	39	39	36	28	28
Avitation Turbo	2,659	2,824	2,710	2,176	3,304	3,758	4,281	3,983	3,847	4,447
Premium Gasoline	6,206	5,954	5,885	6,334	7,055	7,751	8,829	9,390	9,112	9,160
Regular Gasoline	2,971	2,717	2,562	2,808	3,090	3,248	3,471	3,465	2,965	3,236
Kerosene	2,569	2,269	2,074	2,273	2,545	2,815	3,456	3,704	3,580	3,916
Diesel	18,879	17,090	15,702	16,223	17,839	19,186	22,237	25,220	28,263	33,671
Fuel Oil	33,690	24,390	20,039	21,511	26,645	28,002	30,349	30,375	28,757	28,259
LPG	2,533	2,225	2,234	2,464	2,843	3,503	4,183	4,598	4,684	5,431
Energy Products Total	69,558	57,508	51,242	53,824	63,357	68,302	76,845	80,771	81,236	88,148
Process Gas	185	147	0	0	0	0	0	0	0	0
Asphalts	538	347	284	289	282	317	342	286	326	304
Solvents	270	155	160	200	246	288	297	267	182	159
Lubes/Greases	1,067	796	710	747	897	887	1,058	1,070	907	1,023
Waxes/Petrolatum	1	0	0	0	1	3	2	2	0	0
Propylene	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	5	7	7	13	12	10	11
Total Products	71,619	58,953	52,396	55,065	64,790	69,804	78,557	82,408	82,661	89,645
Growth rate (%)		-17.69	-11.12	5.09	17.66	7.74	12.54	4.90	0.31	8.45
Refinery Fuel/Losses	2,853	2,479	2,143	2,139	2,354	2,856	3,052	3,071	2,908	3,246
Grand Total	74,472	61,432	54,539	57,204	67,144	72,660	81,609	85,479	85,569	92,891
MBCD	204.0	168.3	149.4	156.7	184.0	199.1	223.6	234.2	234.4	254.5

Table 3.6 Refinary Production (Includes Refinery Contract)

(In Thousand Barrels of Fuel Oil Equivalent, MTBFOE)

Refining Output	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Avturbo	3,007	3,322	2,996	2,908	3,524	4,978	4,420	3,421	3,453	4,067
Premium Gasoline	6,394	5,975	6,597	6,783	7,931	8,610	9,150	10,863	8,916	10,101
Regular Gasoline	2,954	2,513	2,494	2,617	3,230	3,078	3,450	3,398	2,952	3,278
Kerosene	3,441	2,382	2,128	2,296	2,578	2,889	3,415	3,897	3,299	4,280
Diesel	17,540	17,028	15,371	15,678	17,153	20,789	20,806	23,729	24,156	26,733
Fuel Fuel oil	21,670	18,544	15,353	17,134	20,732	20,721	22,160	26,428	24,131	27,474
Process Gas	185	147	166	310	0	19	0	0	0	0
LPG	1,641	1,592	1,417	1,857	2,309	2,380	2,276	2,703	2,777	2,914
Asphalts	610	363	222	254	280	289	365	300	333	266
Solvents	380	199	170	209	274	332	469	568	778	456
Naphtha	2,282	1,362	1,071	1,230	1,660	2,352	1,256	1,997	3,381	3,200
Avgas	0	0	16	0	1	0	0	0	0	0
Propylene	0	0	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0	0	0
Total Marketable Products	60,104	53,427	48,001	51,276	59,672	66,437	67,767	77,304	74,176	82,769
In-Process & Intermidiate	0	0	45	260	278	469	584	573	469	403
Refinery Fuel/Losses	63	127	2,202	2,139	2,416	2,856	3,052	3,071	2,839	3,300
Grand Total	60,167	53,554	50,248	53,675	62,366	69,762	71,403	80,948	77,484	86,472
MBCD	165	147	138	147	171	191	196	222	212	237

Source : DOE data

Table 3.7 Histrical Coal Production/Importation

(Run-of-Metric Tons)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
PRODUCTION										
Region 2	0	0	0	0	0	0	0	0	0	0
Region 4	11,842	9,622	14,644	13,244	12,449	13,472	11,902	9,618	10,797	6,186
Region 5	53,027	110,532	113,020	64,305	75,691	79,626	73,218	60,461	69,606	34,012
Region 6	325,702	551,890	568,042	592,421	605,032	670,181	693,982	553,369	592,306	795,600
Region 7	326,731	251,150	329,470	380,172	275,713	272,425	225,250	204,111	211,807	230,168
Region 8	16,377	0	0	0	0	0	4,040	23,986	0	44,534
Region 9	246,997	232,614	177,944	115,973	174,915	242,283	266,721	258,501	236,384	201,278
Region 11	38,918	60,580	58,444	69,388	64,272	80,254	82,033	132,967	204,691	348,882
Region 12	0	0	0	0	0	0	270	0	0	0
Total	1,019,594	1,216,388	1,261,564	1,235,503	1,208,072	1,358,241	1,357,416	1,243,013	1,325,591	1,660,660
IMPORTATION	271,853	512,782	1,257,970	957,594	615,034	1,320,579	966,426	1,363,749	1,356,214	1,356,214
Toatal Supply	1,291,447	1,729,170	2,519,534	2,193,097	1,823,106	2,678,820	2,323,842	2,606,762	2,681,805	3,016,874

Table 3.8 Histrical Coal Utilization

(Run-of-Metric Tons)

Consumers	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Cement	430,851	796,719	677,573	625,295	713,771	997,969	631,848	864,006	1,092,699	881,744
Power	386,602	788,409	1,459,765	1,180,563	1,312,370	1,457,113	1,427,095	1,104,964	1,364,172	1,321,774
Industrial & Others	236,783	100,983	276,674	75,117	63,948	63,277	80,173	265,107	390,877	291,044
Total	1,054,236	1,686,111	2,414,012	1,880,975	2,090,089	2,518,359	2,139,116	2,234,077	2,847,748	2,494,562

Source : DOE data

Table 3.9 Existing Generating Plants as of end-1992

LUZON

YEAR OF COMM.	PLANT NAME	INSTALLED CAP (MW)
1946-48	Botocan H.E.	17.0
1947-50	Caliraya Unit 1-4	32.0
1956-57	Ambuklao Unit 1-3	75.0
1957	Barit M.H.	1.8
1959	Cawayan M.H. (out of service)	0.0
1960	Binga Unit 1-4	100.0
1967-68	Angat H.E.	200.0
1977	Pantabangan H.E.	100.0
1978-86	Angat Aux.	46.0
1981	Masiway	12.0
1982	Kalayaan PH	300.0
1983-84	Magat Unit 1-4	360.0
	Total Hydro	1,243.8
1979	Tiwi Plant A	110.0
1979	Mak-Ban Plant A	110.0
1979-80	Tiwi Plant B	110.0
1980	Mak-Ban Plant B	110.0
1981-82	Tiwi Plant C	110.0
1984	Mak-Ban Plant C	110.0
	Total Geothermal	660.0
1984	Calaca Coal I	300.0
	Total Coal Thermal	300.0
1965-66	Manila 1 & 2	200.0
1968-70	Sucat 1 & 2	350.0
1971-72	Sucat 3 & 4	500.0
1972-77	Bataan 1 & 2	225.0
1975-79	Malaya 1 & 2	650.0
	Total Oil Thermal	1,925.0
1989	Malaya GT	90.0
1989	Bataan GT	120.0
1991	Natobas GT	60.0
1991	Hopewell GT	210.0
	Total Gas Turbine	480.0
	TOTAL LUZON	4,608.8

Source : NPC Annual Report 1992

VISAYAS

YEAR OF COMM.	PLANT NAME	INSTALLED CAP (MW)
1957-67	Loboc Unit 1-3	1.2
1962	Amlan Unit 1-2	0.8
	Total Hydro	2.0
1980-82	Palinpinon Pilot	3.0
1983	Palinpinon Geo. I	112.5
1983	Tongonan Geo. I	112.5
	Total Geo.	228.0
1981	Naga Coal I	50.0
1986	Naga Coal II	55.0
	Total Coal	105.0
1977-78	Cebu Diesel I	43.8
1978	Bohol Diesel I	11.0
1979-81	Panay Diesel I	36.5
1984	Panay Diesel II	11.0
1982-83	Cebu Diesel II	57.9
1985	Power Barge 103**	32.0
1986	Bohol Diesel Unit 3	5.5
1989	Bohol Diesel Unit 4	3.5
	Total Diesel	201.2
1990	GT Barge 207*	30.0
1991	Naga GT Land-based	55.0
	Total Gas Turbine	85.0
	TOTAL VISAYAS	621.2

MINDANAO

YEAR OF COMM.	PLANT NAME	INSTALLED CAP (MW)
1957	Agusan M.H.	1.6
1953-77	Agus VI Unit 1-5	200.0
1979	Agus II Unit 1-3	180.0
1982-83	Agus VII Unit 1-2	54.0
1985	Agus V Unit 1-2	55.0
1985	Agus IV Unit 1-3	158.1
1985-86	Pulangi IV Unit 1-3	255.0
1992	Agus I Unit 2	40.0
	Total Hydro	943.7
1977	Aplaya Diesel I	11.0
1979-81	Aplaya Diesel II	115.7
1980	Gen. Santos	22.3
1981	Diedel Barge 101	32.0
1991	Diedel Barge 102	32.0
1985	Diedel Barge 104	32.0
1990	GT Barge 201	30.0
1990	GT Barge 206	30.0
1990	GT Barge 208	30.0
1990	GT Barge 209	30.0
1991	GT Barge 202	30.0
1992	Diedel Barge 105	14.4
1992	Diedel Barge 106	14.4
1992	GT Barge 205	30.0
	Total Oil Based	453.8
	TOTAL MINDANAO	1,397.5

* 1 Unit of 5.5 MW not operational 3.42 MW Talomo Mini-Hydro Plant on lease to Talomo Lights & Power Co. not included in this table.

Table 3.10 Gross Energy Generation by Grid and by Energy Source

(In Million KiloWattHours)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
PHILIPPINES	3,140	3,279	5,006	13,893	15,086	15,988	17,413	18,682	18,666	18,757	19,263	20,995	22,944	24,087	24,799	25,437	25,567
Oil-Based	408	1,155	2,281	10,367	9,507	9,494	10,016	11,514	8,536	6,713	6,970	9,183	9,546	10,075	11,541	12,664	13,436
Hydro	2,732	2,123	2,722	2,869	3,502	3,724	3,751	2,964	5,167	5,514	5,989	5,235	6,212	6,473	6,047	5,077	4,270
Geothermal	0	1	3	657	2,077	2,770	3,586	4,093	4,540	4,945	4,586	4,516	4,842	5,316	5,470	5,761	5,692
Coal	0	0	0	0	0	0	60	111	423	1,585	1,718	2,061	2,344	2,223	1,741	1,935	2,169
GENERATION MIX (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Oil-Based	13.0	35.2	45.6	74.6	63.0	59.4	57.5	61.6	45.7	35.8	36.2	43.7	41.6	41.8	46.5	49.8	52.6
Hydro	87.0	64.7	54.4	20.7	23.2	23.3	21.5	15.9	27.7	29.4	31.1	24.9	27.1	26.9	24.4	20.0	16.7
Geothermal	0.0	0.0	0.1	4.7	13.8	17.3	20.6	21.9	24.3	26.4	23.8	21.5	21.1	22.1	22.1	22.6	22.3
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	2.3	8.5	8.9	9.8	10.2	9.2	7.0	7.6	8.5
LUZON	2,361	2,323	3,731	12,504	13,115	13,666	14,398	15,294	14,655	14,449	14,756	16,030	17,439	18,222	18,822	19,532	19,936
Oil-Based	408	1,111	2,046	10,120	9,173	8,894	9,011	10,145	7,787	5,825	6,328	8,376	8,829	9,150	10,328	11,347	11,927
Hydro	1,953	1,212	1,685	1,731	1,873	2,033	1,832	1,274	2,519	2,869	2,956	1,961	2,588	2,599	2,370	1,873	1,925
Geothermal	0	0	0	653	2,069	2,739	3,555	3,875	4,125	4,284	3,900	3,710	4,024	4,444	4,495	4,490	4,426
Coal	0	0	0	0	0	0	0	0	224	1,471	1,572	1,983	1,998	2,029	1,629	1,822	1,658
VISAYAS	11	55	230	243	321	503	777	1,057	1,177	1,343	1,467	1,693	1,876	1,999	2,051	2,280	2,492
Oil-Based	0	42	216	231	304	464	676	719	551	561	624	800	703	922	955	886	703
Hydro	11	12	11	8	9	8	10	9	12	7	11	9	9	11	9	10	12
Geothermal	0	1	3	4	8	31	31	218	415	661	686	806	818	872	975	1,271	1,266
Coal	0	0	0	0	0	0	60	111	199	114	146	78	346	194	112	113	511
CEBU GRID		42	202	190	178	257	439	503	516	478	542	638	737	808	804	881	1,022
Oil-Based		42	202	190	178	257	379	392	317	364	396	560	391	614	692	768	511
Coal		0	0	0	0	0	60	111	199	114	146	78	346	194	112	113	511
NEGROS GRID	5	4	17	30	35	100	151	203	220	244	260	323	381	422	463	762	741
Oil-Based	0	0	13	27	28	77	126	146	58	0	1	0	0	0	0	0	0
Hydro	5	4	4	3	4	3	3	3	4	3	4	2	2	3	2	3	1
Geothermal	0	0	0	0	3	20	22	54	158	241	255	321	379	419	461	759	740
PANAY GRID				4	84	112	112	135	134	150	173	200	238	241	215	54	137
Oil-Based				4	84	112	112	135	134	150	173	200	238	241	215	54	137
LEYTE GRID[3]		1	3	4	5	11	48	187	278	441	457	490	474	476	514	523	526
Oil-Based		0	0	0	0	0	39	23	21	21	26	5	35	23	0	11	0
Geothermal		1	3	4	5	11	9	164	257	420	431	485	439	453	514	512	526
BOHOL GRID	1	1	12	12	12	12	12	12	12	12	16	16	16	21	21	60	66
Oil-Based	0	0	11	11	11	11	11	11	11	11	14	14	14	20	20	53	55
Hydro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	7	11
MINDANAO	768	901	1,045	1,146	1,650	1,819	2,238	2,331	2,834	2,965	3,040	3,272	3,629	3,866	3,926	3,625	3,139
Oil-Based	0	2	19	16	30	136	329	650	198	327	18	7	14	3	258	431	806
Hydro	768	899	1,026	1,130	1,620	1,683	1,909	1,681	2,636	2,638	3,022	3,265	3,615	3,863	3,668	3,194	2,333
AGUS GRID		901	1,045	1,146	1,622	1,759	2,169	2,255									
Oil-Based		2	19	16	2	76	260	574									
Hydro		899	1,026	1,130	1,620	1,683	1,909	1,681									
ISOLATED GRIDS					28	60	69	76									
Oil-Based					28	60	69	76									130

1 Includes generation of acquired MERALCO plants starting November 1978.

3 Reflects Leyte-Samar system starting 1986.

Table 3.11 Transmission and Distribution Line Length
(In Circuit Kilometers)

GRID	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TOTAL	7,152	8,346	9,137	10,748	11,650	11,832	11,997	12,019	13,437	13,899	14,060	14,260	14,483
500 kV	0	0	0	0	0	0	0	490	490	490	490	490	575
230 kV	1,883	2,363	2,463	3,039	3,398	3,484	3,484	3,310	3,310	3,602	3,634	3,634	3,636
138kV	1,090	1,255	1,359	1,960	2,287	2,336	2,501	2,472	2,720	2,848	2,913	2,919	3,003
115 kV	484	484	484	484	484	484	484	484	499	499	508	508	508
69 kV	2,948	3,497	4,084	4,510	4,726	4,773	4,773	4,531	5,663	5,705	5,760	5,954	6,006
Below 69 kV	747	747	747	755	755	755	755	732	755	755	755	755	755
LUZON	4,781	5,528	5,863	6,688	7,068	7,201	7,201	7,517	7,532	7,824	7,876	7,893	7,980
500 kV	0	0	0	0	0	0	0	490	490	490	490	490	575
230 kV	1,883	2,363	2,463	3,039	3,398	3,484	3,484	3,310	3,310	3,602	3,634	3,634	3,636
115 kV	484	484	484	484	484	484	484	484	499	499	508	508	508
69 kV	1,894	2,161	2,396	2,637	2,658	2,705	2,705	2,705	2,705	2,705	2,716	2,733	2,733
Below 69 kV	520	520	520	528	528	528	528	528	528	528	528	528	528
VISAYAS	552	806	885	1,200	1,471	1,471	1,471	1,165	2,089	2,217	2,317	2,443	2,446
138kV	135	182	182	394	532	532	532	503	627	755	820	820	823
69 kV	290	497	576	679	812	812	812	558	1,335	1,335	1,370	1,496	1,496
Below 69 kV	127	127	127	127	127	127	127	104	127	127	127	127	127
MINDANAO	1,819	2,012	2,389	2,860	3,111	3,160	3,325	3,337	3,816	3,858	3,867	3,924	4,057
138kV	955	1,073	1,177	1,566	1,755	1,804	1,969	1,969	2,093	2,093	2,093	2,099	2,180
69 kV	764	839	1,112	1,194	1,256	1,256	1,256	1,268	1,623	1,665	1,674 2/	1,725	1,777
Below 69 kV	100	100	100	100	100	100	100	100	100	100	100	100	100

1/ Includes 308 km of electric cooperative owned 69kV lines turned over to NPC.

2/ Newly energized 69 kV lines total 148.9 ckt in length; however, a 140-ckt km dataadjustment was reflected vis-a-vis previous year's data to account for current information that only 168 ckt kms of electric cooperatve-owned lines are ctually used by NPC.

Table 3.12 Substation Capacity
(In Million Volt-Amperes) 1/

GRID	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
TOTAL	7,598	8,552	9,215	11,249	12,728	13,307	13,627	13,657	13,857	14,291	14,381	14,738	14,788
230 kV	3,573	4,022	4,511	6,001	7,228	7,278	7,328	7,328	7,328	7,590	7,590	7,640	7,640
138kV	1,135	1,362	1,492	1,971	2,181	2,541	2,811	2,841	2,991	3,243	3,243	3,469	3,519
115 kV	1,827	1,877	1,877	1,927	1,927	1,927	1,927	1,927	1,977	1,977	2,027	2,147	2,147
69 kV	898	1,117	1,147	1,162	1,162	1,331	1,331	1,331	1,331	1,251	1,291	1,252	1,252
Below 69 kV	165	174	188	188	230	230	230	230	230	230	230	230	230
LUZON	6,060	6,663	7,192	8,742	10,011	10,071	10,121	10,121	10,171	10,433	10,483	10,653	10,653
230 kV	3,573	4,022	4,511	6,001	7,228	7,278	7,328	7,328	7,328	7,590	7,590	7,640	7,640
115 kV	1,827	1,877	1,877	1,927	1,927	1,927	1,927	1,927	1,977	1,977	2,027	2,147	2,147
69 kV	521	616	646	656	656	666	666	666	666	666	666	666	666
Below 69 kV	139	148	158	158	200	200	200	200	200	200	200	200	200
VISAYAS	378	629	728	1,177	1,237	1,279	1,360	1,390	1,490	1,609	1,649	1,682	1,682
138kV	290	417	512	956	1,016	1,016	1,097	1,127	1,227	1,309	1,309 2/	1,418	1,418
69 kV	70	194	194	199	199	241	241	241	241	278	318	242	242
Below 69 kV	18	18	22	22	22	22	22	22	22	22	22	22	22
MINDANAO	1,160	1,260	1,295	1,330	1,480	1,957	2,146	2,146	2,196	2,249	2,249	2,403	2,453
138kV	845	945	980	1,015	1,165	1,525	1,714	1,714	1,764	1,934	1,934	2,051	2,101
69 kV	307	307	307	307	307	424	424	424	424	307	307	344	344
Below 69 kV	8	8	8	8	8	8	8	8	8	8	8	8	8

1/ Excludes pilfered/retired transmission lines; includes generating plants step-up axiliary transformers.

2/ Includes step-up transformer Of Cebu Barge- mounted Gas Turbine Plant

Source : NPC Annual report 1992

Table 3.13 Histrical Energy Sales by Grid and by Customer Type

(In Million KilowattHours)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
PHILIPPINES	**2,966**	**3,004**	**4,750**	**12,547**	**14,033**	**14,918**	**16,000**	**17,089**	**17,001**	**17,140**	**17,645**	**19,337**	**21,180**	**22,244**	**22,915**	**23,598**	**23,838**
Utilities	915	989	2,446	10,244	11,506	12,337	13,353	14,356	13,813	13,804	14,213	15,658	17,291	18,219	19,242	20,015	20,952
Industries	1,551	1,620	1,819	1,788	2,037	2,048	2,213	2,445	2,793	2,872	2,955	3,173	3,330	3,509	3,326	3,238	2,884
Misc. Load	500	395	485	515	490	533	434	288	395	464	477	506	559	516	347	345	2
SALES MIX (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Utilities	31.0	33.0	52.0	82.0	82.0	83.0	83.0	84.0	81.0	81.0	81.0	81.0	81.0	82.0	84.0	85.0	88.0
Industries	52.0	54.0	38.0	14.0	15.0	14.0	14.0	14.0	17.0	17.0	17.0	16.0	16.0	16.0	15.0	14.0	12.0
Misc. Load	17.0	13.0	10.0	4.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	1.0	1.0	0.0
LUZON	**2,211**	**2,085**	**3,519**	**11,210**	**12,164**	**12,690**	**13,126**	**13,908**	**13,245**	**13,136**	**13,461**	**14,990**	**16,078**	**16,795**	**17,368**	**18,123**	**18,633**
Utilities	748	792	2,122	9,763	10,496	10,970	11,579	12,457	11,739	11,632	11,915	13,303	14,269	14,915	15,641	16,396	17,196
Industries	967	901	915	937	1,185	1,205	1,134	1,180	1,123	1,049	1,075	1,188	1,256	1,370	1,450	1,461	1,435
Misc. Load	496	392	482	510	483	515	413	271	383	455	471	499	553	510	277	266	2
VISAYAS	**10**	**51**	**214**	**224**	**292**	**456**	**700**	**933**	**1,020**	**1,173**	**1,261**	**1,490**	**1,644**	**1,768**	**1,818**	**2,036**	**2,236**
Utilities	8	10	67	142	241	363	517	657	667	743	892	1,082	1,248	1,373	1,393	1,576	1,877
Industries	1	40	146	80	48	89	178	270	349	426	365	403	392	391	357	383	359
Misc. Load	1	1	1	2	3	4	5	6	4	4	4	5	4	4	68	77	0
CEBU GRID		39	190	178	163	240	395	461	465	433	466	573	650	718	725	803	942
Utilities		0	44	98	116	150	219	284	296	316	424	510	584	643	648	704	908
Industries		39	146	80	46	88	174	175	167	115	40	61	64	73	32	45	34
Misc. Load		0	0	0	1	2	2	2	2	2	2	2	2	2	45	54	0
NEGROS GRID	3	4	14	28	32	82	142	176	174	196	207	268	323	360	362	423	444
Utilities	2	3	13	27	31	81	140	162	151	181	195	254	308	346	343	396	419
Industries	0	0	0	0	0	0	1	13	22	14	11	13	14	13	18	26	25
Misc. Load	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
PANAY GRID				3	75	105	101	122	123	134	156	182	214	224	231	292	329
Utilities				3	75	105	101	122	123	134	156	182	214	224	231	292	329
Industries				0	0	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Load				0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEYTE GRID *		1	3	4	5	11	40	148	234	384	401	429	416	419	449	463	466
Utilities		1	3	4	4	9	36	64	74	88	89	102	104	117	145	155	170
Industries		0	0	0	0	0	2	82	159	295	311	326	311	302	304	308	296
Misc. Load		0	0	0	1	2	2	2	1	1	1	1	1	0	0	0	0
BOHOL GRID	7	7	7	11	17	20	23	26	24	26	31	38	42	47	48	55	55
Utilities	6	6	7	10	14	18	21	24	23	24	28	34	38	43	24	29	51
Industries	1	1	0	0	2	1	1	1	1	2	3	3	3	3	3	4	4
Misc. Load	0	0	0	1	1	1	1	1	0	0	0	1	1	1	21	22	0
MINDANAO	**745**	**868**	**1,017**	**1,113**	**1,577**	**1,772**	**2,174**	**2,248**	**2,741**	**2,831**	**2,923**	**3,127**	**3,458**	**3,681**	**3,729**	**3,439**	**2,969**
Utilities	159	187	257	339	769	1,004	1,257	1,242	1,407	1,429	1,406	1,543	1,774	1,931	2,208	2,043	1,879
Industries	583	679	758	771	804	754	902	995	1,326	1,397	1,515	1,582	1,682	1,748	1,519	1,394	1,090
Misc. Load	3	2	2	3	4	14	15	11	8	5	2	2	2	2	2	2	0
Isolated grid																	119

* Reflects Leyte-Samar grid starting 1986.

Table 3.14 Electric Energy Consumption by Sector

1981 TO 1992

Year	Total Consumption		Residential		Commercial		Industrial		Others		Utilities Own Use		Power Losses	
	(GWh)	%	(GWh)	%	(GWh)	%	(GWh)	%	(GWh)	%	(GWh)	%	(GWh)	%
1981	18,583	100	3,424	18.4	3,157	17.0	7,597	40.9	1,098	5.9	1,157	6.2	2,150	11.6
1982	19,406	100	3,589	18.5	3,205	16.5	7,769	40.0	1,034	5.3	1,333	6.9	2,476	12.8
1983	21,454	100	3,991	18.6	3,487	16.3	8,724	40.7	939	4.4	1,509	7.0	2,804	13.1
1984	21,180	100	4,198	19.8	3,209	15.2	8,554	40.4	1,131	5.3	955	4.5	3,133	14.8
1985	22,766	100	4,482	19.7	3,231	14.2	9,008	39.6	1,356	6.0	943	4.1	3,746	16.5
1986	21,797	100	3,536	16.2	2,927	13.4	5,843	26.8	900	4.1	4,993	22.9	3,598	16.5
1987	22,642	100	4,702	20.8	3,561	15.7	7,750	34.2	1,221	5.4	1,070	4.7	4,338	19.2
1988	24,539	100	5,105	20.8	3,978	16.2	8,566	34.9	1,465	6.0	1,077	4.4	4,348	17.7
1989	25,573	100	5,161	20.2	4,428	17.3	9,763	38.2	1,299	5.1	1,125	4.4	3,797	14.8
1990	25,244	100	5,950	23.6	4,850	19.2	8,982	35.6	1,140	4.5	1,097	4.3	3,225	12.8
1991	25,649	100	6,244	24.3	4,869	19.0	9,339	36.4	930	3.6	1,086	4.2	3,181	12.4
1992	25,682	100	6,336	24.7	4,878	19.0	9,060	35.3	1,069	4.2	1,128	4.4	3,211	12.5

Source : Office of Energy Affairs (1993 Philippine Statistical Yearbook Table 14.5)

Table 3.15 System Peak Demand

(In Megawatts)

GRID	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
LUZON	2,364	2,478	2,374	2,311	2,435	2,592	2,780	2,938	2,973	3,045	3,250
VISAYAS	162	229	242	256	284	306	333	354	380	410	472
CEBU GRID	88	105	98	92	105	118	125	132	142	153	183
NEGROS GRID	30	46	48	50	48	61	68	73	87	154	179
PANAY GRID	21	25	38	38	48	43	53	56	53	3/	-
LEYTE GRID 2/	16	45	50	68	72	74	74	79	83	89	93
BOHOL GRID	7	8	8	8	11	10	13	14	15	14	17
MINDANAO	387	410	433 1/	471	484	533	571	617	621	626	693
AGUS	371	394									
GEN.SANTOS	16	16									

Table 3.16 System Load Factor

(In Percent)

GRID	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
LUZON	69.5	70.5	70.5	71.4	69.2	70.6	71.6	70.8	72.3	73.1	70.0
VISAYAS	46.3	54.8	52.7	55.5	59.9	59.0	63.0	69.1	64.4	61.6	60.3
CEBU GRID	56.9	54.7	60.1	59.3	58.9	61.7	67.3	69.8	64.6	65.7	63.8
NEGROS GRID	57.5	50.4	52.3	55.7	61.8	60.4	63.9	66.0	60.8	60.5	47.3
PANAY GRID	60.9	61.6	40.3	45.1	41.1	53.1	51.2	49.1	46.3	3/	-
LEYTE GRID 2/	34.2	47.4	63.5	74.0	72.5	75.6	73.1	68.8	70.7	67.1	64.6
BOHOL GRID	44.0	41.4	41.4	42.8	36.3	43.6	40.4	42.4	41.9	48.9	44.3
MINDANAO	66.0	64.9	74.7	72.0	71.7	70.1	72.6	71.5	72.2	66.1	51.7
AGUS	66.7	64.5									
GEN.SANTOS	49.2	54.2									

NOTE

1/ The isolated grids of Agus and General Santos were interconnected starting May 1984

2/ Reflects Leyte-Samar grid starting 1986.

3/ Negros and Panay interconnected.

Source : NPC Annual report 1992

Table 3.17 Histrical Electrification Profile

	1986	1987	1988	1989	1990	1991	1992
Rural Electric Cooperatives							
Towns/Cities	1,268	1,279	1,284	1,292	1,301	1,313	1,337
Barangays	19,680	20,155	20,602	20,951	21,314	21,868	22,487
Households ('000)	2,753	2,857	2,950	3,060	3,185	3,318	3,312
Potential ('000)	5,782	5,812	5,821	5,830	5,845	5,880	6,822
% Electrified	48	49	51	52	54	56	49
Meralco							
Towns/Cities	109	109	109	109	109	109	109
Households ('000)	1,948	2,042	2,118	2,174	2,465	2,553	2,473
Potential ('000)	2,132	2,200	2,277	2,332	2,633	2,725	2,762
% Electrified	91	93	93	93	94	94	90
Other Private Utilities							
Towns/Cities	42	42	42	42	42	42	NA
Households ('000)	463	505	539	591	604	604	NA
Potential ('000)	702	702	702	702	702	702	NA
% Electrified	66	72	77	84	86	86	NA
Philippines							
Towns/Cities	1,419	1,430	1,435	1,443	1,452	1,464	1,446
Barangays	19,680	20,155	20,602	20,951	21,314	21,868	22,487
Households ('000)	5,164	5,404	5,607	5,825	6,254	6,475	5,785
Potential ('000)	8,616	8,714	8,800	8,864	9,180	9,307	9,584
% Electrified	60	62	64	66	68	70	60

Note : The decline in the electrification level of 91% from 90% in 1992 is atttributed to the MERALCO take over the Batangas city and San Pascual areas previous ly served by RECs.

Source : DOE Philippine Energy Plan (1993-2000)

Table 3.18 Average Tariff Rate

(Peso/kilowatt-hours)

GRID	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
PHILIPPINES	0.4299	0.5790	0.8754	1.0835	0.9548	0.9038	0.9354	0.9381	1.1263	1.3955	1.5768
LUZON	0.4670	0.6152	0.9740	1.2082	1.0522	0.9793	1.0031	0.9877	1.2049	1.4728	1.6576
VISAYAS	0.5444	0.7244	0.9980	1.0401	0.9063	0.8671	0.9252	1.0385	1.2424	1.5293	1.6922
CEBU (	0.6090	0.7320	1.1010	1.0718	0.9479	0.8502	0.9430	1.0710	1.2703	1.5592	1.7054
NEGRC	0.5400	0.6550	0.8580	1.1531	1.0386	1.0936	1.0932	1.1028	1.3133	1.5887	1.7371
PANAY	0.5630	0.7190	1.1660	1.1185	0.7756	0.7322	0.8000	1.0714	1.2735	1.5651	0.0000 1/
LEYTE	0.5300	0.6130	0.7930	0.9583	0.8550	0.8248	0.8462	0.9045	1.1158	1.3982	1.6137
BOHOL	0.4580	0.6640	0.9540	1.1154	0.7742	0.6579	0.7857	1.0851	1.2941	1.5818	1.7818
MINDANAO	0.1859	0.2996	0.3740	0.5205	0.5086	0.5657	0.6252	0.6690	0.4043	0.9028	0.9644

Note: N 1/ os and Panay grids interconnected

Source : NPC Annual report 1992

Table 3.19 Tariff Rate (As of October,1993)

(Unit Peso/Month)

LUZON GRID		VISAYAS GRID										MINDAO GRID	
		Cebu		Negros		Panay		Bohol		Leyte			
Utilities													
Demand Charge (P/kW)		Demand Charge (P/kW)		Demand Charge (P/kW)		Demand Charge (P/kW)		Demand Charge (P/kW)		Straight Energy)		Demand Charge (P/kW)	
First 500 kW	13.20	First 100 kW	15.40	First 200 kW	13.20	First 100 kW	15.40	First 200 kW	13.20	Charge(P/kWH		First 500 kW	11.00
Next 19,500 kW	17.60	Next 1900 kW	18.70	Over 200 kW	11.00	Next 1900 kW	18.70	Over 200 kW	11.00			Next 4,500 kW	15.95
Over 20,000 kW	24.20	Over 1,000 kW	22.00			Over 1,000 kW	22.00					Over 5,000 kW	19.80
Energy Charge (P/kWh)		Energy Charge (P/kWh)		Energy Charge (P/kWh)		Energy Charge (P/kWh)		Energy Charge (P/kWh)				Energy Charge (P/kWh)	
First 200 kWh	1.77	First 100 kWh	1.8688	First 100 kWh	1.9125	First 100 kWh	1.8802	First 100 kWh	1.9134			First 100 kWh	1.2404
Next 200 kWh	1.79	Next 150 kWh	1.9035	Next 150 kWh	1.9345	Next 150 kWh	1.9149	Next 150 kWh	1.9354			Next 200 kWh	1.2734
Over 400 kWh	1.82	Over 250 kWh	1.9416	Over 250 kWh	1.9785	Over 250 kWh	1.9530	Over 250 kWh	1.9794			Over 300 kWh	1.2954
Industries and Non-utilities													
Demand Charge (P/kW)		Demand Charge (P/kW)		Straight Energy)		Demand Charge (P/kW)				Demand Charge (P/kW)		Demand Charge (P/kW)	
First 1,000 kW	19.80	First 100 kW	25.30	Charge(P/kWh)	1.9735	First 100 kW	25.30			First 1,000 kW	15.84	First 1,000 kW	19.80
Next 9,000 kW	20.90	Over 100 kW	22.00			Over 100 kW	22.00			Next 9,000 kW	16.72	Next 4,000 kW	20.90
Over 10,000 kW	22.11									Over 10,000 kW	17.69	Next 10,000 kW	23.10
												Over 15,000 kW	25.30
Energy Charge (P/kWh)		Energy Charge (P/kWh)				Energy Charge (P/kWh)				Energy Charge (P/kWh)		Energy Charge (P/kWh)	
First 200 kWh	1.85	First 300 kWh	1.9612			First 300 kWh	1.9726			First 200 kWh	1.7501	First 200 kWh	1.3064
Next 250 kWh	1.82	Over 300 kWh	1.9497			Over 300 kWh	1.9611			Next 250 kWh	1.7193	Next 249 kWh	1.2954
Over 450 kWh	1.78									Over 450 kWh	1.6929	Next 250 kWh	1.2844
MERALCO												Over 449 kWh	0.2734
Straight Energy)													
Charge(P/kWh)	1.8435												

Source : NPC data

Table 3.20 Energy Mix

(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

Expected Scenario

	1993		1994		1995		1996		1997		1998		1999		2000	
	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%
INDIGENOUS ENERGY	41.87	31.51	47.86	33.59	58.17	37.69	67.28	40.06	76.50	41.64	81.10	39.92	81.75	36.39	81.40	32.76
I. CONVENTIOANL	29.12	21.91	34.33	24.10	43.86	28.42	52.00	30.96	60.16	32.75	63.64	31.33	62.74	27.93	60.83	24.48
OIL & GAS	3.17	2.39	4.25	2.98	11.99	7.77	13.69	8.15	13.69	7.45	12.41	6.11	10.87	4.84	9.52	3.83
COAL	6.83	5.14	8.06	5.66	8.22	5.33	11.89	7.08	11.85	6.45	11.75	5.78	11.83	5.27	11.93	4.80
HYDRO	8.31	6.25	8.95	6.28	9.00	5.83	8.66	5.16	8.47	4.61	8.47	4.17	9.03	4.02	9.03	3.63
GEOTHERMAL	10.81	8.14	13.07	9.17	14.65	9.49	17.76	10.58	26.15	14.24	31.01	15.26	31.01	13.80	30.35	12.22
II. NONCONVENTIONAL	12.75	9.60	13.53	9.50	14.31	9.27	15.28	9.10	16.34	8.89	17.46	8.59	19.01	8.46	20.57	8.28
BAGASSE	5.35	4.03	5.58	3.92	5.70	3.69	5.98	3.56	6.20	3.38	6.43	3.17	6.67	2.97	6.92	2.79
AGRIWASTE	6.46	4.86	6.98	4.90	7.50	4.86	8.03	4.78	8.57	4.67	9.14	4.50	9.72	4.33	10.32	4.15
OTHERS	0.94	0.71	0.96	0.68	1.11	0.72	1.27	0.76	1.57	0.85	1.89	0.93	2.62	1.17	3.33	1.34
IMPORTED ENERGY	91.01	68.49	94.60	66.41	96.15	62.31	100.66	59.94	107.20	58.36	122.05	60.08	142.90	63.61	167.04	67.24
OIL	86.40	65.02	88.32	62.00	89.09	57.73	85.15	50.70	89.28	48.60	97.42	47.95	108.37	48.24	118.73	47.79
COAL	4.61	3.47	6.28	4.41	7.06	4.57	15.51	9.24	17.92	9.76	24.63	12.12	34.53	15.37	48.31	19.45
TOTAL ENERGY	132.88	100.00	142.46	100.00	154.32	100.00	167.94	100.00	183.70	100.00	203.15	100.00	224.65	100.00	248.44	100.00
GROWTH RATE		3.79		7.20		8.33		8.82		9.38		10.59		10.59		10.58
% Over the previous year shown																
ENERCON IMPACT	3.40		5.00		6.60		8.50		10.50		12.60		15.00		17.30	
TOTAL ENERGY W/ENERCON	129.48		137.46		147.72		159.44		173.20		190.55		209.65		231.14	
POWER USE, % OF TOTAL	46.62	35.08	54.45	38.22	60.06	38.92	66.33	39.50	75.84	41.28	85.71	42.19	98.25	43.73	111.55	44.90
OIL SHARE IN POWER USE, %	23.74	50.92	28.02	51.46	31.23	52.00	24.79	37.37	23.20	30.59	19.70	22.98	19.09	19.43	15.46	13.86
Self-Sufficiency (%)		32		34		36		40		42		40		36		33

Source : DOE Philippines Energy Plan 1993-2000

Table 3.21 Energy Mix

(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

Agressive Scenario

	1993		1994		1995		1996		1997		1998		1999		2000	
	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%
INDIGENOUS ENERGY	42.01	31.61	48.97	34.38	60.90	39.47	71.62	42.65	83.81	45.62	131.56	64.76	139.65	62.16	143.47	57.75
I. CONVENTIOANL	29.12	21.91	34.79	24.42	44.57	28.88	52.85	31.47	61.12	33.27	106.60	52.47	111.10	49.45	111.59	44.92
OIL & GAS	3.17	2.39	4.25	2.98	12.20	7.91	13.91	8.28	13.91	7.57	54.00	26.58	52.46	23.35	51.10	20.57
COAL	6.83	5.14	8.52	5.98	8.72	5.65	12.52	7.46	13.19	7.18	13.23	6.51	15.65	6.97	16.39	6.60
HYDRO	8.31	6.25	8.95	6.28	9.00	5.83	8.66	5.16	8.76	4.77	9.02	4.44	10.54	4.69	10.95	4.41
GEOTHERMAL	10.81	8.14	13.07	9.18	14.65	9.49	17.76	10.58	25.26	13.75	30.35	14.94	32.45	14.44	33.15	13.34
II. NONCONVENTIONAL	12.89	9.70	14.18	9.95	16.33	10.58	18.77	11.18	22.69	12.35	24.96	12.29	28.55	12.71	31.88	12.83
BAGASSE	5.35	4.03	5.58	3.92	5.97	3.87	6.34	3.78	6.79	3.70	7.11	3.50	7.28	3.24	7.47	3.01
AGRIWASTE	6.60	4.97	7.64	5.36	8.87	5.75	10.25	6.10	12.07	6.57	13.91	6.85	15.95	7.10	17.83	7.18
OTHERS	0.94	0.71	0.96	0.67	1.49	0.97	2.18	1.30	3.83	2.08	3.94	1.94	5.32	2.37	6.58	2.65
IMPORTED ENERGY	90.87	68.39	93.48	65.62	93.41	60.53	96.32	57.35	99.89	54.38	71.59	35.24	85.00	37.84	104.95	42.25
OIL	86.26	64.92	87.66	61.54	86.86	56.29	81.44	48.49	82.61	44.97	51.90	25.55	63.12	28.10	69.79	28.09
COAL	4.61	3.47	5.82	4.09	6.55	4.24	14.88	8.86	17.28	9.41	19.69	9.69	21.88	9.74	35.16	14.15
TOTAL ENERGY	132.88	100.00	142.45	100.00	154.31	100.00	167.94	100.00	183.70	100.00	203.15	100.00	224.65	100.00	248.42	100.00
GROWTH RATE		3.79		7.20		8.33		8.83		9.38		10.59		10.58		10.58
% Over the previous year shown																
ENERCON IMPACT	3.40		5.40		7.90		10.60		13.60		16.90		21.30		26.30	
TOTAL ENERGY W/ENERCON	129.48		137.05		146.41		157.34		170.10		186.25		203.35		222.12	
POWER USE, % OF TOTAL	46.62	35.08	54.45	38.22	60.17	38.99	66.44	39.56	75.80	41.26	85.71	42.19	98.25	43.73	111.55	44.90
OIL SHARE IN POWER USE, %	23.74	50.92	28.02	51.46	31.23	51.90	24.79	37.31	23.20	30.61	10.39	12.12	7.69	7.83	4.48	4.02
Self-Sufficiency (%)		32		34		39		43		46		65		62		58

Source : DOE Philippines Energy Plan 1993-2000

Table 3.22 Energy Mix

(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

Ambitious Scenario

	1993		1994		1995		1996		1997		1998		1999		2000	
	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%	VOL	%
INDIGENOUS ENERGY	42.09	31.67	49.55	34.78	62.24	40.33	74.25	44.21	89.57	48.76	143.63	70.70	155.60	69.26	174.53	70.25
I. CONVENTIOANL	29.13	21.92	34.81	24.43	44.57	28.88	52.85	31.47	63.79	34.73	113.55	55.89	120.92	53.83	135.77	54.65
OIL & GAS	3.17	2.39	4.25	2.98	12.20	7.91	13.91	8.28	15.63	8.51	57.40	28.25	55.85	24.86	62.48	25.15
COAL	6.84	5.15	8.54	5.99	8.72	5.65	12.52	7.46	13.89	7.56	14.05	6.92	18.71	8.33	23.16	9.32
HYDRO	8.31	6.25	8.95	6.28	9.00	5.83	8.66	5.16	8.77	4.77	9.42	4.64	11.58	5.15	13.48	5.43
GEOTHERMAL	10.81	8.13	13.07	9.17	14.65	9.49	17.76	10.58	25.50	13.88	32.68	16.09	34.78	15.48	36.65	14.75
II. NONCONVENTIONAL	12.96	9.75	14.74	10.35	17.67	11.45	21.40	12.74	25.78	14.03	30.08	14.81	34.68	15.44	38.76	15.60
BAGASSE	5.35	4.03	5.72	4.02	6.11	3.96	6.55	3.90	6.93	3.77	7.26	3.57	7.44	3.31	7.62	3.07
AGRIWASTE	6.67	5.02	7.81	5.48	9.43	6.11	11.25	6.70	13.68	7.45	16.27	8.01	19.03	8.47	21.53	8.67
OTHERS	0.94	0.71	1.21	0.85	2.13	1.38	3.60	2.14	5.17	2.81	6.55	3.22	8.21	3.65	9.61	3.87
IMPORTED ENERGY	90.80	68.33	92.91	65.22	92.08	59.67	93.69	55.79	94.13	51.24	59.52	29.30	69.05	30.74	73.90	29.75
OIL	86.19	64.86	87.10	61.14	85.52	55.42	78.81	46.93	76.84	41.83	39.83	19.61	48.43	21.56	43.28	17.42
COAL	4.61	3.47	5.81	4.08	6.56	4.25	14.88	8.86	17.29	9.41	19.69	9.69	20.62	9.18	30.62	12.33
TOTAL ENERGY	132.89	100.00	142.46	100.00	154.32	100.00	167.94	100.00	183.70	100.00	203.15	100.00	224.65	100.00	248.43	100.00
GROWTH RATE		3.79		7.20		8.33		8.82		9.38		10.59		10.59		10.58
% Over the previous year shown																
ENERCON IMPACT	3.40		5.40		9.30		12.70		16.70		21.60		28.30		36.80	
TOTAL ENERGY W/ENERCON	129.49		137.06		145.02		155.24		167.00		181.55		196.35		211.63	
POWER USE, % OF TOTAL	46.62	35.08	54.45	38.22	60.17	38.99	66.44	39.56	75.80	41.26	85.71	42.19	98.25	43.73	111.55	44.90
OIL SHARE IN POWER USE, %	23.74	50.92	28.02	51.46	31.23	51.90	24.79	37.31	23.20	30.61	10.39	12.12	7.69	7.83	4.48	4.02
Self-Sufficiency (%)		32		35		40		44		49		71		69		70

Source : DOE Philippines Energy Plan 1993-2000

Table 3.23 Oil Demand Forcast
(In Thousand Barrels, MB)

Expected Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
Premium Gasoline	10,401	10,911	11,704	12,521	13,330	14,099	14,946	15,823
Regular Gasoline	3,449	3,612	3,714	3,817	3,883	3,768	3,731	3,708
Diesel	41,274	33,832	36,614	38,740	40,893	43,393	46,707	50,067
LPG	6,197	6,284	6,996	7,765	8,553	9,331	10,225	11,201
Kerosene	4,217	4,942	5,691	6,460	7,167	7,739	8,407	9,126
Avturbo	4,744	5,253	5,834	6,435	7,009	7,554	8,151	8,777
Avgas	28	28	28	28	28	28	28	28
Fuel Oil	30,488	38,337	43,650	40,049	40,947	39,948	41,208	39,804
TOTAL	100,798	103,199	114,231	115,815	121,810	125,860	133,403	138,534

Aggressive Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
Premium Gasoline	10,401	10,911	11,704	12,521	13,330	14,099	14,946	15,823
Regular Gasoline	3,449	3,612	3,714	3,817	3,883	3,768	3,731	3,708
Diesel	41,274	33,832	36,614	38,740	40,893	43,393	46,707	50,007
LPG	6,197	6,284	6,996	7,765	8,553	9,331	10,225	11,201
Kerosene	4,217	4,942	5,691	6,460	7,167	7,739	8,407	9,126
Avturbo	4,744	5,253	5,834	6,435	7,009	7,554	8,151	8,777
Avgas	28	28	28	28	28	28	28	28
Fuel Oil	30,488	38,337	43,650	40,049	40,947	33,928	32,388	29,974
TOTAL	100,798	103,199	114,231	115,815	121,810	119,840	124,583	128,644

Ambitious Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
Premium Gasoline	10,401	10,911	11,704	12,521	13,330	14,099	14,946	15,823
Regular Gasoline	3,449	3,612	3,714	3,817	3,883	3,768	3,731	3,708
Diesel	41,274	33,832	36,614	38,740	40,893	43,393	46,707	49,777
LPG	6,197	6,284	6,996	7,765	8,553	9,331	10,225	11,201
Kerosene	4,217	4,942	5,691	6,460	7,167	7,739	8,407	9,126
Avturbo	4,744	5,253	5,834	6,435	7,009	7,554	8,151	8,777
Avgas	28	28	28	28	28	28	28	28
Fuel Oil	30,488	38,337	43,650	40,049	40,947	31,428	30,768	29,974
TOTAL	100,798	103,199	114,231	115,815	121,810	117,340	122,963	128,414

Source : Philippine Energy Plan (1993 - 2000)

Table 3.24 Coal Demand Forecast
(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

Expected Scenario

Name of Comsumers	1993	1994	1995	1996	1997	1998	1999	2000
Power Generation	5.48	6.21	6.81	17.76	19.80	26.32	36.17	49.94
Local	2.54	2.76	2.78	5.95	5.71	5.57	5.57	5.57
Imported	2.94	3.45	4.03	11.81	14.09	20.75	30.60	44.37
Cement Industry	4.10	4.67	4.97	6.08	6.32	6.39	6.47	6.55
Local	2.46	1.87	1.99	2.43	2.53	2.56	2.59	2.62
Imported	1.64	2.80	2.98	3.65	3.79	3.83	3.88	3.93
Mining	1.49	2.88	2.87	2.89	2.93	2.95	2.99	3.02
Coco-Vegetables	0.17	0.30	0.30	0.30	0.31	0.31	0.31	0.31
Others	0.21	0.29	0.32	0.37	0.41	0.41	0.41	0.41
Local	0.17	0.26	0.29	0.33	0.37	0.37	0.37	0.37
Imported	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Total	**11.45**	**14.35**	**15.27**	**27.40**	**29.77**	**36.38**	**46.35**	**60.23**
Local	5.17	4.89	5.06	8.71	8.61	8.50	8.53	8.56
Imported	4.62	6.28	7.04	15.50	17.92	24.62	34.52	48.34

Aggressive Scenario

Name of Comsumers	1993	1994	1995	1996	1997	1998	1999	2000
Power Generation	5.48	6.21	6.81	17.76	20.50	22.85	27.35	41.26
Local	2.54	2.76	2.78	5.95	6.41	6.39	8.75	9.41
Imported	2.94	3.45	4.03	11.81	14.09	16.46	18.60	31.85
Cement Industry	4.10	4.66	4.98	6.08	6.32	6.40	6.48	6.56
Local	2.46	2.33	2.49	3.04	3.16	3.20	3.24	3.28
Imported	1.64	2.33	2.49	3.04	3.16	3.20	3.24	3.28
Mining	1.49	2.88	2.87	2.89	2.93	2.95	2.99	3.02
Coco-Vegetables	0.17	0.30	0.30	0.30	0.31	0.31	0.31	0.31
Others	0.21	0.29	0.32	0.37	0.41	0.41	0.41	0.41
Local	0.17	0.26	0.29	0.33	0.37	0.37	0.37	0.37
Imported	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Total	**11.45**	**14.34**	**15.28**	**27.40**	**30.47**	**32.92**	**37.54**	**51.56**
Local	5.17	5.35	5.56	9.32	9.94	9.96	12.36	13.06
Imported	4.62	5.81	6.55	14.89	17.29	19.70	21.88	35.17

Ambitious Scenario

Name of Comsumers	1993	1994	1995	1996	1997	1998	1999	2000
Power Generation	5.48	6.21	6.81	17.76	21.19	23.68	29.15	43.49
Local	2.54	2.76	2.78	5.95	7.10	7.22	11.81	16.18
Imported	2.94	3.45	4.03	11.81	14.09	16.46	17.34	27.31
Cement Industry	4.10	4.66	4.98	6.08	6.32	6.40	6.48	6.56
Local	2.46	2.33	2.49	3.04	3.16	3.20	3.24	3.28
Imported	1.64	2.33	2.49	3.04	3.16	3.20	3.24	3.28
Mining	1.49	2.88	2.87	2.89	2.93	2.95	2.99	3.02
Coco-Vegetables	0.17	0.30	0.30	0.30	0.31	0.31	0.31	0.31
Others	0.21	0.29	0.32	0.37	0.41	0.41	0.41	0.41
Local	0.17	0.26	0.29	0.33	0.37	0.37	0.37	0.37
Imported	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Total	**11.45**	**14.34**	**15.28**	**27.40**	**31.16**	**33.75**	**39.34**	**53.79**
Local	5.17	5.35	5.56	9.32	10.63	10.79	15.42	19.83
Imported	4.62	5.81	6.55	14.89	17.29	19.70	20.62	30.63

Source : DOE Philippine Energy Plan 1993-2000

Table 3.25 Coal Production Forecast

Expected Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
FEILD								
Numbers of Field Contract (Cum.)	50	52	54	56	58	60	62	64
Proven Reserves (Cum.MMMT)	372	373	378	379	384	385	389	391
Local Production (' 000 MT)1	1,535	1,586	1,700	2,320	2,879	2,957	3,894	3,989
Equivalent Fuel Oil Displacement of Local Production (MMBFOE)	6.83	8.06	8.22	11.89	11.85	11.75	11.83	11.93
POWER								
Installed Generating Capacity (Cum. MW)	405	405	705	1,705	2,005	2,505	3,805	5,605
Equivalent Fuel Oil Displacement (MMBFOE)	3.75	4.41	5.15	15.09	18.00	26.51	39.09	56.68
CONSUMPTION, POWER AND NON-POWER (MMBFOE)	11.44	14.34	15.28	27.40	29.77	36.38	46.36	60.24

Aggressive Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
FEILD								
Numbers of Field Contract (Cum.)	50	52	54	56	58	60	62	64
Proven Reserves (Cum.MMMT)	372	373	378	379	384	385	389	391
Local Production (' 000 MT)1	1,535	1,608	1,737	3,693	3,904	3,930	5,215	5,432
Equivalent Fuel Oil Displacement of Local Production (MMBFOE)	6.83	8.52	8.72	12.52	13.19	13.23	15.65	16.39
POWER								
Installed Generating Capacity (Cum. MW)	405	405	705	1,705	2,005	2,505	2,405	4,145
Equivalent Fuel Oil Displacement (MMBFOE)	3.75	4.41	5.15	15.09	18.00	21.03	23.76	40.69
CONSUMPTION, POWER AND NON-POWER (MMBFOE)	11.44	14.34	15.27	27.40	30.47	32.92	37.53	51.55

Ambitious Scenario

	1993	1994	1995	1996	1997	1998	1999	2000
FEILD								
Numbers of Field Contract (Cum.)	50	52	54	56	58	60	62	64
Proven Reserves (Cum.MMMT)	372	373	378	379	384	385	389	391
Local Production (' 000 MT)1	1,535	1,608	1,737	3,720	4,126	4,173	6,684	8,846
Equivalent Fuel Oil Displacement of Local Production (MMBFOE)	6.83	8.54	8.72	12.52	13.89	14.05	18.71	23.16
POWER								
Installed Generating Capacity (Cum. MW)	405	405	705	1,705	1,985	1,985	2,385	4,025
Equivalent Fuel Oil Displacement (MMBFOE)	3.75	4.41	5.15	15.09	18.00	21.03	22.16	34.90
CONSUMPTION, POWER AND NON-POWER (MMBFOE)	11.44	14.35	15.28	27.40	31.18	33.74	39.33	53.78

Source : DOE Philippine Energy Plan 1993-2000

Table 3.26 Capital Investment Requirements

NATIONAL ENERGY PROGRAM 1993 - 2000

(In Million Pesos, at Constant 1993 Prices)

	EXPECTED SCENARIO				AGGERESSIVE SCENARIO				AMBITIOUS SCENARIO			
	TOTAL 1993 - 2000		GRAND TOTAL	% SHARE	TOTAL 1993 - 2000		GRAND TOTAL	% SHARE	TOTAL 1993 - 2000		GRAND TOTAL	% SHARE
	Local	Forex			Local	Forex			Local	Forex		
ENERGY SOURCE												
DEVELOPMENT	40,850	30,545	71,395	12.6	91,609	62,521	154,130	23.0	101,915	68,280	170,195	20.0
OIL & GAS	17,663	11,324	28,987	5.1	62,559	41,237	103,796	15.5	67,826	44,749	112,575	13.2
Government	744	0	744	0.1	744	0	744	0.1	744	0	744	0.1
Private	16,919	11,324	28,243	5.0	61,815	41,237	103,052	15.4	67,082	44,749	111,831	13.2
COAL	14,603	7,017	21,620	3.8	18,938	6,999	25,937	3.9	22,356	6,999	29,355	3.5
Government	9,759	6,999	16,758	3.0	9,759	6,999	16,758	2.5	9,997	6,999	16,996	2.0
Private	4,844	18	4,862	0.9	9,179	0	9,179	1.4	12,359	0	12,359	1.5
GEOTHERMAL	8,584	12,204	20,788	3.7	10,112	14,285	24,397	3.6	11,733	16,532	28,265	3.3
Government	7,890	11,510	19,400	3.4	7,890	11,509	19,399	2.9	7,890	11,509	19,399	2.3
Private	694	694	1,388	0.2	2,222	2,776	4,998	0.7	3,843	5,023	8,866	1.0
POWER	98,433	323,061	421,494	74.4	96,403	309,517	405,920	60.6	101,910	327,246	429,156	50.5
Government	86,738	179,694	266,432	47.0	84,102	158,306	242,408	36.2	83,678	154,864	238,542	28.1
Private	11,695	143,367	155,062	27.4	12,301	151,211	163,512	24.4	18,232	172,382	190,614	22.4
ELECTRIFICATION	15,503	17,463	32,966	5.8	30,563	17,463	48,026	7.2	51,181	17,753	68,934	8.1
Government	3,394	8,525	11,919	2.1	17,101	8,525	25,626	3.8	35,916	8,784	44,700	5.3
Private	12,109	8,938	21,047	3.7	13,462	8,938	22,400	3.3	15,265	8,969	24,234	2.9
DOWN STREAM	10,496	18,710	29,206	5.2	10,496	18,710	29,206	4.4	10,496	18,660	29,156	3.4
Government	1,173	1,499	2,672	0.5	1,173	1,499	2,672	0.4	1,173	1,449	2,622	0.3
Private	9,323	17,211	26,534	4.7	9,323	17,211	26,534	4.0	9,323	17,211	26,534	3.1
NON-CONVENTIONAL	1,844	2,299	4,143	0.7	4,360	9,200	13,560	2.0	31,682	72,805	104,487	12.3
Government	375	183	558	0.1	477	183	660	0.1	537	183	720	0.1
Private	1,469	2,116	3,585	0.6	3,883	9,017	12,900	1.9	31,145	72,622	103,767	12.2
ENERGY EFFICIENCY	6,736	826	7,562	1.3	8,580	10,728	19,308	2.9	8,580	39,318	47,898	5.6
Government	2,000	621	2,621	0.5	2,000	3,324	5,324	0.8	2,000	3,324	5,324	0.6
Private	4,736	205	4,941	0.9	6,580	7,404	13,984	2.1	6,580	35,994	42,574	5.0
GRAND TOTAL	173,862	392,904	566,766	100.0	242,011	428,139	670,150	100.0	305,764	544,062	849,826	100.0
Government	112,073	209,031	321,104	56.7	123,246	190,345	313,591	46.8	141,935	187,112	329,047	38.7
Private	61,789	183,873	245,662	43.3	118,765	237,794	356,559	53.2	163,829	356,950	520,779	61.3

Source : DOE Philippine Energy Plan 1993 - 2000

Table 3.27 Potential Carbon Dioxide Emission from Sectral Energy Activities

EXPECTED SCENARIO

Sector	1993		1995		1998		2000	
	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent
Energy and Transformation	59,178	58.80	67,547	58.74	78,496	60.40	95,401	62.90
Residential	2,332	2.32	2,905	2.53	3,917	3.01	4,681	3.09
Commercial	3,898	3.87	4,358	3.79	4,482	3.45	4,882	3.22
Agriculture	1,258	1.25	1,179	1.03	1,391	1.07	1,380	0.91
Transport	18,696	18.58	19,549	17.00	22,717	17.48	25,676	16.93
Industry	15,281	15.18	19,446	16.91	18,950	14.58	19,640	12.95
Total	100,643	100	114,984	100	129,953	100	151,660	100

AGGRESSIVE SCENARIO

Sector	1993		1995		1998		2000	
	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent
Energy and Transformation	59,178	58.80	67,547	58.75	71,248	59.43	81,842	61.36
Residential	2,332	2.32	2,905	2.53	3,917	3.27	4,681	3.51
Commercial	3,898	3.87	4,358	3.79	4,127	3.44	4,288	3.21
Agriculture	1,258	1.25	1,179	1.03	1,368	1.14	1,251	0.94
Transport	18,696	18.58	19,549	17.00	22,411	18.69	25,146	18.85
Industry	15,281	15.18	19,445	16.91	16,816	14.03	16,169	12.12
Total	100,643	100	114,983	100	119,887	100	133,377	100

AMBITIOUS SCENARIO

Sector	1993		1995		1998		2000	
	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent	CO2 Emission (KT)	Percent
Energy and Transformation	59,178	58.80	67,547	58.74	69,509	59.42	82,879	61.66
Residential	2,332	2.32	2,905	2.53	3,917	3.35	4,681	3.48
Commercial	3,898	3.87	4,358	3.79	3,979	3.40	4,281	3.18
Agriculture	1,258	1.25	1,179	1.03	1,359	1.16	1,342	1.00
Transport	18,696	18.58	19,549	17.00	22,284	19.05	25,086	18.66
Industry	15,281	15.18	19,446	16.91	15,932	13.62	16,147	12.01
Total	100,643	100	114,984	100	116,980	100	134,416	100

Source : DOE Philippine Energy Plan 1993 - 2000

Table 3.28 System Load Forecast (Philippines)

YEAR	ENERGY SALES IN GWH				PEAK DEMAND IN MW			
	LUZON	VIS	MIN	PHIL	LUZON	VIS	MIN	PHIL
Actual								
1986	13,535	1,355	2,960	17,850	2,435	309	489	3,233
1987	14,980	1,305	3,146	19,431	2,592	334	533	3,459
1988	16,319	1,768	3,486	21,573	2,780	358	573	3,711
1989	17,142	1,881	3,708	22,731	2,938	378	618	3,934
1990	17,638	1,924	3,761	23,323	3,023	381	626	4,030
1991	18,123	2,138	4,010	24,271	3,045	427	730	4,202
% ROWTH RATE (1987 -1991)	**6.01**	**9.55**	**6.26**	**6.34**	**4.57**	**6.68**	**8.34**	**6.01**
Forecast								
1992	18,880	2,307	4,237	25,424	3,250	475	727	4,452
1993	19,874	2,639	4,892	27,405	3,463	511	837	4,811
1994	21,592	3,125	5,381	30,098	3,762	600	920	5,282
1995	23,678	3,501	6,027	33,206	4,126	663	1,031	5,820
% ROWTH RATE (1992 -1995)	**6.91**	**13.12**	**10.72**	**8.15**	**7.89**	**11.63**	**9.01**	**8.48**
1996	26,051	3,956	6,841	36,848	4,539	752	1,183	6,474
1997	28,913	4,510	7,832	41,255	5,038	859	1,354	7,251
1998	32,420	5,142	9,046	46,608	5,732	978	1,564	8,274
1999	37,400	5,913	10,472	53,785	6,613	1,124	1,810	9,547
2000	42,022	6,794	12,123	60,939	7,430	1,291	2,096	10,817
% ROWTH RATE (1992 -1995)	**12.61**	**14.18**	**15.00**	**12.91**	**12.48**	**14.26**	**15.25**	**13.20**
2001	46,561	7,872	14,184	68,617	8,232	1,495	2,452	12,179
2002	51,031	8,821	16,451	76,303	9,023	1,675	2,844	13,542
2003	55,623	9,772	18,919	84,314	9,977	1,856	3,271	15,104
2004	60,295	10,526	21,756	92,577	10,816	2,000	3,761	16,577
2005	65,360	11,270	25,020	101,650	11,724	2,143	4,326	18,193
% ROWTH RATE								
(1992 -1995)	9.43	14.29	13.47	10.63	9.92	12.79	13.62	10.88
(1999 -2005)	10.54	11.86	15.64	11.78	10.76	11.86	15.64	11.91
(1992 -2005)	9.60	12.61	13.97	10.77	10.11	12.21	13.55	11.04

Source : NPC Power Development Program 1993-2005

Table 3.29 Philippine Resource Power Potential

LOCATION	HYDRO POWER						GEOHERMAL										COAL			
	STATUS	NO OF	CAPACITY		ENERGY		STATUS	NO OF	LOW POTENTIAL				HIGH POTENTIAL				LOCATION	MINABLE RESERVE	HEATING VALUE	PLANT CAPACITY
									CAPACITY		ENERGY		CAPACITY		ENERGY					
		UNIT	MW	%	GWh	%		UNIT	MW	%	GWh	%	MW	%	GWh	%		(M.TON)	(BTU/LB)	(MW)
LUZON	EXISTING	12	1,226	12	3,675	13	EXISTING	2	660	60	4,336	60	660	45	4,336	45	SEMIRARA	93.00	7,000	673
	PRE-FEASIBILITY	120	5,083	50	13,644	46	PRE-FEASIBILITY	3	170	16	1,117	16	240	16	1,577	16	CAGAYAN VALLEY	88.04	4,600	418
	FEASISBILITY	35	2,510	25	7,785	26	FEASISBILITY	1	60	5	394	5	170	11	1,117	11	SOUTH MINDANAO	2.40	8,500	21
	DEFINITE DESIGN	4	1,281	13	4,396	15	DEFINITE DESIGN	5	210	19	1,380	19	410	28	2,694	28	POLIPIA BATAN	7.70	12,000	95
																	QUESON	0.08	12,000	1
																	MASBATE	0.18	9,800	2
	TOTAL	171	10,100	100	29,500	100	TOTAL	11	1,100	100	7,227	100	1,480	100	9,724	100	TOTAL	191.40	-	1,210
VIASAYAS	EXISTING	2	2	0	15	1	EXISTING	2	227	24	1,489	24	227	15	1,491	15	NEGROS	1.05	8,100	9
	PRE-FEASIBILITY	42	339	53	1,507	64	PRE-FEASIBILITY	2	418	43	2,746	43	578	37	3,797	37	NORTH CEBU	1.03	9,300	10
	FEASISBILITY	6	279	44	792	33	FEASISBILITY	0	0	0	0	0	0	0	0	0	CENTRAL CEBU	1.42	9,800	14
	DEFINITE DESIGN	1	20	3	58	2	DEFINITE DESIGN	10	320	33	2,102	33	740	48	4,862	48	SOUTH SEBU	3.32	11,500	39
																	BOHOL	0.53	8,700	5
																	SAMAR LEYETE	6.35	7,300	48
	TOTAL	51	640	100	2,372	100	TOTAL	14	965	100	6,337	100	1,545	100	10,150	100	TOTAL	13.70	-	125
MINDANAO	EXISTING	9	986	27	4,552	31	EXISTING	0	0	0	0	0	0	0	0	0	DABAO	0.12	7,100	1
	PRE-FEASIBILITY	45	1,327	37	5,183	35	PRE-FEASIBILITY	0	0	0	0	0	0	0	0	0	SURIGAO	34.28	7,100	251
	FEASISBILITY	17	1,314	36	5,154	35	FEASISBILITY	1	120	86	788	86	240	63	1,577	63	ZAMBOANGA	11.15	11,100	233
	DEFINITE DESIGN	0	0	0	0	0	DEFINITE DESIGN	5	20	14	131	14	140	37	920	37				
	TOTAL	71	3,627	100	14,889	100	TOTAL	6	140	100	919	100	380	100	2,497	100	TOTAL	45.55	-	485
PHILIPPINES	EXISTING	23	2,214	15	8,242	18	EXISTING	4	887	40	5,825	40	887	26	5,827	26				
	PRE-FEASIBILITY	207	6,749	47	20,334	43	PRE-FEASIBILITY	5	588	27	3,863	27	818	24	5,374	24				
	FEASISBILITY	58	4,103	29	13,731	29	FEASISBILITY	2	180	8	1,182	8	410	12	2,694	12				
	DEFINITE DESIGN	5	1,301	9	4,454	10	DEFINITE DESIGN	20	550	25	3,613	25	1,290	38	8,476	38				
	TOTAL	293	14,367	100	46,761	100	TOTAL	31	2,205	100	14,483	100	3,405	100	22,371	100	TOTAL	250.65	-	1,820

DATA SURCE : NPC POWER DEVELPMENT PROGRAM (1993 - 2005)

Table 3.30 Summary of Capacity Additions (MW)

1993 POWER DEVELOPMENT PROGRAM

YEAR	PLANT TYPE							TOTAL
	HYDRO	GEO	COAL	OTHER BASELOAD 1/	DIESEL	GT	CC	
1993	-	190	-	-	293	130	645	1,258
1994	40	163	-	-	555	-	90	848
1995	-	60	300	-	100	-	-	460
1996	-	190	1,000	-	11	-	-	1,201
1997	-	675	300	-	6	-	-	981
1998	-	395	500	-	11	200	-	1,106
1999	380	-	700	600	6	100	-	1,786
2000	-	-	-	1,800	6	-	300	2,106
2001	224	-	-	900	-	200	600	1,924
2002	45	-	-	1,200	-	100	600	1,945
2003	-	-	-	2,100	-	100	-	2,200
2004	563	-	-	1,500	-	-	300	2,363
2005	620	-	-	1,500	-	100	300	2,520
TOTAL	1,872	1,673	2,800	9,600	988	930	2,835	20,698

1/ STILL TO BE IDENTIFIED

Source :NPC POWER DEVELOPMENT PROGRAM 1993-2005

Table 3.31 Power Development Program

LUZON GRID

YEAR	MO.	POWER PLANT	TYPE	CAP (MW)
1993	JAN.	SUCAT - LBGT	OIL	30
	MAR.	FAST TRACK HOPEWELL	OIL	100
	APR.	FAST TRACK ENRON DSL-1	OIL	25
	APR.	BATAAN I SC-1	OIL	70
	MAY	BACMAN I - 1	GEO	55
	MAY	FAST TRACK ENRON DSL-2	OIL	25
	MAY	BATAAN I SC-2	OIL	70
	MAY	BATAAN I SC-3	OIL	70
	JUN.	FAST TRACK ENRON DSL-3	OIL	55
	JUL.	POLAR PB	OIL	90
	AUG.	BACMAN I - 2	GEO	55
	AUG.	BACMAN II - 1	GEO	20
	SEP.	BATAAN II SC-1	OIL	70
	OCT.	BATAAN II SC-2	OIL	70
	NOV.	BATAAN II SC-3	OIL	70
1994	JAN.	BACMAN II - 2	GEO	20
	JAN.	SUBIC (ENRON) - 2	OIL	105
	MAR.	ORMAT MAKBAN	GEO	16
	MAY	BATAAN I CC-4	OIL	90
	JUN.	ORMAT BACMAN	GEO	16
	JUL.	FPPC	OIL	200
	OCT.	MAIBARARA BINARY	GEO	11
	OCT.	BATAAN II CC-4	OIL	90
	OCT.	MAKBAN D&E	GEO	80
1995	JAN.	DIESEL PLANT	OIL	100
	NOV.	CALACA II	COAL	300
1996	FEB.	HOPEWELL I - BOT	COAL	350
	MAY	HOPEWELL II - BOT	COAL	350
	DEC.	MASINLOC COAL I	COAL	300
1997	JAN.	LEYTE-LUZON INT.		
	JAN.	DEL GALLEGO	GEO	120
	DEC.	MASINLOC COAL II	COAL	300
1998	JAN.	SUAL COAL I	COAL	500
	JAN.	GAS TURBINE	OIL	200
1999	JAN.	SUAL COAL II	COAL	500
	JAN.	BASELOAD PLANT	- 1_/	600
	JAN.	GAS TURBINE	OIL	100
	JAN.	KALAYAAN 3 & 4	HYD	300
	JAN.	NALATANG B	HYD	45
2000	JAN.	BASELOAD PLANT	- 1_/	1,800
	JAN.	COMBINED-CYCLE	OIL	300
2001	JAN.	BASELOAD PLANT	- 1_/	900
	JAN.	COMBINED-CYCLE	OIL	600
	JAN.	GAS TURBINE	OIL	200
2002	JAN.	BASELOAD PLANT	- 1_/	1,200
	JAN.	COMBINED-CYCLE	OIL	600
	JAN.	GAS TURBINE	OIL	100
	JAN.	BAKUN A/B	HYD	45
2003	JAN.	BASELOAD PLANT	- 1_/	2,100
	JAN.	GAS TURBINE	OIL	100
2004	JAN.	BASELOAD PLANT	- 1_/	1,500
	JAN.	COMBINED-CYCLE	OIL	300
	JAN.	AMBURAYAN	HYD	93
	JAN.	PASIL B	HYD	20
2005	JAN.	BASELOAD PLANT	- 1_/	1,500
	JAN.	COMBINED-CYCLE	OIL	300
	JAN.	GAS TURBINE	OIL	100
	JAN.	SAN ROQUE	HYD	390
	JAN.	KANAN B1	HYD	112
	JAN.	PASIL C	HYD	22
		TOTAL		17,850

1_/ SITES AND TYPE STILL TO BE INDENTIFIED
SOURCE : NPC POWER DEVELOPMENT PROGRAMS

VISAYAS GRID

YEAR	MO.	POWER PLANT	TYPE	CAP (MW)
1993	OCT.	CEBU-NEGROS INT		
	OCT.	PALINPINON II UNIT 1	GEO	20
	OCT.	PALINPINON II UNIT 2	GEO	20
1994	FEB.	PALINPINON II UNIT 3	GEO	20
	APR.	PALINPINON II UNIT 4	GEO	20
1995				
1996	JAN.	LEYETE-CEBU INT		
	JAN.	TONGONAN GEO	OIL	110
	JAN.	BOHOL DIESEL	OIL	11
	JAN.	MAMBUCAL GEO	GEO	20
1997	JAN.	TONGONAN GEO	GEO	495
	JAN.	MAMBUCAL GEO	GEO	80
	JAN.	BOHOL DIESEL	OIL	9
1998	JAN.	TONGONAN GEO	GEO	275
	JAN.	BOHOL DIESEL	OIL	11
1999	JAN.	BOHOL DIESEL	OIL	9
	JAN.	TIMBABAN HE	HYD	35
2000	JAN.	BOHOL DIESEL	OIL	9
2001	JAN.	CEBU-BOHOL INT		
2002	-	-	-	-
2003	-	-	-	-
2004	-	-	-	-
2005	JAN.	VILLA SIGA	HYD	29
		TOTAL		1,144

MINDANAO GRID

YEAR	MO.	POWER PLANT	TYPE	CAP (MW)
1993	APR.	FAST TRACK	OIL	11
	MAY	FAST TRACK	OIL	22
	MAY	OREBETA COMBI-CYCLE	OIL	135
	JUN.	FAST TARCK	OIL	25
	SEP.	FAST TARCK	OIL	40
1994	JAN.	AGUS-1 HEP	HYD	40
	MAR.	POWER BARGE DIESEL	OIL	200
	JUL.	NCS DIESEL	OIL	50
1995	AUG	MT. APO GEO	GEO	60
1996	JAN	MT. APO GEO	GEO	60
1997	JAN.	LEYETE-MINDANAO INT		
1998	JAN.	MT. APO GEO	GEO	120
1999	JAN.	MINDANAO COAL	CAOL	200
2000	-	-	-	-
2001	JAN.	AGUS III HEP	HYD	224
2002	-	-	-	-
2003	-	-	-	-
2004	JAN.	BULANG-BATANG	HYD	150
	JAN.	PULANGI V	HYD	300
2005	JAN.	SMALL HYDRO 1	HYD	27
	JAN.	SMALL HYDRO 2	HYD	40
		TOTAL		1,704

Table 3.32 Generating Capacity Build-Up (MW)

GRID	1993 1/	1994 2/	1995 3/	1996 4/	1997	1998	1999	2000	2001	2002	2003	2004	2005
LUZON GRID													
EXISTING	4,591	5,576	6,094	6,294	6,944	7,064	7,674	9,319	11,119	12,819	14,689	16,689	18,402
NEW PROJECT	985	518	400	1,000	420	700	1,745	2,100	1,700	1,945	2,200	1,913	2,424
RETIREMENT 5/			-200	-350	-300	-90	-100	-300		-75	-200	-200	
NET CAPACITY	5,576	6,094	6,294	6,944	7,064	7,674	9,319	11,119	12,819	14,689	16,689	18,402	20,826
VISAYAS GRIDS													
EXISTING	704.2	796.6	899.5	931.1	1,006.1	1,552.1	1,814.1	1,784.1	1,751.1	1,732.1	1,700.1	1,700.1	1,700.1
NEW PROJECT	46.0	40.0		141.0	561.0	286.0	41.0	6.0					29.0
RETIREMENT				-66.0	-15.0	-24.0	-71.0	-39.0	-19.0	-32.0			-3.0
NET CAPACITY	750.2	836.6	899.5	1,006.1	1,552.1	1,814.1	1,784.1	1,751.1	1,732.1	1,700.1	1,700.1	1,700.1	1,726.1
MINDANAO GRID													
EXISTING	1,397.9	1,584.5	1,761.6	1,784.5	1,844.5	1,805.9	1,730.0	1,710.7	1,691.4	1,915.4	1,883.4	1,883.4	2,333.4
NEW PROJECT	233.0	240.0	60.0	60.0		120.0			224.0			450.0	67.0
RETIREMENT			-5.5		-38.6	-195.9	-19.3	-19.3		-32.0			
NET CAPACITY	1,630.9	1,824.5	1,816.1	1,844.5	1,805.9	1,730.0	1,710.7	1,691.4	1,915.4	1,883.4	1,883.4	2,333.4	2,400.4
PHILIPPINES													
EXISTING	6,693	7,957	8,755	9,010	9,795	10,422	11,218	12,814	14,562	16,467	18,273	20,273	22,436
NEW PROJECT	1,264	798	460	1,201	981	1,106	1,786	2,106	1,924	1,945	2,200	2,363	2,520
RETIREMENT 5/	0	0	-206	-416	-354	-310	-190	-358	-19	-139	-200	-200	-3
NET CAPACITY	7,957	8,755	9,010	9,795	10,422	11,218	12,814	14,562	16,467	18,273	20,273	22,436	24,953

NOTES:
1/ PBGT 201 (31.6 MW) WILL BE MOVED FROM VISAYAS TO MINDANAO
2/ PBDSL 101 (32 MW) AND SMPB 106 (14.4 MW) WILL BE MOVED FROM MINDANAO TO VISAYAS
3/ PBDSL 102 (32 MW) AND PBGT 206 (30.9 MW) WILL BE MOVED FROM MINDANAO TO VISAYAS
4/ PBGT 205 (31.6 MW) WILL BE MOVED FROM MINDANAO TO VISAYAS
5/ LEASE AGREEMENT EXPIRATION OF POLAR DIESEL (90 MW) AND ORBETA (135 MW) - MAY 1998.

Source : NPC Power Development Program 1993-2005

Table 3.33 Retirement Schedules

POWER PLANT	CAPACITY (MW)	COMMISSIONING	YEARS IN SERVICE	REHABILITATION	RETIREMENT
LUZON	1,775				
MANILA 1	100	SEP 1965	27	-	SEP 1995
MANILA 2	100	OCT 1965	27	-	OCT 1995
MALAYA 2	350	MAR 1979	13	OCT 1986	OCT 1996
MALAYA 1	300	SEP 1975	17	JAN 1987	JAN 1997
SUCAT 1	150	OCT 1968	24	JAN 1989	JAN 1999
SUCAT 4	300	SEP 1972	20	SEP 1990	SEP 2000
BATAAN 1	75	SEP 1972	20	-	SEP 2002
SUCAT 3	200	JUL 1971	21	JAN 1993	JAN 2003
SUCAT 2	200	JAN 1970	22	JAN 1994	JAN 2004
VISAYAS	205				
CEBU DSL. I	44	1977	16		1996
CEBU DSL. II					
o UNIT 1/2	39	1982	11		2000
o UNIT 3	19	1983	10		2001
PALIN. PILOT	3	1980-1982	11		2005
PANAY DSL. I					
o UNIT 1/2	15	1979	14		1997
o UNIT 3/4	15	1980	13		1998
o UNIT 5	7	1981	12		1999
PANAY DSL. II	11	1978	15		1996
BOHOL DSL.	20	1978	15		1996
POWER BARGE					
o 103	32	1985	8		2003
MINDANAO	237				
APLAYA I	6	1977	16		1995
APLAYA II					
o UNIT 1	19	1979	14		1997
o UNIT 2	19	1979	14		1997
o UNIT 3	19	1980	13		1998
o UNIT 4	19	1980	13		1998
o UNIT 5	19	1982	11		2000
o UNIT 6	19	1981	12		1999
GEN. SANTOS	21	1980	13		1998
POWER BARGE					
o 101	32	1981	12		1999
o 102	32	1981	12		1999
o 104	32	1985	8		2003

TOTAL:	2,217

Table 3.34 Philippines - Energy Generation Mix (GWH)

YEAR	HYDRO	GEO	OIL		COAL		OTHER	TOTAL
			BUNKER	DIST.	LOC	IMP	BASE-LOAD	
1992	4,270	5,693	10,899	2,713	1,154	829	0	25,558
1993	4,953	6,577	11,628	2,618	1,423	828	0	28,027
1994	5,066	8,078	15,368	1,445	1,682	961	0	32,600
1995	5,197	8,832	17,027	1,711	2,259	828	0	35,854
1996	5,197	10,658	13,626	1,246	3,333	5,577	0	39,637
1997	5,080	15,687	13,085	835	3,332	7,466	0	45,485
1998	5,080	18,604	11,152	665	3,252	12,652	0	51,405
1999	5,419	18,604	10,684	765	3,252	16,784	3,440	58,948
2000	5,419	18,211	8,460	815	3,252	16,798	13,975	66,930
2001	6,142	18,211	9,676	1,317	3,252	16,816	19,831	75,245
2002	6,305	18,211	10,068	1,705	3,252	16,817	27,279	83,637
2003	6,305	18,211	7,861	1,145	3,252	16,817	38,954	92,545
2004	8,406	18,211	6,982	938	3,252	16,817	46,931	101,537
2005	10,809	18,211	6,218	817	3,252	16,817	55,248	111,372

Source : NPC Power Development Program 1993-2005

Table 3.35 Fuel Requirements

YEAR	COAL (1000 MT 1./			OIL (MILLION BARREL)		
	LOCAL	IMPORTED	TOTAL	BUNKER	DISTRILLATE	TOTAL
1993	751	386	1,137	19.4	6.8	26.2
1994	816	448	1,264	24.8	3.2	28.0
1995	822	443	1,265	27.2	3.4	30.6
1996	1,761	2,153	3,914	20.8	2.5	23.3
1997	1,648	2,882	4,530	20.0	1.7	21.7
1998	1,648	4,884	6,532	17.0	1.4	18.4
1999	1,648	7,807	9,455	16.3	1.6	17.9
2000	1,648	11,880	13,528	12.9	1.7	14.6
2001	1,648	14,147	15,795	14.8	2.7	17.5
2002	1,648	17,023	18,671	15.4	3.5	18.9
2003	1,648	21,530	23,178	12.0	2.3	14.3
2004	1,648	24,609	26,257	10.7	1.9	12.6
2005	1,648	27,820	29,468	9.5	1.7	11.2

ASSUMPTIONS

1. PLANT HEAT RATE BTU/KWH	9,478	9,478		9,478	11,754	
2. HEAT CONTENT MMBTU/BBL MMBTU/MT	18.70	24.55		6.21	5.76	

1./ ASSUMES OTHER BASE-LOAD PLANTS TO COAL.

Source : NPC Power Development Program 1993-2005