No.

Japan International Cooperation Agency
Department of Energy, Republic of the Philippines
Provincial Government of Palawan, Republic of the Philippines

The Master Plan Study of Power Development In Palawan Province Republic of the Philippines

Final Report (Technical Background Report)

September 2004

Chubu Electric Power Co., Inc.

Nomura Research Institute, Ltd.

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Preface

In response to the request from the Government of Republic of the Philippines, the Government of Japan decided to conduct the Master Plan Study of Power Development in Palawan Province, and the study was implemented by the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines the study team headed by Mr. Yoshitaka SAITO of Chubu Electric Power Co., Inc. and organized by Chubu Electric Power Co., Inc. and Nomura Research Institute, Ltd. five times from February 2003 to September 2004.

The team held discussions with the officials concerned of the Government of Republic of the Philippines and the Provincial Government of Palawan, and conducted related field surveys. After returning to Japan, the study team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of the Philippines and the Provincial Government of Palawan for their close cooperation throughout the study.

September 2004

Tadashi IZAWA
Vice President
Japan International Cooperation Agency

September 2004

Tadashi IZAWA
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the report of the Master Plan Study of Power Development in Palawan Province. This study was implemented by Chubu Electric Power Co., Inc. and Nomura Research Institute, Ltd from February 2003 to September 2004 based on the contract with your Agency.

This report presents the comprehensive proposal, such as the Optimal Power Development Plan considering environmental aspects in the Province, Transmission Development Plan and System Operation Plan considering appropriate placement of power plants, Rural Electrification Plan focusing on its sustainability and measures from technical, organizational and institutional aspects in order to realize the above plans.

We trust that the realization of our proposal will much contribute to the enhancement of sustainability in rural electrification activities, the stable progress of electric power sector and will contribute the improvement of the public welfare as well in Palawan.

In view of urgency to increase efficiency of the power sector and promote rural electrification, we recommend that the Government of Republic of the Philippines and the Provincial Government of Palawan implement our proposal by applying results of technology transfer in the study as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Economy, Trade and Industry. We also wish to express our deep gratitude to the Department of Energy, the Provincial Government of Palawan, other authorities concerned of the Government of Republic of the Philippines for the close cooperation and assistance extended to us during our investigations and study.

Very truly yours,

Yoshitaka SAITO
Team Leader
The Master Plan Study of Power Development in Palawan Province

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Environmental Checklist & Database

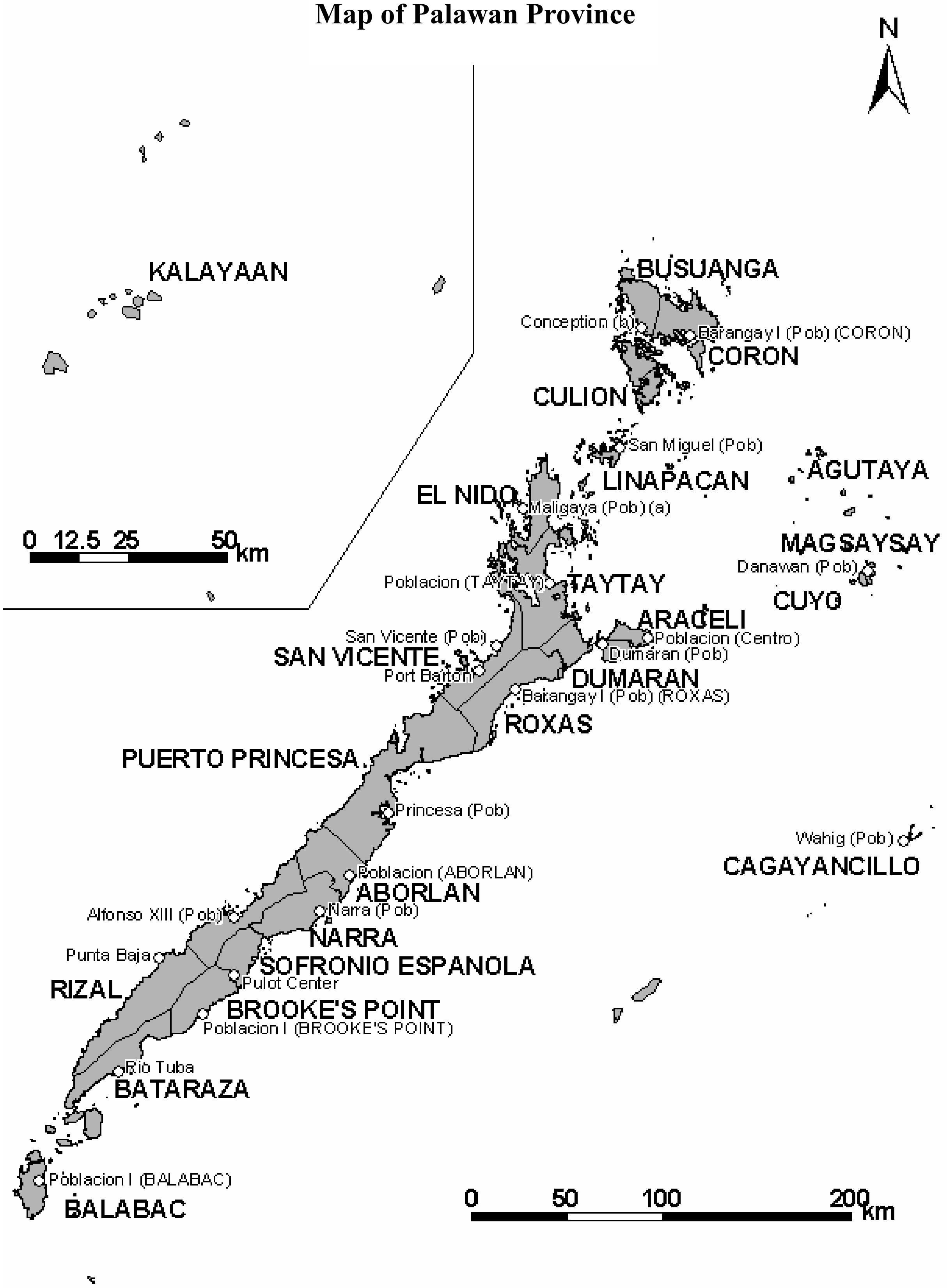
Abbreviation

ADB	Asian Development Bank
APL	Adaptable Program Loan
ARCs	Agrarian Reform Communities
BAPA	Barangay Power Association
BASPA	Barangay Solar Power Association
BCS	Battery Charging System or Battery Charging Station
BEP	Barangay Electrification Program
BISELCO	Busuanga Island Electric Cooperative
BOS	Balance of System
CAR	Cordillera Autonomous Region
CBRED	Capacity Building to Remove Barriers to Renewable Energy Development
CDM	Clean Development Mechanism
CENRO	Community Environment and Natural Resources Office
CNC	Certificate of Non-Coverage
CRREE	Center for Renewable Resources and Energy Efficiency
DBM	Department of Budget and Management
DBP	Development Bank of Philippines
DDP	Distribution Development Plan
DEM	Digital Elevation Model
DENR	Department of Environment and Natural Resources
DOE	Department of Energy
DPP	Diesel Power Plant
ECs	Electric Cooperatives
ECAN	Environmentally Critical Areas Network
ECAs	Environmentally Critical Areas
ECC	Environmental Clearance Certificate
ECPs	Environmentally Critical Projects
ECPP	Environmental Conservation and Protection Program
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
ENS	Energy Not Served
EPIRA	Electric Power Industry Reform Act
ER	Expanded Rural Electrification
ERC	Energy Regulatory Commission
FOR	Forced Outage Rate
GDP	Gross Domestic Products
GEF	Global Environment Facility
GHG	Green House Gas
GIS	Geographic Information System
GPDP	Gross Provincial Domestic Products

GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit** in German
IEE	Initial Environmental Examinations
IPP	Independent Power Producer
IRR	Implementing Rules and Regulations
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
KEPCO	Korea Electric Power Corporation
LGU	Local Government Unit
LOLP	Loss-of-Load Probability
LRMC	Long Run Marginal Cost
MEDP	Missionary Electrification Development Program
MEP	Missionary Electrification Plan
MGB	Mines and Geosciences Bureau
MOA	Memorandum of Agreement
NAMRIA	National Mapping and Resource Information Authority
NCDC	National Climate Data Center
NEA	National Electrification Administration
NEDA	National Economic Development Authority
NRE	New and Renewable Energy
NGO	Non-Governmental Organization
NIPAS	National Integrated Protected Areas System
NPC	National Power Corporation
NPC-SPUG	National Power Corporation - Small Power Utilities Group
NREL	National Renewable Energy Laboratory
O&M	Operation & Maintenance
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PALECO	Palawan Electric Cooperative
PCSD	Palawan Council for Sustainable Development
PDP	Power Development Program
PENRO	Provincial Environment and Natural Resources Office
PGP	Provincial Government of Palawan
PIADPO	Palawan Integrated Area Development Project Office
PNOC-EDC	Philippines National Oil Company - Energy Development Corporation
PCO	Pollution Control Officer
POPS	Private Owned Power Sources or Privately Owed Power System
PPA	Purchased Power Adjustment
PPDO	Provincial Planning and Development Office
PSALM	Power Sector Assets and Liabilities Management Corporation
PV	Photovoltaic
QTPs	Qualified Third Parties
RA	Republic Act

RE	Rural Electrification
REDC	Renewable Energy Development Center
REFC	Rural Electrification Financing Corporation
RESCO	Renewable Energy Service Company
SCADA	Supervisory Control And Data Acquisition System
SEP	Strategic Environmental Plan for Palawan
SHS	Solar Home System
SMA	Single Moving Average
SONA	Stated of the Nation address
SPCP-ANEC	State Polytechnic College of Palawan - Affiliated Non-conventional Energy Center
TRANSCO	Transmission Corporation
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UP	University of Philippines
USAID	United States Agency for International Development
WASP-IV	Wien Automatic System Planning

Map of Palawan Province



Chapter 1 Introduction

"The Master Plan Study of Power Development in Palawan Province" (hereinafter referred to as "the Study") will be carried out in accordance with the Implementing Arrangement for the Technical Cooperation (hereinafter referred to as "I/A") and Minutes of Meeting for the Preparatory Study (hereinafter referred to as "M/M") agreed among the Provincial Government of Palawan (hereinafter referred to as "PGP"), the Department of Energy (hereinafter referred to as "DOE") and Japan International Cooperation Agency (hereinafter referred to as "JICA").

1.1 Background

In the Philippines, the barangay electrification ratio in urban areas is almost 100%, while the actual barangay electrification ratio remained at 83.1 % as of December 2001. Based on the primary issues pointed out by the Philippines President Gloria Macapagal Arroyo, DOE recognized that promotion of rural electrification had to be enhanced in order to support poverty alleviation and economic growth, thus DOE plans to electrify all barangays by 2006 under the Philippine Energy Plan 2001-2011.

In Palawan Province, located in the western-most part of the Philippines and composed of a main island and 1,768 smaller islands, the electric power is being provided by the National Power Corporation - Small Power Utility Group (hereinafter referred to as "NPC-SPUG"), and two electric cooperatives, namely, the Palawan Electric Cooperative (hereinafter referred to as "PALECO") and the Busuanga Island Electric Cooperative (hereinafter referred to as "BISELCO"), both affiliated with the National Electrification Administration (hereinafter referred to as "NEA").

Rural Electrification is one of the most vital issues in the Palawan Province where the barangay electrification ratio in August of 2002 was 59.1%, well below the ratio for other provinces. PGP has already organized an energy committee composed of PGP, DOE, NPC, PALECO and BISELCO for Palawan. The committee formulated "The Palawan Provincial Energy Master Plan 2000-2010" and planned to increase the total installed capacity in Palawan from 37MW in 1999 to 101MW in 2010.

To keep consistency between this plan and the national power development plan, the master plan should be periodically revised in closer coordination with the Power Development Plan formulated by DOE.

Under the situation mentioned above, the Government of Japan decided to conduct the Study in response to the request from the Government of the Philippines. Herewith JICA dispatched a preliminary study team in March 2002 and a preparatory study team in June 2002. The PGP, DOE and JICA preparatory study team agreed upon I/A and M/M on July 1, 2002.

1.2 Objectives of the Study

The objectives of the Study are:

- To formulate a Master Plan up to 2015 with adequate environmental considerations, which is composed of a barangay electrification plan, an optimal power development plan, an implementation plan, database, institutional and organizational arrangements, as well as many other considerations

- To transfer the technologies and know-how through on-the-job-training in the study to the counterparts so that they are by themselves able to revise a Master Plan both autonomously and continuously

1.3 Work Plan

1.3.1 Flow of the Overall Study

The Study is composed of the following 4 stages.

In the 1st stage, namely the basic study stage, the Study team will clarify the conceptual framework of the Study with the counterparts and will collect and analyze the data, information and reports to prepare for the next study stage.

In the 2nd stage, namely the detailed study stage, the Study team will implement the site survey on renewable energy potential, the socio-economic conditions of the barangays, the existing power facilities and natural environmental impacts and collect and analyze data and information for formulating the Master Plan.

In the 3rd stage, namely the alternatives study stage, the Study team will estimate various parameters such as Long-Run-Marginal-Cost (hereinafter referred to as "LRMC"), willingness to pay, power demand and construction costs. The Study team will then prepare the alternatives for the barangay electrification, generation, power development and system operation plans.

In the final stage, namely the master plan study stage, the Study team will optimize the alternatives and prepare the database and manual. At the same time the Study team will also formulate the implementation plan up to 2015 and the checklist for environmental considerations, and prepare the institutional and organizational arrangements for the Palawan Province power sector.

The conceptual framework is shown in Figure 1.3.1.

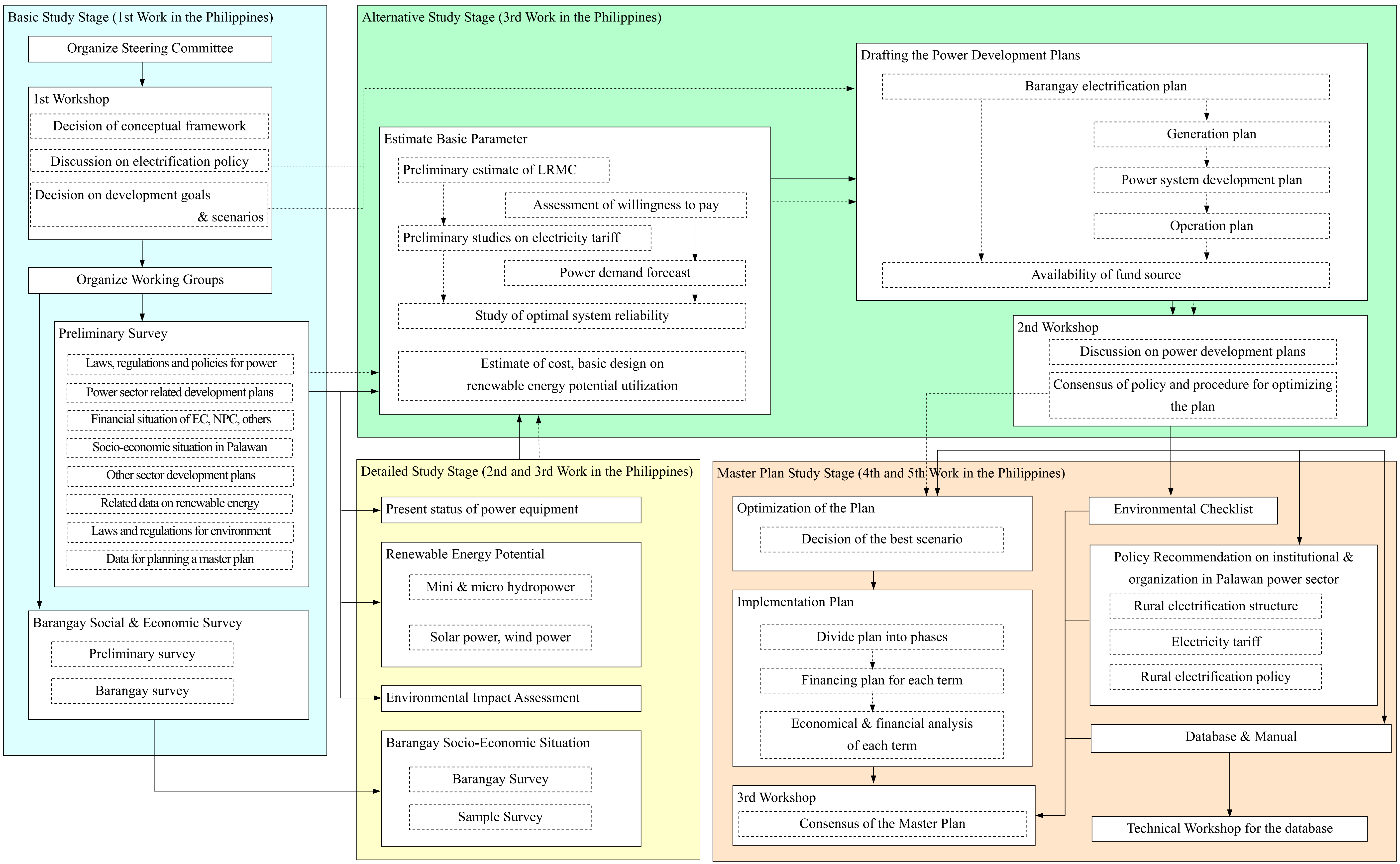
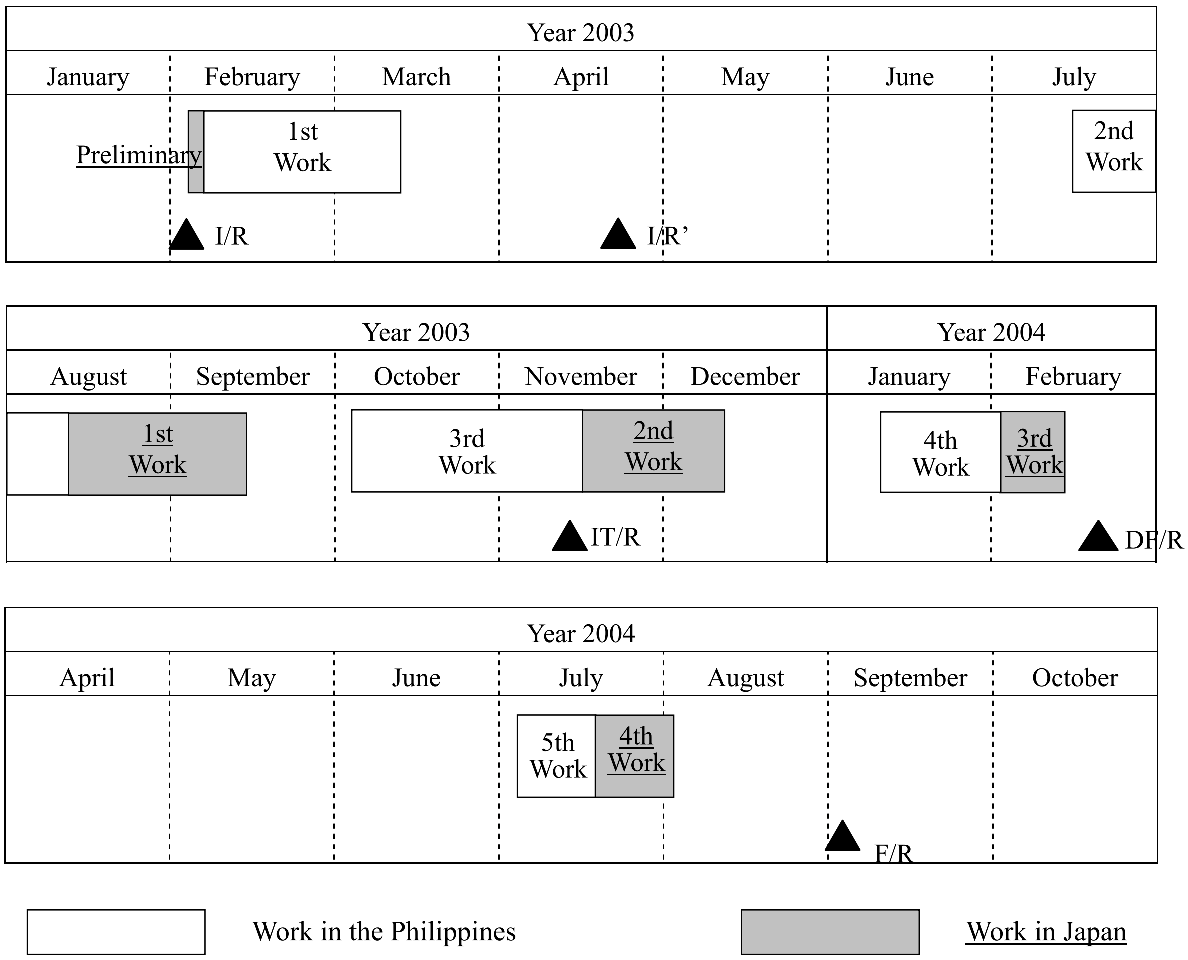


Figure 1.3.1 Conceptual Framework of the Master Plan Study of Power Development in Palawan Province

1.3.2 Study Schedule

The Study is composed of five works in the Philippines. Figure 1.3.2 shows the overall schedule of the Study.



I/R: Inception Report
I/R': Revised Inception Report
IT/R: Interim Report
DF/R: Draft Final Report
F/R: Final Report

Figure 1.3.2 Overall Schedule of the Study

1.4 Steering Committee, Working Groups and the Study Teams

(1) Steering Committee

As of March 6, 2003

Member	Organization
Chairman:	
Hon. Joel T. Reyes	Governor, PGP
Co-Chairman:	
Atty. Cyril C. Del Callar	Undersecretary, DOE
Member:	
Hon. Antonio C. Alvarez	Chairman, SP committee on Energy
Nelson P. Devanadera	PPDC, PGP
Atty. Romeo Seratubias	Legal Officer, PGP
Ponciano D. Payuyo	General Manager, PALECO
Mario Jefferey D. Olleras	Manager, NPC-SPUG
Nieves Osorio	Undersecretary, DOF
Silvano C. Zanoria	Sr. Vice-President, NPC
Ruben S. Reinoso	Asst. Director-General, NEDA
Antonio Corpuz	Sr. Vice-President, PSALM
Julinette Bayking	Director, NEA
Edgar F. Samonte	Division Chief, ERC

(2) Working Groups

As of November 3, 2003

Member	Activity
Socio-Economic Working Group	
Yoshitaka Saito (JICA Study Team)	Barangay Electrification Plan
Darrell S.Elivera (PGP)	
Madonna M. Nailng (DOE)	
Masayasu Ishiguro (JICA Study Team)	Institutions and Organizations
Darrell S.Elivera (PGP)	
Thelma B. Ejercito (DOE)	
Hiroo Yamagata (JICA Study Team)	Energy Economic Analysis
Aireen L. Marcaida (PGP)	
Deborah Desiree Penuliar (DOE)	
Shigenobu Handa (JICA Study Team)	Social Environment
June R. Valencia (PGP)	
Mini-Micro Hydropower Working Group	
Yoshiki Mizuguchi (JICA Study Team)	Mini-Micro Hydropower Plan
Hiroshi Ozawa (JICA Study Team)	
Roberto D. Abacial (PGP)	
Epifanio G. Gacusan, Jr. (DOE)	
Arturo F. Torralba, Jr. (DOE)	
Hajime Saito (JICA Study Team)	Distribution System
Darrell S.Elivera (PGP)	
Bienvenido C. Mendoza	
Yukifumi Ishiguro (JICA Study Team)	Environmental Impact Assessment
Aireen L. Marcaida (PGP)	
Irma C. Exconde (DOE)	

Database Working Group	
Hiroshi Ozawa (JICA Study Team)	Database
June R. Valencia (PGP)	
Deborah Desiree Penuliar (DOE)	
Power Development Plan Working Group	
Yoshiki Mizuguchi (JICA Study Team)	Mini-Micro Hydropower Plan
Hiroshi Ozawa (JICA Study Team)	
Roberto D. Abacial (PGP)	
Epifanio G. Gacusan, Jr. (DOE)	
Arturo F. Torralba, Jr. (DOE)	
Hajime Saito (JICA Study Team)	Distribution System
Darrell S.Elivera (PGP)	
Bienvenido C. Mendoza (DOE)	
Kazuhiko Mizuno (JICA Study Team)	Renewable Energy (PV, Wind)
Rex D. Vilches (PGP)	
Rodel T. Padrique (DOE)	
Hisanori Ito (JICA Study Team)	Transmission Planning & Distribution
Dennis P. Valdeztamon (PGP)	
Ronald V. Siquioco (DOE)	
Masatoshi Asai (JICA Study Team)	Diesel Generator
Roberto D. Abacial (PGP)	
Thelma B. Ejercito (DOE)	

(3) PGP Study Team

Member	Activity
Darrell S.Elivera	Barangay Electrification Plan / Institutional and Organizational Arrangement / Distribution System
Roberto D. Abacial	Mini and Micro Hydropower Development Plan / Diesel Generator
Dennis P. Valdeztamon	Renewable Energy / Transmission System Planning and Operation
Aireen L. Marcaida	Energy Economic Analysis / Environmental Impact Assessment
June R. Valencia	Social Environment / Database
Rex D. Vilches	Renewable Energy

(4) DOE Study Team

Member	Activity
Madonna M. Nailng	Barangay Electrification Plan
Thelma B. Ejercito	Institutional and Organizational Arrangement / Diesel Generation
Epifanio G. Gacusan, Jr.	Mini and Micro Hydropower Development Plan (1)
Arturo F. Torralba, Jr.	Mini and Micro Hydropower Development Plan (2)
Rodel T. Padrique	Renewable Energy
Bienvenido C. Mendoza	Distribution System
Ronald V. Siquioco	Transmission System Planning and Operation
Deborah Desiree Penuliar	Energy Economic Analysis
Irma C. Exconde	Environmental Impacts Assessment / Coordinator

(5) JICA Study Team

Member	Activity
Yoshitaka Saito	Team Leader / Barangay Electrification Plan
Masayasu Ishiguro	Institutional and Organizational Arrangement
Yoshiki Mizuguchi	Mini and Micro Hydropower Development Plan (1)
Hiroshi Ozawa	Mini and Micro Hydropower Development Plan (2) / Database
Kazuhiko Mizuno	Renewable Energy
Hajime Saito	Distribution System
Hisanori Ito	Transmission System Planning and Operation
Masatoshi Asai	Diesel Generation
Hiroo Yamagata	Energy Economic Analysis
Yukifumi Ishiguro	Environmental Impacts Assessment
Shigenobu Handa	Social Environment
Masaya Kawaguchi	Coordinator

Chapter 2 Current Status of Policy on Power Sector Development in the Philippines

2.1 Passage of the Electric Power Industry Reform Act and Reorganization of the Power Industry

The legal foundation for the complete restructuring of the power sector, which had been under consideration since the late 1990s, was enacted in 2001 by the passage of Republican Law No. 9136, i.e., the Electric Power Industry Reform Act (EPIRA).

The EPIRA was aimed at increasing the economic rationality of the power industry through the process of unbundling and privatizing the National Power Corporation (NPC), which had monopolized the generation and transmission sectors; segmenting the industry into four sectors (generation, transmission, distribution, and supply); creating conditions conducive to competition and thereby encouraging private investment and promoting further power development.

The general framework of the reform may be outlined as follows:

- The generation sub-sector was opened up to private participation for business in a climate of competition. This step meant that the sector no longer belonged exclusively to the public sector and made it possible for private firms to enter it freely upon obtaining a certification of compliance from the Energy Regulatory Commission (ERC). In addition, prices applied in the purchase of power from power generators (producers) were placed outside the scope of ERC regulation as a general rule by providing for competition in the retail market and opening up the transmission and distribution networks.
- The transmission sector is to remain under the province of a regulated common carrier whose tariff rates must be approved by the ERC. For this reason, the National Transmission Corporation (TRANSCO) was established within the NPC and vested with the authority for the planning and operation of the high-voltage transmission network.
- The distribution sector is also to be the domain of a regulated common carrier in each franchise. The distribution network will be made available to all users, and the distribution utilities will collect wheeling fees from them. The distribution sector may consist of private utilities, local public utilities and electric cooperatives (ECs), and must obtain ERC approval for their franchise and wheeling rates.
- Parties other than the distribution utilities or ECs with licensed franchises may supply power to users upon obtaining ERC approval.
- The establishment of a wholesale spot market is to provide a mechanism for price-setting between power buyers and sellers. Parties including power producers, distribution utilities, suppliers, and big (industrial) users can become members of the transaction market. (In reality, the volume of transactions in the spot market will be limited because most transactions with users will be made by bilateral contracts.)
- A universal charge scheme is applied to serve as the source of funds to cover the repayment of the debt held by the national government and the NPC, missionary

electrification (to be described in Section 2.2.1), replacement of imported energy with domestically produced and renewable energy, environmental measures and internal subsidies.

2.2 Promotion of Rural Electrification

2.2.1 Definition of Terminology

A comprehension of rural electrification in the Philippines requires an understanding of the distinction between two terms.

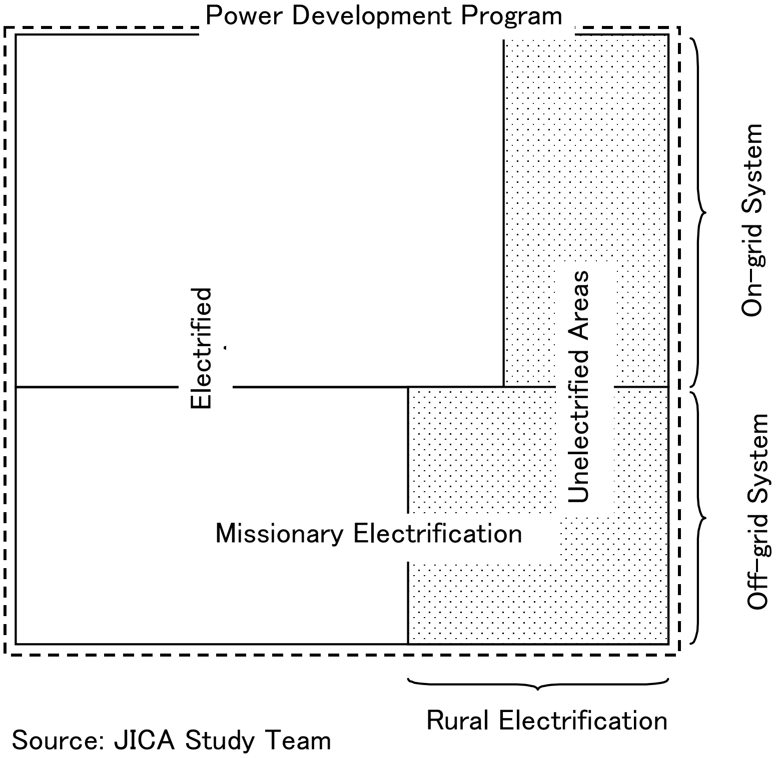
The work of bringing power service to rural areas that have been without it is referred to by the term "rural electrification (RE)" as in other countries. The similar term of "missionary electrification" is a legally defined term as opposed to a general concept such as RE.

"Missionary electrification" refers to the execution of power projects in areas that have not been connected to the (interconnected) transmission network because supplying them with power in this manner would not be economically feasible. Thus far, the Small Power Utility Group (NPC-SPUG) within the NPC has been in possession of generation facilities and supply systems, and responsible for the operation of such projects. The EPIRA also states its responsibility.

The power supply system of the NPC-SPUG has the legal status of an off-grid system, but the usage of this term differs from that in ordinary technical terminology. In Philippine law, the term "on-grid system" refers to the high-voltage backbone of the interconnected transmission system. More specifically, this is the system linkage among the TRANSCO Luzon, Visayas, and Mindanao grids. All other systems are considered off-grid. For this reason, the generation plants and high-voltage backbone transmission lines owned and operated by NPC-SPUG in Palawan have the legal status of an off-grid system.

Under these legal definitions of the terms "on-grid" and "off-grid," the Power Development Program (PDP) in the Philippines consists of two components: electrification through connection to the TRANSCO high-voltage backbone system (i.e., "on-grid electrification") and the Missionary Electrification Development Program (MEDP) depending on NPC-SPUG sources.

In contrast, the thrust of the RE concept is action for the purpose of bringing electrical power to areas that have been without it, and this differs from that of missionary electrification as defined in Philippine law. As a result, most of the geographical scope of areas that could be subjects of RE programs is, in effect, occupied by areas to be electrified through the MEDP. Additionally, this includes electrification of currently un-electrified areas that would probably be supplied with power through the high-voltage backbone of the interconnected transmission system in the future (see Figure 2.2.1).



Source: JICA Study Team

Figure 2.2.1 Power Development Program and Rural Electrification

2.2.2 Outline of the RE Plans of the Philippine Government

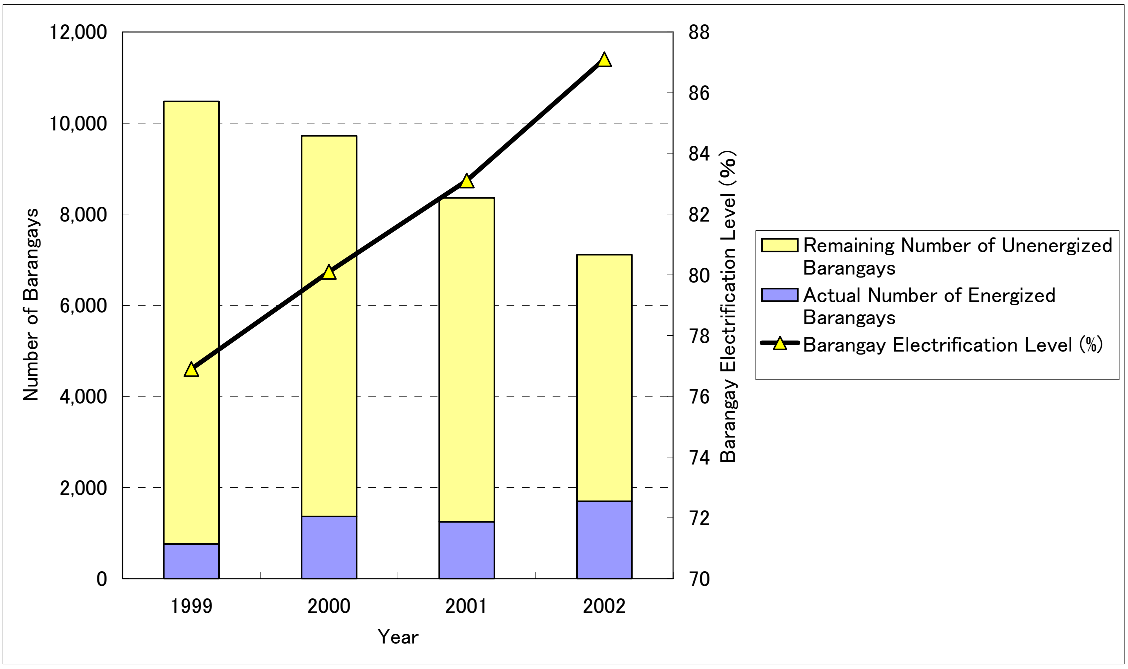
(1) O-Ilaw Program

The O-Ilaw Program is aimed at bringing electricity to all barangays by 2006. In the context of this program, electrification is on a barangay-base; electrification of all households within the barangay is not the objective. "Barangay electrification" therefore denotes the availability of power at the barangay hall or center as opposed to all households in the barangay.

Initiated under the former Joseph Estrada administration, the O-Ilaw Program was originally supposed to attain this objective by 2004, but the terminal year was pushed back to 2006 under the Gloria Arroyo administration. The project work has, in effect, ended and a termination report has been submitted.

As of the end of 2002, the remaining number of un-electrified barangays was reduced to 5,409, and the barangay electrification rate reached 87.1% (see Figure 2.2.2). An additional 1,699 barangays were electrified in 2002 and this brought the cumulative number of electrified barangays to 36,590.

Comparison in terms of the funding source and implementing party reveals that by far the single-largest portion (55% of the total for the years 1999-2002) of electrification projects were implemented by ECs with funding from the National Energy Administration (NEA). If 2002 were taken separately, however, a total of 608 barangays were electrified by independent power producers (IPPs). This was more than the corresponding figure of 543 barangays electrified by the NEA/ECs (see Figure 2.2.3).



Source: See Table 2.2.1.

Figure 2.2.2 Barangay Electrification Performance 1999-2002

Table 2.2.1 Barangay Electrification Performance 1999-2002

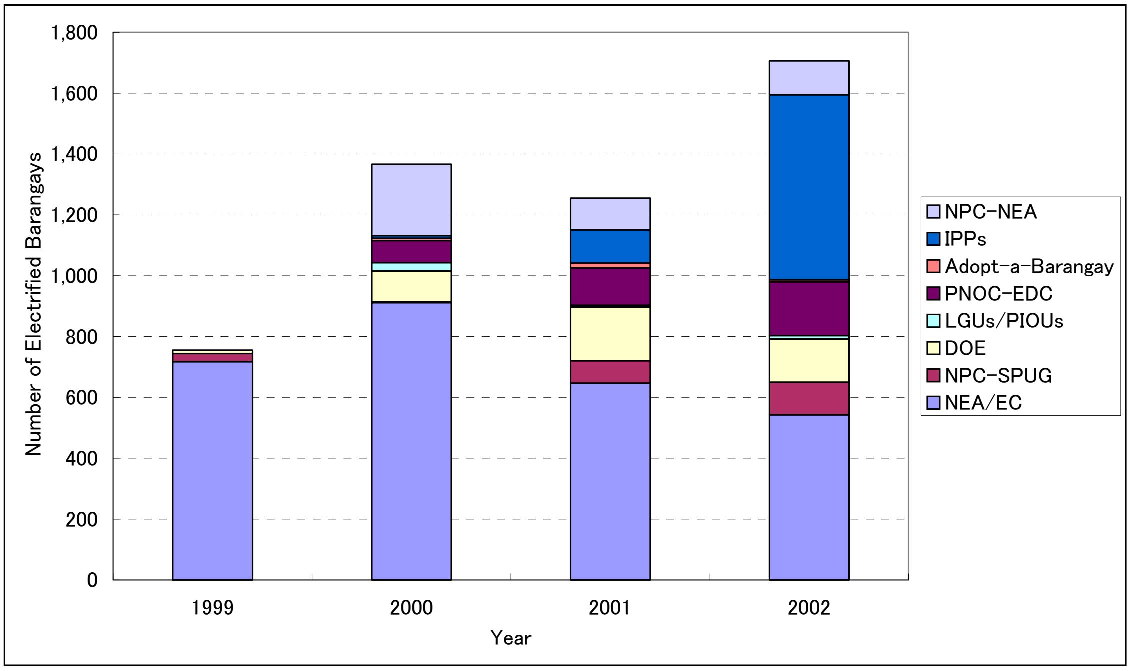
	Target Number of Barangays for	Actual Number of Energized Barangays	Cumulative Number of Energized Barangays	Remaining Number of Unenergized Barangays	Barangay Electrification Level (%)
1999	900	755	32,281	9,718	76.9
2000	1,621	1,366	33,647	8,352	80.1
2001	1,353	1,244	34,891	7,108	83.1
2002	1,636	1,699	36,590	5,409	87.1

Note:

1/ Exclude 11 enhancement projects but include 2 newly created barangays for an aggregate total of 1255 barangay electrification project in 2001.

2/ Exclude 7 enhancement projects for an aggregate total of 1706 barangay electrification project in 2002.

Source: Ō-Īlaw Project Team Terminal Report



Source: See Table 2.2.2.

Figure 2.2.3 Barangay Electrification Performance by Fund Source/Implementer 1999-2002

Table 2.2.2 Barangay Electrification Performance by Fund Source/Implementer 1999-2002

	1999	2000	2001	2002	Total	Level of Performance (%)
NEA/EC	717	911	647	543	2,818	95.6
NPC-SPUG	27	2	73	107	209	65.5
DOE	11	102	177	142	432	42.8
LGUs/PIOUs		28	6	11	45	67.2
PNOC-EDC		72	123	177	372	98.8
Adopt-a-Barangay		8	16	7	31	48.4
IPPs		9	108	608	725	185.3
NPC-NEA		234	105	111	450	170.7
Total	755	1,366	1,255	1,706	5,082	92.1

Note: Figures include enhancement projects.
Source: O-Ilaw Project Team Terminal Report

(2) Expanded Rural Electrification (ER) Program

In 2003 an ER team was instituted for the electrification of all barangays by 2006 as targeted in the O-Ilaw Program and for the attainment of a household electrification rate of at least 90% by 2017. The mission of the ER team is to manage the various RE programs and oversee that they are efficiently operated.

The ER team is composed of the Overseeing Committee and the Inter-Agency Technical Working Group. The chairman of the former is appointed by the undersecretary of the Department of Energy (DOE) and includes three program managers, one each from the NEA, DOE, and NPC-SPUG. The latter is headed by an appointee of the NEA who is assisted by an appointee of the DOE. Members of the concerned institutions participate in the ER team and the Group.

Through the RE Program, the DOE made a public commitment to promote electrification toward the goal of electrifying all barangays by 2006 in accordance with the State of the Nation Address (SONA) (see Table 2.2.3). The schedule envisions the electrification of 1,619 barangays in 2003 and from 1,200 to 1,300 barangays each year from 2004 to 2006, for electrification of all of the 5,409 barangays that were without power as of the end of 2002. As a result, electric power would be available in all of the country's 41,999 barangays.

Table 2.2.3 SONA Commitment for Rural Electrification

	Target	Accumulative	Electrification Level (%)
2003	1,619	38,209	91
2004	1,258	39,467	94
2005	1,304	40,771	97
2006	1,228	41,999	100
Total	5,409		

Source: DOE

(3) Missionary Electrification Development Program (MEDP)

The EPIRA and its implementing rules and regulations (IRR) oblige the DOE to review the MEDP, which is formulated as a five-year plan, in collaboration with NPC-SPUG and the NEA.

After the EPIRA was put into effect, MEDP plans were announced in 2002 and 2003. In 2002 the DOE was unable to prepare a complete MEDP and adopted the NPC-SPUG Missionary Electrification Plan (MEP) as the MEDP for 2002 - 2006. The preparation of the 2003 edition drew upon technical assistance (TA) from the Asian Development Bank (ADB).

The MEDP interim report issued in 2003 presented a more comprehensive examination of the subject and took up perspectives on the order of priority in use of the universal charge as the source of funding for missionary electrification, the rules of concerned institutions and the establishment of criteria for electrification for areas that are still not electrified. The applications of the universal charge and rules for use of revenue from it are key agenda items for the MEDP.

NPC-SPUG projects are operated with funding from official development assistances (ODAs) and other sources in addition to sales revenue. The law recognizes compensation by a universal charge for any gap between the actual project cost and tariff revenue. A universal charge is also to be applied for the cost of investment in areas where electrification would not be economically feasible.

The cost of investment required for the electrification of additional barangays in 2003 will amount to some 2.3 billion pesos. Even after subtracting grant aid from inside and outside the country as well as beneficiary burdens, there will still be a total of 2.2 billion pesos that must be covered by a universal charge. This arrangement is to permit the electrification of an additional 1,795 barangays during the year.

Defrayment of the outstanding cost of 2.2 billion pesos would compel an imposition of a universal charge amounting to 5.01 centavos per kilowatt-hour. The universal charge requested by NPC-SPUG for the Missionary Electrification Plan (MEP) running from 2002 to 2006 was 9.52 centavos per kilowatt-hour[1]. However, an MEDP analysis found that the estimate for the final power consumption used as the grounds for the NPC-SPUG calculation was too high. Based on the estimate made by the Power Sector Assets and Liabilities Management Corporation (PSALM), power sales would be 21% less than estimated by the NPC-SPUG and this would entail an increase of 1.97 centavos in the universal charge. With adjustments for the cost burden required for newly electrified areas, it was concluded that a universal charge of 15.76 centavos would be necessary in 2003.

However, the approved universal charge by ERC was merely 3.37 centavos, and the implementation of the barangay electrification program in 2003 became almost unrealized (see Section 2.3.4 for more details).

2.3 Funding for RE

The financial sources for RE programs are as follows:

- DOE Barangay Electrification Program (BEP)
- Electrification funding from DOE Energy Regulation 1-94
- NEA subsidies (general appropriation)
- NPC-SPUG Missionary Electrification
- PNOC-EDC
- Funding from IPPs
- Funding from ODA (bilateral, multilateral, and Global Environment Facility (GEF))

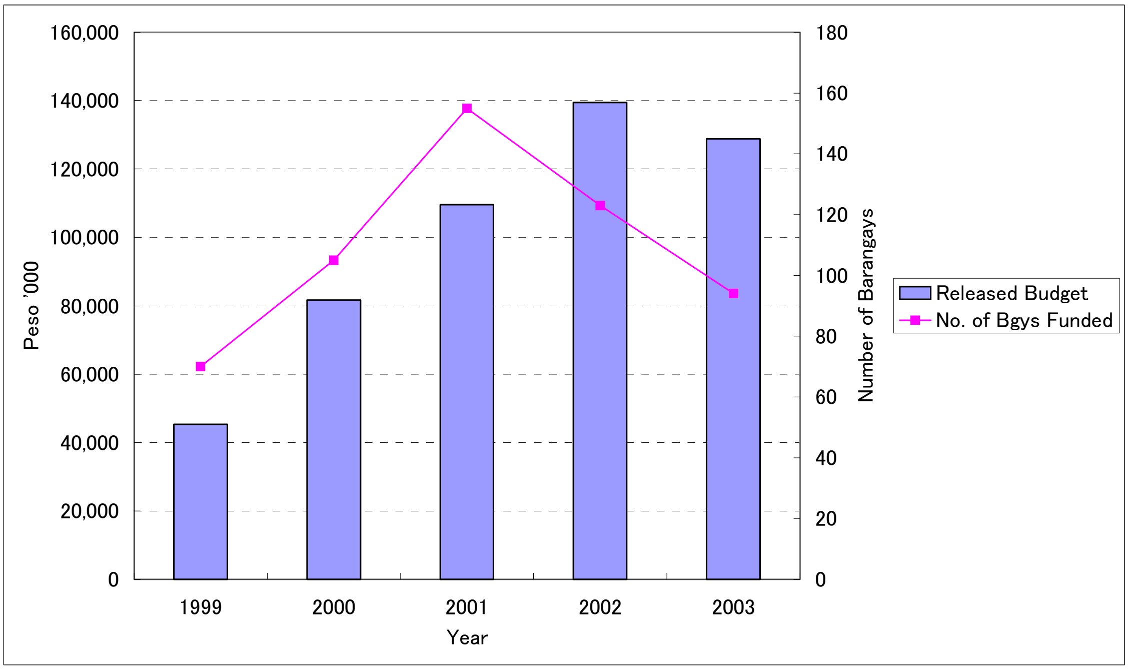
Of these, the sources enabling management and also predictions of the approximate amounts by the national government are the DOE, NEA and NPC-SPUG funding. Obviously, it would be financially impossible to promote the current RE plans solely on funding from these sources; they must be supplemented with funds mobilized from the private sector as well as aid from international institutions and developed countries.

[1] 9.52 centavos include subsidizations for not only new capital investment but also necessary O&M of the existing facilities.

2.3.1 DOE Barangay Electrification Program (BEP) Fund

BEP expenditures are confined to electrification utilizing renewable energy. The subjects are consequently limited to facilities for mini-hydropower, photovoltaic (PV) systems, wind power and others.

The amount of expenditures has increased each year since 1999. In each of the last three years the BEP was allotted a budget in excess of 100 million pesos (see Figure 2.3.1).



Source: See Table 2.3.1.

Figure 2.3.1 DOE Barangay Electrification Program Fund 1999-2003

Table 2.3.1 DOE Barangay Electrification Program Fund 1999-2003

(Unit: Peso '000)

	Released Budget	No. of Bgys Funded
1999	45,314	70
2000	81,659	105
2001	109,538	155
2002	139,430	123
2003	128,809	94

Source: DOE

2.3.2 DOE ER 1-94 Electrification Fund

The ER 1-94 effectuated by the DOE on May 24, 1994 provides for the payment, into an escrow account, of one centavo per kilowatt-hour of power generated by power producers such as IPPs and NPC power plants. The ER funding is distributed among three funds in the following manner:

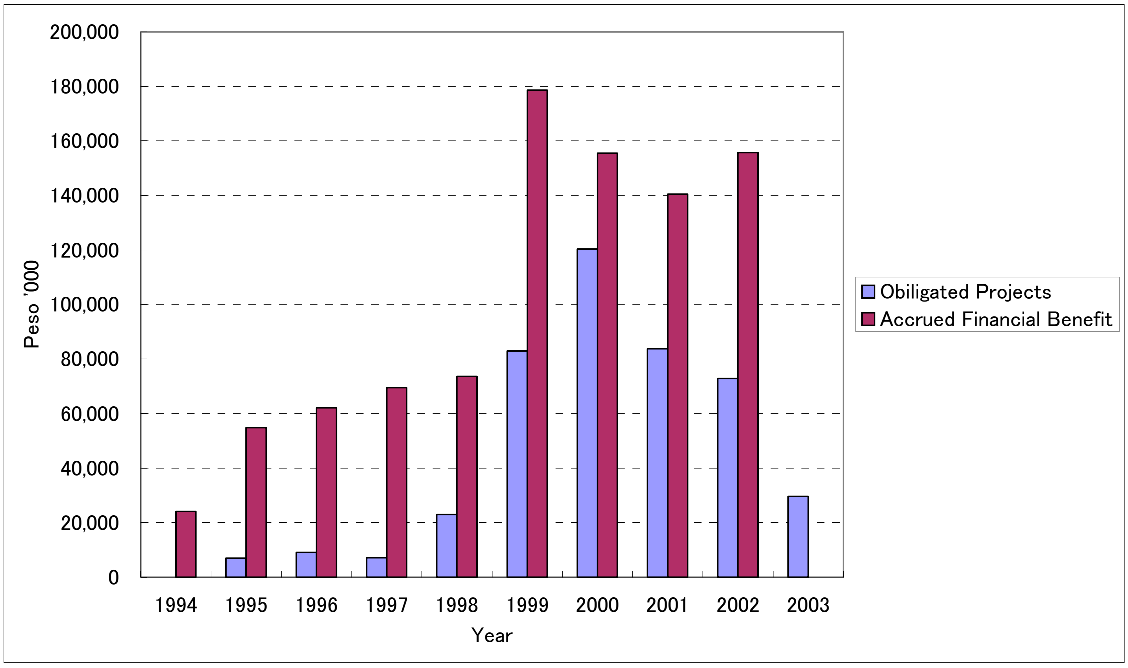
・Electrification Fund (50% share)
・Livelihood Fund (25% share)
・Fund for afforestation, drought control, welfare, and environmental improvement (25% share)

Provision of these funds is limited to areas that are sites of power plants, in accordance with the following order of priority.

・Areas to which residents have relocated as a result of power plant siting
・Barangays that are sites of power plants
・Municipalities or cities that are sites of power plants

Part of the electrification funding furnished under ER 1-94 is used for the repair of installed facilities, and the remainder is used for electrification, i.e., RE in the area in question.

As of December 2002, the Electrification Fund totaled 479 million pesos. Since 1999 its average annual income has been about 160 million pesos (see Figure 2.3.2).



Source: See Table 2.3.2.

Figure 2.3.2 ER 1-94 Electrification Fund 1994-2003

Table 2.3.2 ER 1-94 Electrification Fund 1994-2003

(Unit: Peso '000)

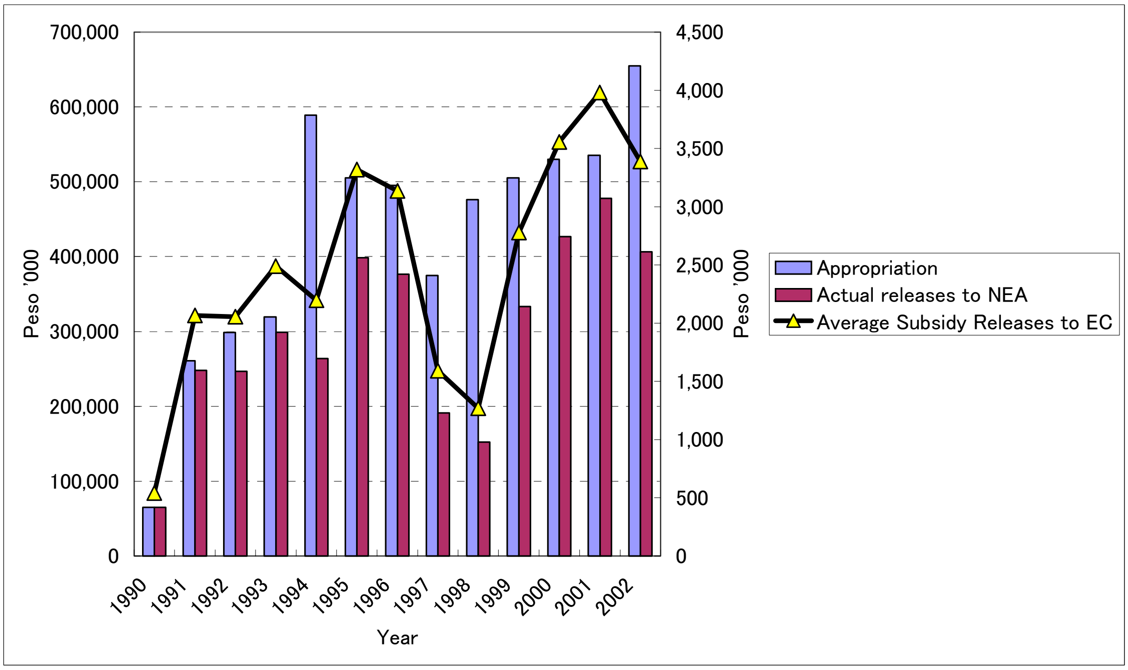
	Obiligated Projects	Accrued Financial Benefit	Subtotal	Available Fund
1994		24,167	24,167	–
1995	6,966	54,824	47,858	–
1996	9,101	62,125	53,024	–
1997	7,134	69,544	62,410	–
1998	22,993	73,594	50,601	–
1999	82,960	178,597	95,637	–
2000	120,314	155,513	35,199	–
2001	83,832	140,437	56,605	–
2002	72,858	155,680	82,822	–
2003	29,544	–	–	478,779

Source: DOE

2.3.3 NEA Subsidies

NEA subsidies are expenditures from the ordinary national budget (i.e., general appropriation). The cumulative expenditure since 1990 has reached 3,888.46 million pesos. Although the budget was cut back in 1997 and 1998 immediately after the outbreak of the Asian currency crisis, it was increased to the pre-crisis level in 1999 and has topped 400 million pesos since 2000 (see Figure 2.3.3).

Also for 2003 the government approved appropriation of some 450 million pesos, on par with the level in the preceding years. However, it decided to defer provision of 15% of this total to the next year, so the actual budget was 382.5 million pesos. Nevertheless, funding for the general appropriation is fairly tight, and the Department of Budget and Management (DBM) postponed the release of the 2003 budget. But the NEA budget was finally executed in October of 2003.



Source: See Table 2.3.3.

Figure 2.3.3 Annual Subsidy Appropriation of the NEA 1990-2002

Table 2.3.3 Annual Subsidy Appropriation of the NEA 1999-2002

(Unit: Peso '000)

	Appropriation	Actual releases to NEA	Average Subsidy Releases to EC
1990	65,000	65,000	542
1991	261,000	247,950	2,066
1992	298,500	246,686	2,056
1993	319,405	298,803	2,490
1994	588,918	263,649	2,197
1995	505,000	398,327	3,319
1996	495,000	376,369	3,136
1997	375,000	191,094	1,592
1998	476,000	152,378	1,270
1999	505,000	333,461	2,779
2000	530,000	426,862	3,557
2001	535,350	477,623	3,980
2002	654,783	406,402	3,387

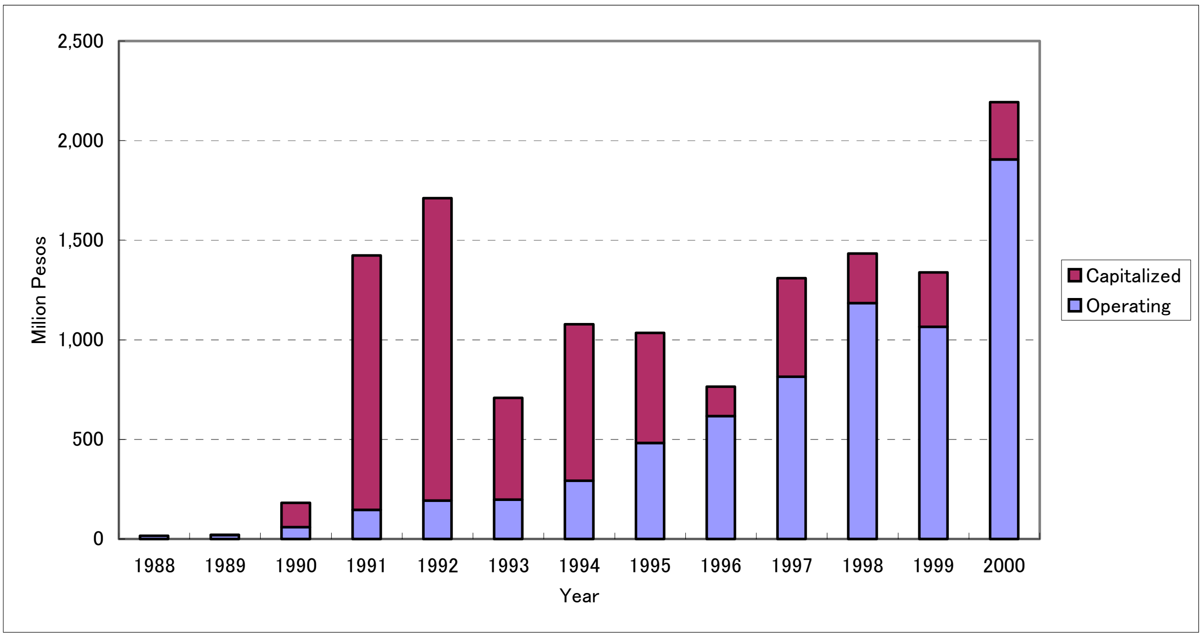
Source: NEA

2.3.4 NPC-SPUG Missionary Electrification

NPC-SPUG missionary electrification is funded by the universal charge instated in accordance with the EPIRA. A substantial portion of the power source development for additional RE now depends on facility investment by NPC-SPUG, and high expectations have been placed on the universal charge.

However, the realities are harsh. As indicated by the figures for the actual subsidies paid to NPC-SPUG over the years 1988-2000, the burden of operation and maintenance (O&M) costs has been increasing faster than the subsidies. Investment for new facilities in the late 1990s was held to less than 20% of the total subsidies (see Figure 2.3.4). As a result, the additional number of barangays electrified by NPC-SPUG in 2002 came to only 107.

It may also be observed that there is a big gap between the universal charge requested and the amount approved by the ERC in 2003; the NPC-SPUG requested a charge of 9.52 centavos per kilowatt-hour, but the ERC approved one of only 3.37 centavos.



Source: See Table 2.3.4.

Figure 2.3.4 Subsidies to NPC-SPUG 1988-2000

Table 2.3.4 Subsidies to NPC-SPUG 1988-2000

(Unit: Million Pesos)

	Operating	Capitalized	Total
1988	16.19	–	16.19
1989	18.61	3.01	21.62
1990	59.29	122.78	182.07
1991	146.80	1,276.88	1,423.68
1992	193.46	1,518.10	1,711.56
1993	197.52	511.49	709.01
1994	292.57	785.83	1,078.40
1995	481.32	552.71	1,034.03
1996	616.50	147.51	764.01
1997	814.58	494.36	1,308.94
1998	1,183.53	250.35	1,433.88
1999	1,065.32	273.57	1,338.89
2000	1,905.90	287.34	2,193.24

Source: 2002MEDP

2.3.5 Funding from IPPs

There are two types of RE funding from IPPs. One is the advance payment under the aforementioned ER 1-94 and the other is the "Adopt-a-Barangay" scheme of donations.

The advance payment under ER 1-94 is paid in the form of an advance payment by the IPP to the Electrification Fund for 0.5 centavos of the universal charge. Repayments are made for this in correspondence with the actual generated output.

The barangay donations are made with the burden assumed by the IPPs and differ from the ER 1-94 advance payments in that they cannot be retrieved. Thus far, Mirant Philippines has committed to donating 20 million US dollars (1 billion pesos) to electrify 1,500 barangays. Of that, 1,000 barangays have been already energized and an additional 300 barangays will be electrified in 2004 and another 200 barangays in 2005[2].

Meanwhile, KEPCO Philippines Corporation also committed to providing 5 million US dollars to electrify 260 barangays. Electrification of 60 barangays has been already completed, and 200 barangays will be energized in 2004 and after[3].

2.3.6 Funding from ODA

Thus far, funding has been provided on several occasions in the context of both bilateral and multilateral frameworks. Most of the funding has been furnished for individual projects; almost none of it has been large enough to fund programs continuing over the long term.

In light of this situation, the Philippine government and the World Bank are planning to promote RE using adaptable program loans. In the project they also intend to test new models for input of funds and RE. (See Section 2.4.2 for the details of the project.)

2.4 Execution of RE Programs

2.4.1 United Nations Development Programme (UNDP): Palawan New and Renewable Energy and Livelihood Support Project

The objective of this project was to include the reduction of greenhouse gas emissions into the long term plan by replacing diesel-fueled generators with renewable energy. In addition, a portion of the funding came from the Global Environmental Facility (GEF).

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[2] In Palawan, Mirant planed to electrify a total of 50 barangays--17 in 2003 and 33 in 2004-05.
[3] In 2004, KEPCO will electrify 34 barangays in Palawan.

The project consisted of the following four major elements.

・Capacity building of local governmental units (LGUs) and ECs
・Campaign to deepen citizen awareness about renewable energy
・Establishment of the Renewable Energy Development Center
・Design and implementation of a risk-sharing mechanism for support of the renewable energy service company (RESCO) model

Table 2.4.1 Palawan New and Renewable Energy and Livelihood Support Project

Starting Date	February 2000 (planned for three years)	
Executing Agency	Center for Renewable Resources and Energy Efficiency (CREE)	
Fund Source	UNDP/GEF	US$ 750,000
	Co-financing	
	UNDP/TRAC	US$ 100,000
	Provincial Government	US$ 300,000
	Shell	US$1,400,000
	Total	US$2,550,000

Source: UNDP

Through this project the RESCOs were to expand its provision of renewable energy services to Palawan barangays that had been without electricity, and bring a reduction of 15 million liters of diesel fuel and 12,000 tons of emissions of carbon dioxide (CO_2).

To increase the use of renewable energy, the provincial government has decided to provide income based on natural gas development in Palawan. The plan estimates that the project will generate income for the provincial government totaling in the range of 100-200 million dollars per year and 2 billion dollars overall.

Of particular note is the idea of expanding installation of solar home systems (SHSs) under the RESCO model. To investigate the feasibility of this approach, pilot systems are to be installed in 6 barangays with the cooperation of Shell International Renewable Ltd. and the Community Power Corporation.

The application of the RESCO model is to be accompanied by a mechanism for risk-sharing to mitigate the risks existing between suppliers and consumers (associated with payments from consumers and retrieval of costs by the supplier). The funding for this mechanism is being furnished by the GEF.

Meanwhile, to furnish private-sector RESCOs with incentives in the funding aspect, institutional arrangements are being made for tax breaks, exemption from import duties and procedural simplification.

The preparation of the framework for RESCO projects was premised on a business model consisting of the installation of small systems owned by the company to consumer households, and retrieval of initial investment and running costs through the collection of service charges. Subsequently, however, it was decided to switch to a model based on the outright sale of the SHS equipment, as proposed by Shell in light of its experience.

In parallel with the construction of the business model, the project included the establishment of the Renewable Energy Development Center (REDC) for mediation among the government, RESCOs and citizens to promote human resource development and technology transfers as needed for the spread of renewable energy. The REDC is operated as a non-governmental organization (NGO).

The implementation of the project was undertaken on commission with the Center for Renewable Resources and Energy Efficiency (CRREE) as the prime contractor and the University of the Philippines (UP) Solar Laboratory, UP Engineering Research and Development Foundation, and other parties as subcontractors.

Yearly reports (in the form of interim reports) were submitted in 2000 and 2001. The 2001 report advised an extension of the project period to the end of 2003.

2.4.2 Adaptable Program Loan from the World Bank

The Philippine government and the World Bank are now negotiating a program loan to support the reform and investment required for RE promotion.

This loan project consists of the following three major components.

(a) RE

- Dispersed power sources: Promotion of RE using mini-grids or stand-alone systems in areas where extension of the grid would be economically unfeasible
  Various schemes are being tried to encourage private-sector investment and curtail governmental subsidies as far as possible.
- Extension of the EC grid: Reinforcement of EC management capabilities and finances
  To this end, efforts are being made to improve the existing facilities, recruit new customers within the existing distribution network and bolster institutional support for ECs.

(b) Capacity building

- Off-grid systems: Reinforcement of the capabilities of concerned authorities, financial institutions, and private sector to remove barriers to commercialization of renewable energy
- Development of various schemes to lower investment risks
- Drafting and execution of policy measures regarding subsidization, tariffs, and regulations to promote RE programs

(c) Reconstruction of the NEA

・Financing for the cost of NEA restructuring

The total cost of the project over a period of 14 years is estimated at 244 million dollars, and is being met by adaptable program loans from the World Bank and grant aid from the GEF. This funding is to be provided in four phases, each with separate targets. The work is not allowed to proceed to the next phase unless these targets are met. Table 2.4.2 shows the targets for connection in each phase. The project is to electrify 50,000 households with mini-grids and 135,000 households with SHS by the end of the fourth phase.

The system based on dispersed power sources and mini-grids is aimed at inducing private-sector participation to minimize the governmental subsidization. In this connection, attempts are being made to lump a plural number of barangays together to obtain the quantitative scale required for commercialization. The private firms (properly speaking, qualified third parties (QTPs), including NGOs and local ECs, as well as private enterprises) are to perform the distribution service through mini-grids based on concession agreements with a term in the range of 15-20 years, for example. Naturally, the business will not necessarily be able to subsist entirely on a profitable basis because of factors related to scale and demand density, and assistance will presumably have to be furnished in some form. For this reason, the selection of firms in concession bidding is to be performance-based, and therefore accompanied by an assessment grounded in anticipated results. Concessions are to be awarded to the firms which offer the lowest rates and need the least subsidies.

As for stand-alone renewable energy systems, the project will promote the spread of SHSs in areas not amenable to connection to the grid or installation of systems utilizing mini-grids.

Table 2.4.2 Indicative Connection Target by Phase

	APL1	APL2	APL3	APL4
Mini-Grid				
· Target Connection by Phase	8,000	13,500	14,500	14,000
· Cum. Target Connection	8,000	21,500	36,000	50,000
· Trigger for the next APL	2,000	11,000	22,600	
SHS				
· Target Connection by Phase	10,000	18,000	40,000	67,000
· Cum. Target Connection	10,000	28,000	68,000	135,000
· Trigger for the next APL	2,000	14,500	35,000	

APL: Adaptable Program Loan

Source: DOE&DBP 2003

(1) Investment (244 million dollars)

Mini-grid electrification

The key to mini-grid electrification is to achieve a scale enabling the supply of power through a mini-grid to subsist as a business by putting several neighboring barangays into a single package to assure adequate demand. The project envisions the participation of QTPs stipulated in the EPIRA. The plan in the first phase is to try out various business models involving RESCOs, NGOs and cooperatives set up for electrification, then and select the best one. More specifically, 6,000 households are to be electrified through a total of 6 packages of mini-grid electrification businesses. As a whole, the project is targeting electrification of 60,000 households and capacity of up to 30,000kW. Of the capacity total, at least 5,000kW are to consist of stand-alone renewable energy systems and hybrid systems combining diesel generators and renewable energy. The cost is estimated at 66 million dollars, and 200,000 dollars is to come from GEF funding.

SHS credit line

At present there are about 2.5 million households without electricity in the Philippines. Even if all barangays were to be electrified by the end of 2006, there would still be more than 1 million without power.

For such households without electricity in scattered locations, private suppliers and NGOs intend to provide small-scale SHSs (20-60 Wp) under the GEF capacity-building program and others. In addition, the World Bank is to provide loans to customers purchasing SHSs and dealers through local banks and micro-finance institutions. GEF funding is to be utilized for programs of training for these financial institutions and partial credit guarantees for customers and dealers. The project is to electrify a total of 200,000 households with SHSs and other such Photovoltaic (PV) systems by the end of all phases and 11,000 households in the first phase. The project cost is estimated at 131 million dollars, and 700,000 dollars are to be received from the GEF scheme in the first phase.

Partial credit guarantee fund

One of the barriers to the spread of renewable energy is the unavailability of medium- and long-term loans from private financial institutions.

This problem has already been recognized in the UNDP/GEF project for Capacity Building to Remove Barriers to Renewable Energy Development (CBRED), which is scheduled to include a pilot program involving partial credit guarantees for installation of renewable energy systems. However, SHSs are not eligible for coverage. For this reason, provisions are to be made for credit guarantees for loans to SHS purchasers based on the results of the CBRED project. These loans will be funded by the GEF scheme, which is scheduled to furnish 1 million dollars in the first phase and 3.4 million dollars over the entire project term.

Reform-related investment

This project will provide investments to fund the NEA reform revolving around staff rationalization, rehabilitation of distribution networks and reduction of distribution loss in order to put ECs on firmer footing. Throughout the project, this investment will be made for about 30 ECs. The number of additional households electrified by this investment is estimated at about 40,000.

(2) Technical assistance (19.2 million dollars)

Technical assistance is being furnished in the following fields.

Removal of barriers to the installation of renewable energy systems adapted to off-grid electrification

Capacity-building at the DOE, NEA, ERC, financial institutions (Development Bank of Philippines, Land Bank of Philippines, regional banks, micro-finance organizations) and private-sector parties (PV firms, ECs and NGOs).

Support for the drafting of a strategy for EC reform

In-depth analysis of the market structure for mitigation of investment risks and determination of measures regarding subsidies, tariffs, regulations and others.

2.4.3 SHS Aid from the Government of the Netherlands (Environmental Improvement for Economic Sustainability, 2002-2006)

The Philippine National Oil Company (PNOC) is to lead this project and install some 15,000 SHSs in Regions I-IV and the Cordillera Autonomous Region (CAR). This is an export-promoting project under which the Dutch company Shell Solar will furnish 50-Wp SHSs, with the Dutch government funding 60% of the installation cost. Shell Renewable Philippines is to specify customers and provide technical guidance based on a contract with the PNOC. The project includes two visits to the installers within the first six months after installation to provide after-sales service. However, all subsequent maintenance and management work is to be performed for a fee and on the basis of contracts between installers and dealers.

In the pilot project charges were collected on a prepaid basis. The project also specifies the recycling of batteries and the PNOC has concluded a contract with Philippine Recycling Inc. for this purpose. As of May 2003, more than 1,000 households had been outfitted with SHSs.

2.4.4 Proposed French Project (Photovoltaic Rural Electrification Service Project)

This project is being planned for the installation of PV systems in villages that are already electrified in Visayas and Mindanao. It is now at the feasibility study stage. This project would electrify a total of 18,000 households in 128 barangays, through a combination of a mini-grids composed of systems that are PV-diesel hybrids and SHSs.

The power tariffs would be set on a level commensurate with the current amount of energy consumption, the tariff revenue would be applied for system operation and maintenance and for the purchase of spare parts. Another feature of the plan is the proposed implementation in partnership with a non-profit organization (TSPI Development Corporation) providing support for micro-finance institutions and small firms, to ensure that electrification is directly linked to a higher standard of living.

2.4.5 Spanish Project (Solar Power Technology Support to Agrarian Reform Communities)

The object of this project is electrification of agrarian reform communities (ARCs) in Mindanao by means of PV systems as part of a larger policy for the alleviation of poverty. The Spanish economic ministry is to provide soft loans worth about 25 million dollars during the term of the project, which began in March 2003 and is to terminate in September 2004. The Philippines counterpart is the Department of Agrarian Reform. The DOE is offering technical support for the area of energy supply. The project will concern several regions in Mindanao such as Regions IX (Zamboanga Peninsula), X (Northern Mindanao), XI (Davao Region), XII (Soccsksargen), and XIII (Caranga Region). The Philippine side will design the project and the Spanish firm BP-Solar will supply the materials. The beneficiaries will be responsible for the PV system operation and management as well as the collection of fees.

This project consists of two components: i) PV electrification of ARC public facilities, schools, clinics, water supply facilities, agricultural production facilities and housing; and ii) promotion of agriculture and the processing of agricultural products.

2.5 Outstanding Issues Related to RE Promotion

RE is being promoted in the context of the restructuring of the power sector and the conditioning of the market climate through the enactment of the EPIRA, but there remain certain outstanding issues. One is the preparation of the institutional setup for RE promotion and the other is the question of how to obtain funding for this setup.

2.5.1 Setup for RE Promotion under the EPIRA

Presently the NPC-SPUG is responsible for the supply of power sources needed for missionary electrification, but there is a need for stimulation of private investment in this field as well. To this end, the EPIRA order recognized the sale of existing NPC-SPUG power plant assets to private firms and the provision of subsidies for capital investment by the latter in RE.

Regarding the promotion of RE with a universal charge, qualified third parties (QTPs) are now allowed to engage in the power business in areas not served by EC with licensed franchises.

One of the factors behind the instatement of this policy is the steady increase in costs required for the NPC-SPUG missionary electrification programs. Although the amounts of subsidization have definitely increased as well, there are not enough subsidies to go around for additional investments for electrification of areas still without power (see Section 2.3.4). In other words, the rapid expansion of losses due to operating costs for existing programs has tightened NPC-SPUG finances to the point that the NPC-SPUG must do every thing it can just to keep the existing programs running.

The aim is to attract investors from the private sector to take the place of the NPC-SPUG in order to resolve this problem. Nevertheless, there remains some doubt about how effectively the prevailing setup will function as an incentive. The private firms will be able to receive subsidies through the universal charge for the requisite initial investment, but there is a general consensus among investors that the rate of return on RE investment is still too low.

It is clear that the areas where RE will have to be promoted in the future are saddled with conditions that are even worse when viewed from the standpoint of economic feasibility. Considerations of the market climate suggest that the very stance of putting the NPC-SPUG and the supply of power by ECs through the distribution network at the center of RE promotion, as has been the case to date, is going to become hard to maintain.

2.5.2 Appropriation of Budget

The total amount of funding that can be procured under the government's control for attainment of the immediate target of barangay electrification by the end of 2006 is estimated at 690 million pesos (see Table 2.5.1). This consists of funding from sources such as the Barangay Electrification Program (BEP) of the DOE, the electrification fund under ER 1-94, the ordinary budget of the NEA and the universal charge.

At the average cost of one million pesos per barangay applied by the NEA in its estimates, electrification of as yet un-electrified barangays through extension of the EC distribution lines would require 1.2-1.3 billion pesos per year, assuming that 1,200-1,300 barangays would be electrified each year over the three-year period 2004 - 2006.

As indicated by this figure, the funding available from the government comes to only about half of the requisite amount. Besides, the mobilization of ODA funding and private-sector investment to supplement the governmental expenditures and the procurement of the remaining funds would demand consideration of payment of a certain portion by beneficiaries as part of their cost burden.

It may also be noted that the big gap between the requisite amount and the amount procurable by means under governmental management would make it difficult to achieve the barangay electrification solely through extension of the distribution lines. As such, the government must consider approaches to curtail the total amount of investment through incorporation of alternative means of electrification not requiring large outlays, such as stand-alone systems[4].

Table 2.5.1 Size of Annual Funds under the Control of the National Government

BEP	130 million pesos per annum
ER 1-94	160 million
NEA	400 million
Universal Charge	??
Total	690 million

Source: JICA Study Team estimate

4 This refers to the size of the initial investment and does not necessarily mean that the generation cost per kilowatt-hour would be lower. A typical example of this is the installation of SHSs. Furthermore, viewed from the standpoint of output, the number of electric appliances that could be connected at one time would be smaller than in the case of service through distribution networks. It is also not clear whether or not stand-alone systems would be better for electrification of a fairly sizable number of homes at once.

Chapter 3 Current Status of Power Sector in Palawan Province

3.1 Structure of Power Sector in Palawan Province

Figure 3.1.1 shows the structure of the power sector in Palawan Province.

(a) NPC-SPUG and ECs

NPC-SPUG is responsible for the development planning, operation and maintenance of generation and transmission facilities in Palawan.

In addition to the generation facilities owned by NPC-SPUG, there is one IPP power plant in the Palawan grid. This IPP, Delta-P, was constructed in 1997 and has sold its generated electricity to NPC-SPUG through a ten-year contract.

All generated electricity by NPC-SPUG and Delta-P is supplied to the two ECs, PALECO and BISELCO. Both ECs are responsible for distribution and supply. Presently PALECO covers about 90% of all consumers in Palawan. PALECO's main service area is the Palawan main island, and BISELCO is responsible for the four island municipalities of Busuanga, Coron, Culion and Linapacan.

(b) Others

In addition to NPC-SPUG and ECs, there are some other entities that supply electricity to consumers. One is the Barangay Power Association (BAPA). BAPA has generators and distribution lines for its own use and is responsible for their operation and maintenance. In this connection, PALECO gives technical assistance to BAPA[1]. Additionally, some people have access to electricity through small diesel generators, SHS, BCS and other means.

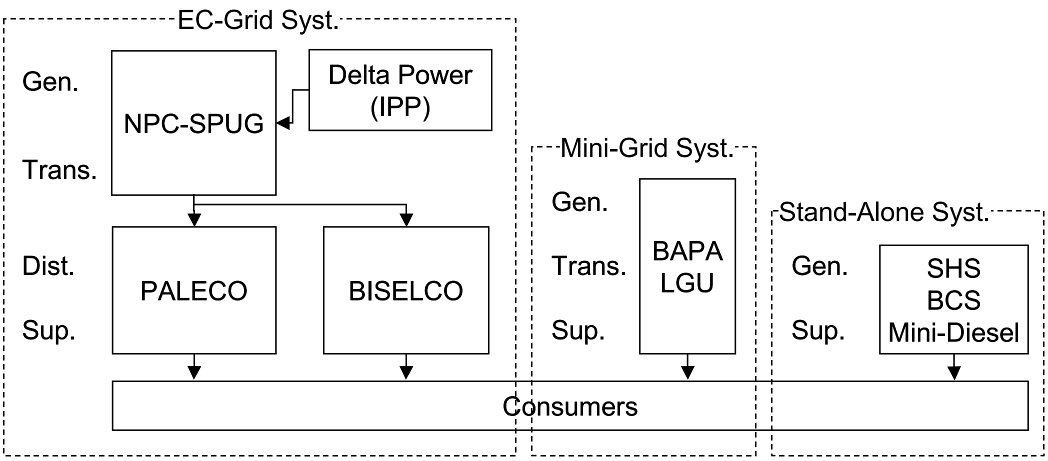

Figure 3.1.1 Structure of Power Sector in Palawan Province

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[1]There is no BAPA in the BISELCO service areas at present.

3.2 Status of Barangay Electrification

3.2.1 Status of Barangay Electrification based on the PGP Definition

In February of 2003 the Sangguniang Panlalawigan passed a resolution entitled "A Resolution Adopting the Provincial Government of Palawan Definition regarding the Level of Barangay Electrification." Listed below are the criteria of barangay electrification within that resolution.

LEVEL I - At least 10 households but less than 30% of households in the barangay is energized.

LEVEL II - At least 30% of households but less than 80% of households in the barangay is energized. Power is supplied for less than 24 hours each day.

LEVEL III - At least 80% of households in the barangay is energized. Power is supplied for 24 hours each day and the system can support economic activities in the area.

Based on this PGP definition, Figures 3.2.1 and 3.2.2 show the status of barangay electrification and household electrification as of December 2003. The PGP criteria for electrification include not only the household electrification ratio but also the system reliability and availability. As of December 2003, 271 barangays out of 431 were electrified (63% in terms of the barangay electrification ratio) and 56,924 households out of 167,391 were electrified (34% in terms of the households electrification ratio).

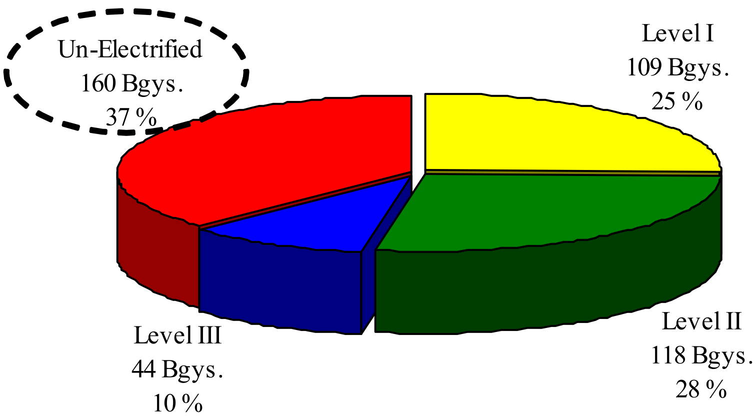


Figure 3.2.1 Status of Barangay Electrification (as of December 2003)

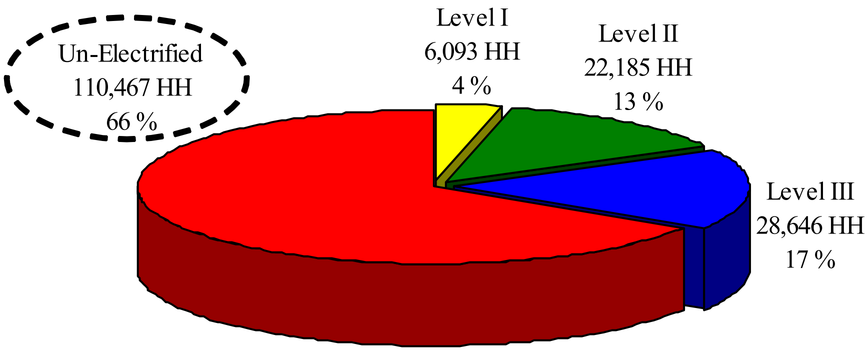


Figure 3.2.2 Status of Household Electrification (as of December 2003)

Table 3.2.1 shows the number of barangays and households in every level of electrification that are served by EC system, mini-grid system, stand-alone Solar Home System (SHS) and Battery Charging Station (BCS).

Table 3.2.1 Type of System by Electrification Level

Status	Type of System	No. of Bgys.	No. of HH connections
LEVEL III	EC System & 24 Hrs. Power Supply	44	28,646
LEVEL II	EC System & 12 Hrs. Power Supply	111	21,512
	Mini-grid & 6 Hrs. Power Supply	1	300
	SHS / BCS	6	373
LEVEL I	EC System & 12 Hrs. Power Supply	57	4,258
	Mini-grid & 6 Hrs. Power Supply	5	570
	EC System & 24 Hrs. Power Supply	47	1,265

3.2.2 PGP Energy Programs and Projects

(1) Rural electrification program

Since 1997 to date the Provincial Government had spent P120 million in financing the expansion and upgrading of distribution lines belonging to PALECO and BISELCO, construction of mini-grid power systems and fuel subsidies for NPC-SPUG's power plants in the unviable areas. There are two schemes in PGP financing, one is the "dole out" scheme and the other is the PGP non-interest bearing loan. In the latter scheme, PGP offers the loan to EC when it can afford to provide the loan.

(2) Creation of permanent energy unit

The Provincial Government is now in the process of creating an Energy Unit under the Provincial Planning and Development Office (PPDO). The task of this unit is to prepare, integrate, coordinate, supervise and control all plans, programs and projects, and activities of the PGP related to energy concerns. At present there are 6 staff members working in this energy unit assigned as the PGP counterpart of this study to formulate the Energy Master Plan. This unit also will be responsible in revising the Energy Master Plan in the future.

(3) Palawan new and renewable energy and livelihood support project (PNRELSP)

This project is intended to demonstrate the viability of the RESCO (Rural Energy Service Company) delivery mechanism of renewable energy systems, and economic activities of productive use of renewable energy services for rural communities. The stakeholders of this project are the Center for Renewable Resources and Energy Efficiency (CRREE), Provincial Government of Palawan (PGP), United Nation Development Programme (UNDP), University of Philippines Solar Lab and Shell Solar Philippines.

(4) PV-wind hybrid system for rural electrification

This project is a pilot centralized utility-type 5kWp PV and 10kW wind turbine hybrid system that will provide electricity to 200 households in Sitio Sicud, Bgy. Candawaga, Rizal. The stakeholders of this project are the Department of Energy (DOE), UNDP, PGP, State Polytechnic College of Palawan – Affiliated Non-conventional Energy Center (SPCP-ANEC) and the Municipal Government of Rizal.

3.2.3 BAPA Scheme (Barangay Power Association)

As of October 2003, the PGP owned 7 small power systems located in Bgy. Port Barton, San Vicente, Bgy. Sta. Teresita, Dumaran, Bgy. Poblacion, Dumaran, Bgy. Liminangcong, Taytay, Bgy. Manamoc, Cuyo, Bgy. Calandagan, Araceli and Bisucay Island, Cuyo. Figures 3.2.3, 3.2.4 and 3.2.5 show the scheme of BAPA and one of the power plants owned by PGP. The PGP, PALECO and BAPA have entered a Tripartite Memorandum of Agreement regarding the implementation. The PGP role is to finance the construction, to own the system and to lease it to BAPA at P1.00 per annum. The PALECO role is to construct the system and provide technical assistance to the operation of BAPA. The association will operate and maintain the system.

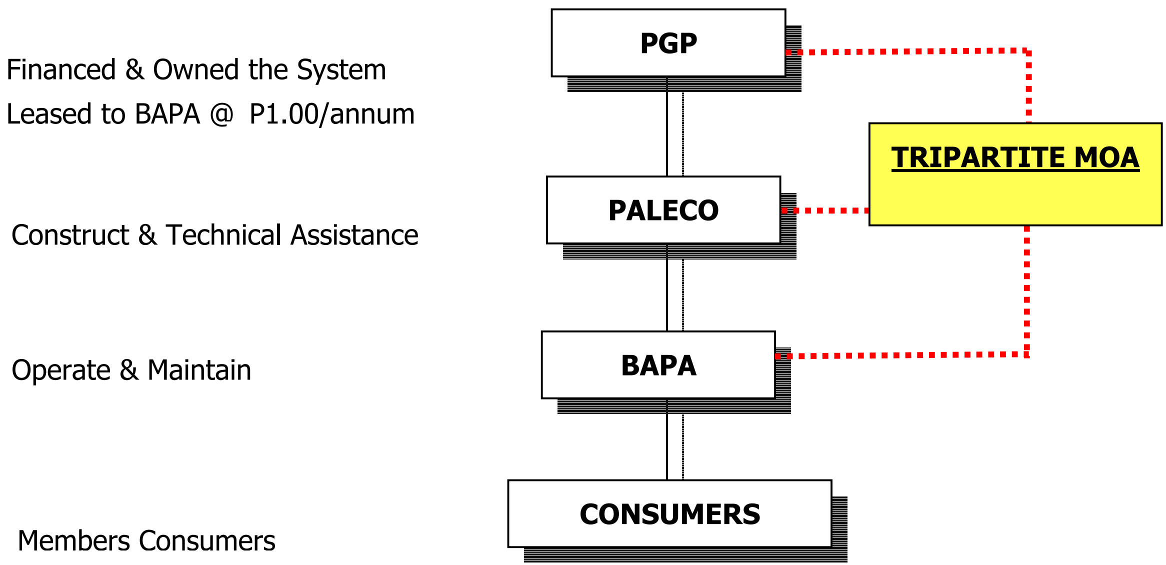


Figure 3.2.3 BAPA Scheme

Figure 3.2.4 Port Barton Power Plant

Figure 3.2.5 3 x 50 kVA Gensets

Table 3.2.2 shows the comparison of operations between PGP&BAPA and NPC-SPUG&EC. NPC-SPUG&EC has a capacity of more than 300kW per power plant and BAPA has installed capacity of 150 kVA. The distribution line installed in the BAPA system is also in accordance with NEA standards for constructing the 13.8 kV primary line and the 440/220V secondary line.

In terms of operating hours, NPC-SPUG&EC supply energy for 24 hours in the main grid and for 12 hours in the island grids, while the BAPA supply energy for only 6 hours daily to small barangay and for 12 hours to the barangay with a large number of households.

In operation, NPC-SPUG is responsible for the power generation and EC is responsible for the power distribution. In PGP&BAPA, the association operates the power generation and distribution.

In terms of subsidies, NPC-SPUG operations are subsidized by the Universal Charge and EC receives a subsidy from NEA. In the case of BAPA, PGP subsidizes the depreciation of the system.

In comparison to power rate, NPC-SPUG&EC is 5.80 P/kWh, while BAPA is 15.00 P/kWh.

In terms of reliability and sustainability, NPC-SPUG&EC is more reliable and sustainable than PGP&BAPA because of its strong organization and access to the universal charge. Presently the BAPA has no technical expertise to do the major repair and overhauling of generators.

Table 3.2.2 NPC-SPUG&EC Operation vs. BAPA

	NPC-SPUG & EC	BAPA
System	>300 kW Power Plant Capacity & Distribution Line	150 kVA Power Plant Capacity & Distribution Line
Operating Hours	6 to 12 hours & 24 hours	6 to 12 hours
Operation	NPC-SPUG – Generation EC - Distribution	Generation & Distribution
Subsidy	NEA & NPC-SPUG (Universal Charge)	PGP (No recovery cost of PGP investment)
Consumers	Urban/Poblacion Households Commercial Users	Rural Households (Farmers & Fishermen)
Power Rate / kWh	P 5.80	P 15.00
Reliability / Sustainability	Reliable & Sustainable	Issues in maintenance

3.3 Generation Facilities

3.3.1 Diesel Power

(1) Outline of diesel generators in Palawan

In Palawan, aside from the small-scale power generation system using renewable energy, the only power generation system is the diesel generator. The main organizations, which operate the diesel generators in Palawan, are NPC-SPUG, IPP, BAPA (Barangay Power Association) and LGU (Local Government Unit).

NPC-SPUG owns 16 diesel generators including the Power Barge. The barge was originally in Mindanao Island, but it was moved to Palawan Province in 2001 in order to ease the electric power shortage of Puerto Princesa City. The oldest generator belonging to NPC-SPUG started operations in 1988 and the newest one started operations in 2002.

Delta-P, the former Paragua power plant, which is only one IPP in Palawan, has a diesel generator with a total capacity of 16MW and started operations from 1997.

In addition to the above-mentioned power plants connected with the existing EC grid, BAPA is operating 7 plants and Rizal LGU is managing 1 plant. All BAPA power plants started operations in 2001. Although Rizal LGU started to operate a plant in 1996, the plant is now used as the back-up power plant and so has stopped its regular operations.

In addition to the above-mentioned facilities, there are numerous small-scale diesel generators that are owned and operated by individuals or BAPA-like organizations[2] in Palawan. These are not included in this study, since most of them are extremely small and an accurate grasp of their conditions would be nearly impossible to obtain.

The general location of diesel generators that are operated by the IPP, NPC-SPUG, BAPA and LGU in Palawan are shown in Figure 3.3.1. Table 3.3.1 shows the manufacturer of these diesel generators. According to this table, all diesel generators that have been installed since 1997 are made by Perkins[3].

Table 3.3.1 Numbers of Diesel Generators by Commissioning Year and Manufacturer

Manufacturer	1988	1990	1992	1993	1995	1996	1997	1998	1999	2001	2002
CKD (Czech)					1	1					
Daihatsu (Japan)			4								
GM (USA)	2										
MAN (Germany)	2	2									
Perkins (UK)			8	3	3		3	3	6	2	2
Pielstick	2										
Total	6	2	12	3	4	1	3	3	6	2	2

[2] According to PGP personnel, there may be about 30 places where local residents have formed BAPA-like organizations, in order to supply their own electricity. Such organizations often use diesel generators (about 15kW) with roughly several dozens consumers.

[3] Perkins diesel generators can be classified as high speed generators. Although the price of a high speed diesel engine is usually low, accumulative running hours is short. As almost all Perkins generators are used in the area with 12 hours daily supply, there is no significant problem until now. However, when considering extending the operation hours to 24 hours per day in the future, there will likely be some problems. Therefore it is necessary to make an installation plan that takes into consideration the supply hours, specifically the operation hours resulting from the future installation of diesel generators.

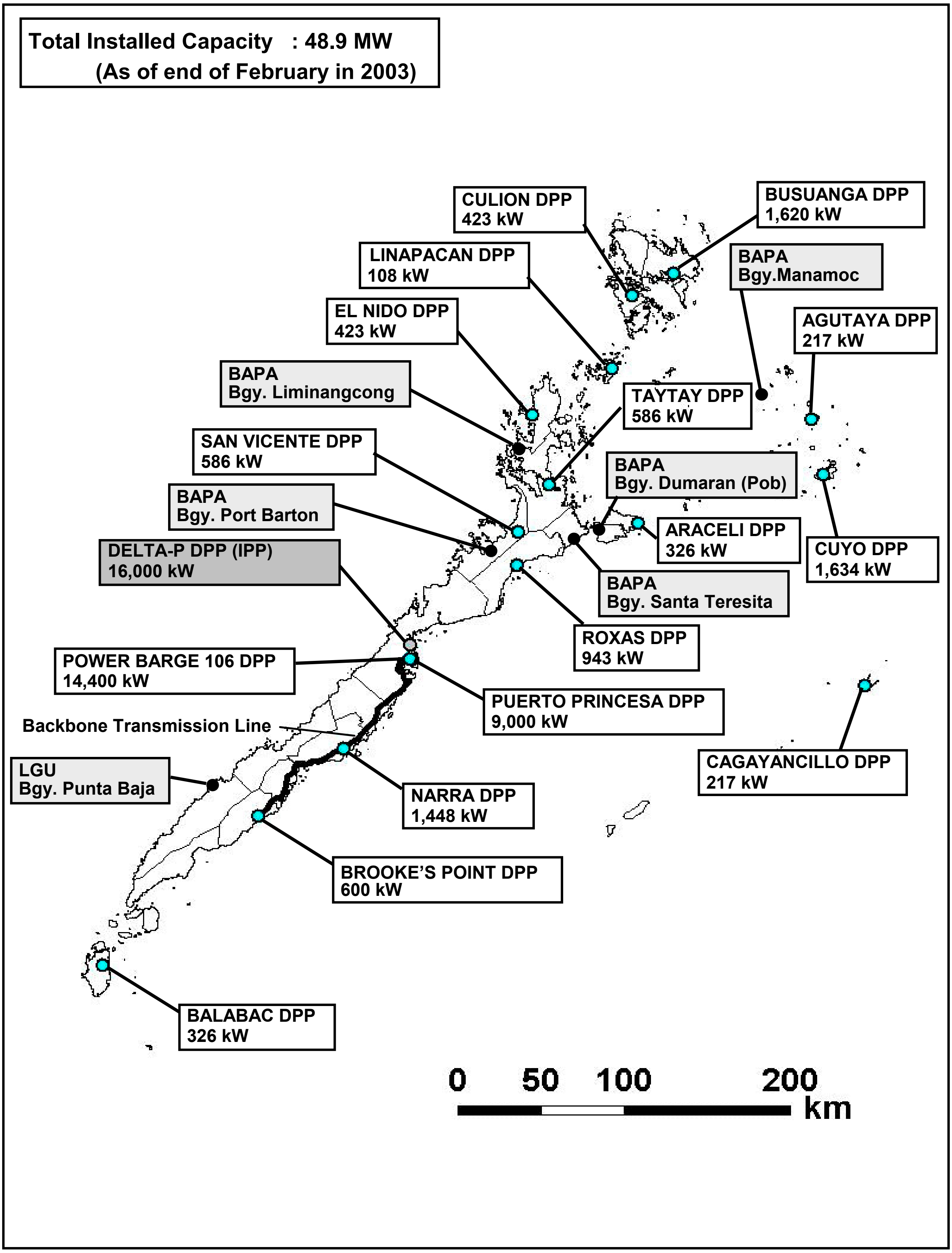


Figure 3.3.1 Existing Power Plants and Installed Capacity

The installation of diesel generators in Palawan depended largely on aid from various donor countries. It is likely that the donor countries had influenced the choice of the diesel generators in favor of manufacturers from the donor countries themselves, either explicitly as a condition for aid or implicitly in their specifications. MAN is a German manufacturer, GM is an American company, Daihatsu is Japanese, CKD in Czechoslovakian and Perkins is British. Recently, diesel generators have been purchased through competitive bidding, and such aid conditions have been discouraged. However, such projects involve a large number of orders for units within a short period. This tends to allow a single manufacturer to become dominant.

All diesel generators installed in Palawan Province after 1997 are made by Perkins. The rated output of diesel generators owned by NPC-SPUG range from 54kW to 5,500kW.

(2) Output of diesel generators in Palawan

The outputs of NPC-SPUG diesel generators are managed by the rated capacity and the dependable capacity in the monthly reports. Generally speaking, the dependable capacity is defined as the output in which continuous operation is possible without any damage in an engine. For example, if at a certain load the temperatures of the coolants and the exhaust may reach the upper limit or the engine causes unusual vibrations, the continuous operation could be impossible at that load. In this case the load becomes the dependable capacity.

The total rated capacity of the diesel generators operated by IPP and NPC-SPUG in Palawan Province as of February 2003 is 48.9MW, and that of the dependable capacities is 36.8MW. The dependable capacity is about 20 percent smaller than the rated capacity.

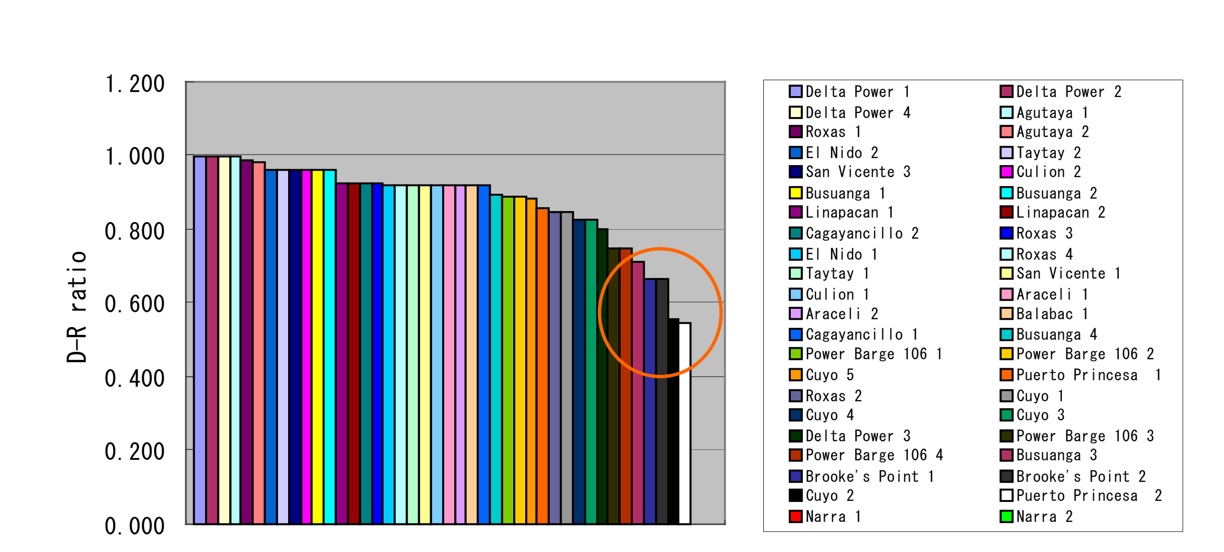
The ratio of the dependable capacity to the rated capacity is called the D-R ratio. For example, the D-R ratios for two generators in Puerto Princesa City DPP are as follows;

Table 3.3.2 D-R Ratio of Puerto Princesa City DPP

Diesel Power Plant		Rated Capacity(kW)	Dependable Capacity(kW)
Puerto Princesa City DPP	1	3,500	3,000
	2	5,500	3,000

D-R ratio = Dependable Capacity / Rated Capacity
Unit No. 1 D-R ratio 3,000 / 3,500 = 0.857
Unit No. 2 D-R ratio 3,000 / 5,500 = 0.545

D-R ratios for all diesel generators that are operated by the IPP and NPC-SPUG in Palawan Province have been calculated based on the data as of February 2003. Figure 3.3.2 shows the sorted generators by the higher D-R ratios.

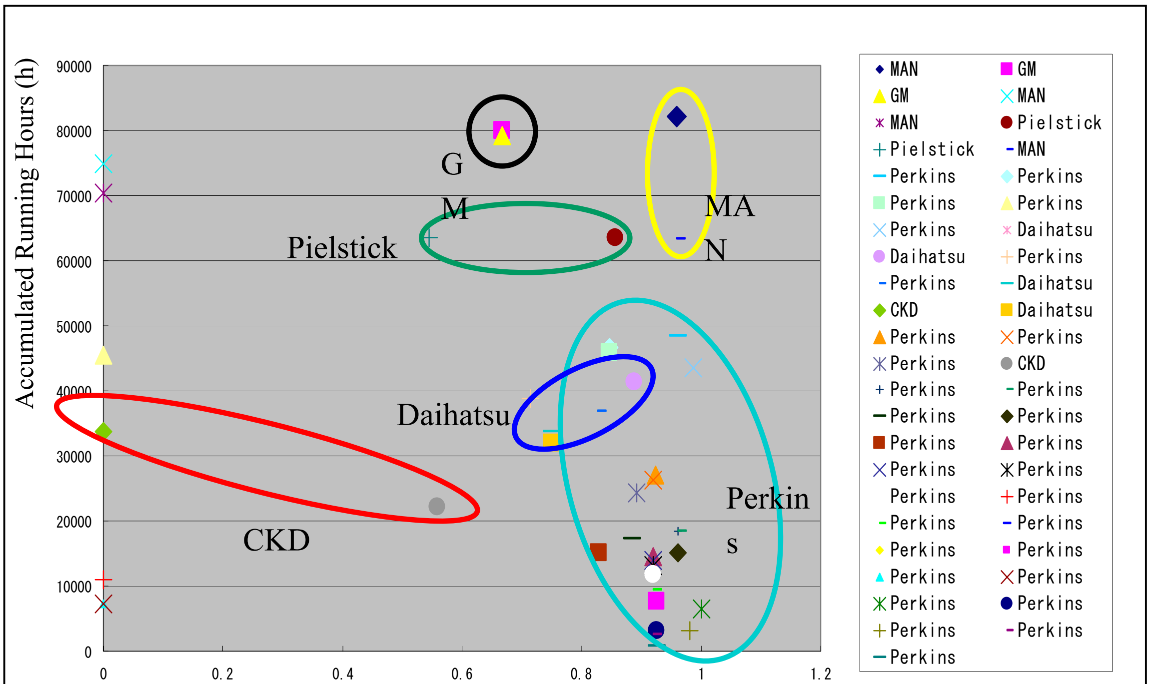


(Source: JICA Study Team As of end of February in 2003)

Figure 3.3.2 D-R Ratio for each Diesel Generator

Each part of the engine will gradually deteriorate along with the operations, which causes the reduction of the dependable capacity. For diesel generators with a D-R ratio of less than 80%, such as Power Barge 106 No. 3 and No. 4, Brooke's Point No. 1 and No. 2, Busuanga No. 3, Cuyo No. 2, and Puerto Princesa City No. 2, there would be unknown faults besides those caused by the longer operation time.

Figure 3.3.3 shows the engines sorted by accumulated running time. Proper overhaul can restore the engine's dependable capacity.



(Source: JICA Study Team As of end of February in

Figure 3.3.3 Relation between Accumulated Running Hours and D-R Ratio by Manufacturer

Engines made by MAN tend to maintain high levels of dependable capacity, even under long accumulated running hours. Daihatsu engines show large declines in output even under comparatively short running hours. CKD engines seem to be the most problematic, with large output declines despite the short accumulated running hours.

(3) Thermal efficiency

The average thermal efficiency of a diesel generator can be measured in gross terms and net terms. The net average thermal efficiency[4] is used in the following discussion.

Figure 3.3.4 shows the NPC-SPUG diesel generators sorted by their net average thermal efficiency as of February of 2003.

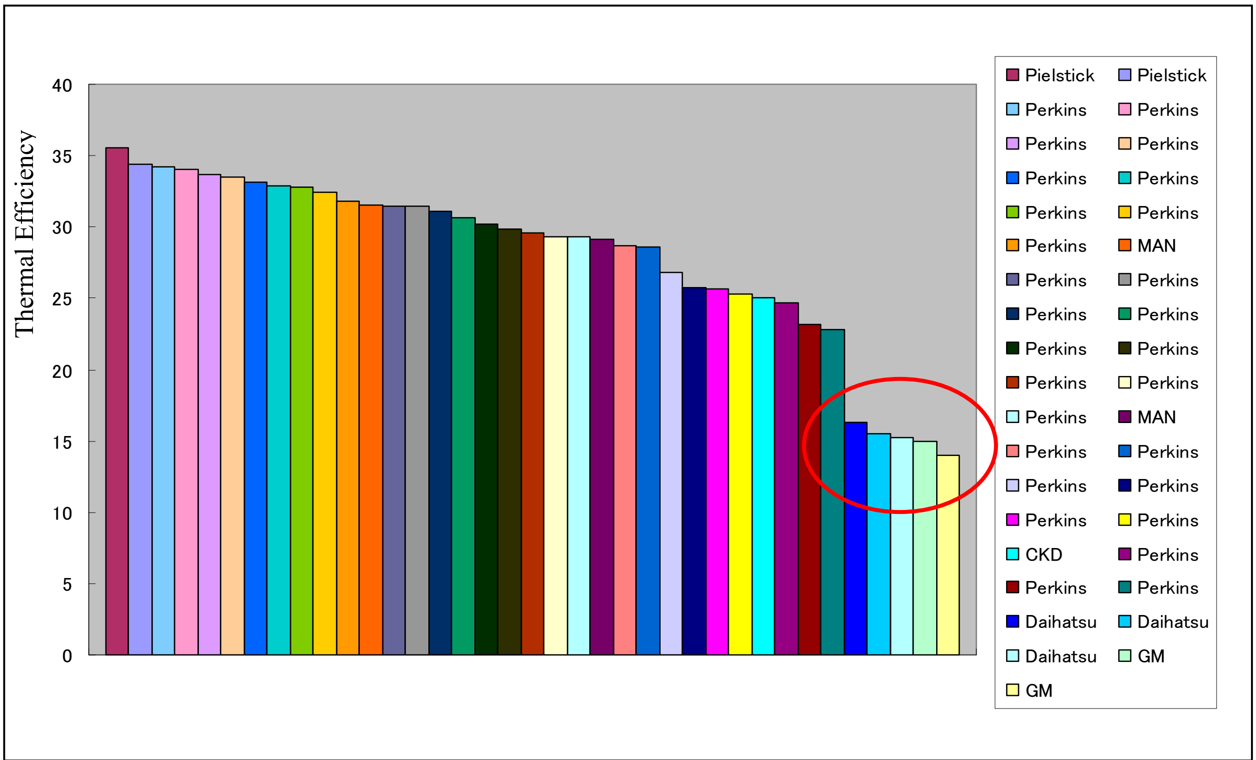


Figure 3.3.4 Average Net Thermal Efficiency of the NPC-SPUG Diesel Generators

Some engines show extremely low thermal efficiency. Figure 3.3.5 shows the relationship between accumulated running hours and the net average thermal efficiency, again grouped by the manufacturers. The figure shows that GM engines fare quite badly in terms of thermal efficiency. Thermal efficiency of Daihatsu engines is also quite low, even with relatively low accumulated running hours. The CKD engines also have comparatively low thermal efficiency.

[4] The definition of the net average thermal efficiency is as the following.
Average Net Thermal Efficiency = Net Generation (Gross Generation - Station Use) / Heat Supplied

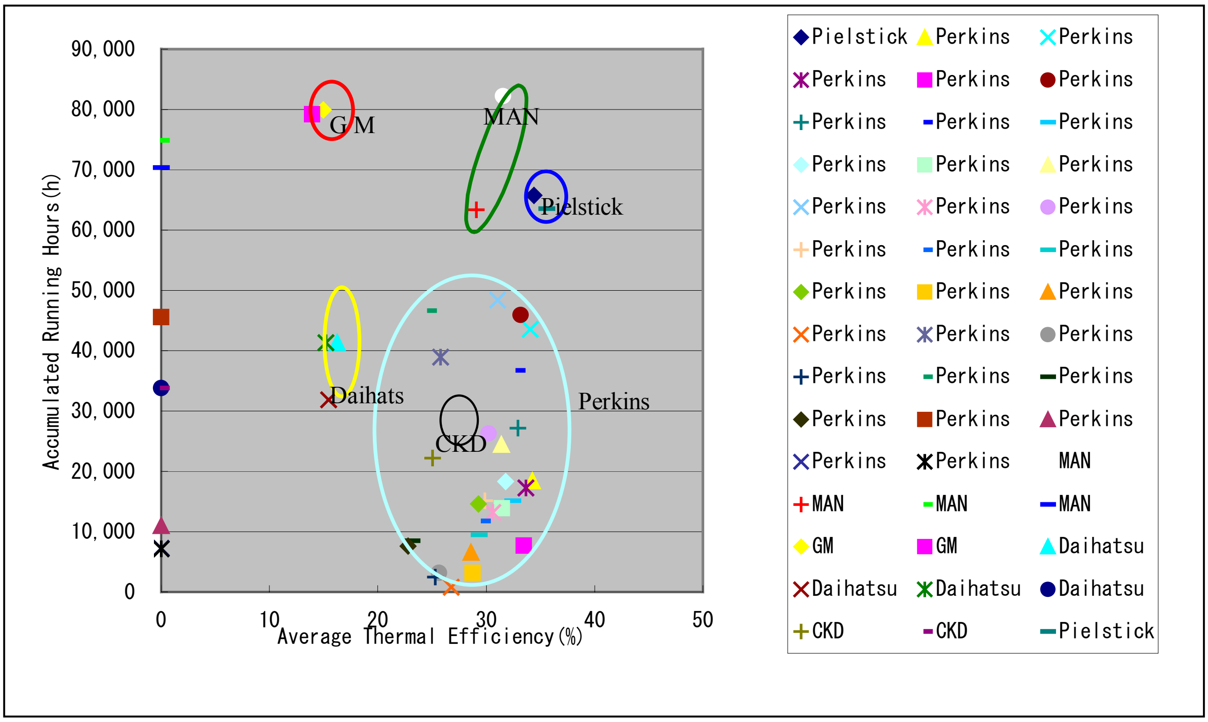


Figure 3.3.5 Relationship between Accumulated Running Hours and Average Thermal Efficiency by Manufacturer

However, thermal efficiency is influenced considerably by the engine's load (actual output / rated capacity). An engine that is operated at around the rated capacity has high thermal efficiency, while an engine operated at a lower load has low thermal efficiency. Figure 3.3.6 shows a typical relationship between the rate of load and the thermal efficiency. As for diesel A, the thermal efficiency will decline about 10% when the load decreases from 100% to 50%. The degree of the change varies depending on manufacturer and type. Figure 3.3.7 adds the rate of load of each generator to the net thermal efficiency.

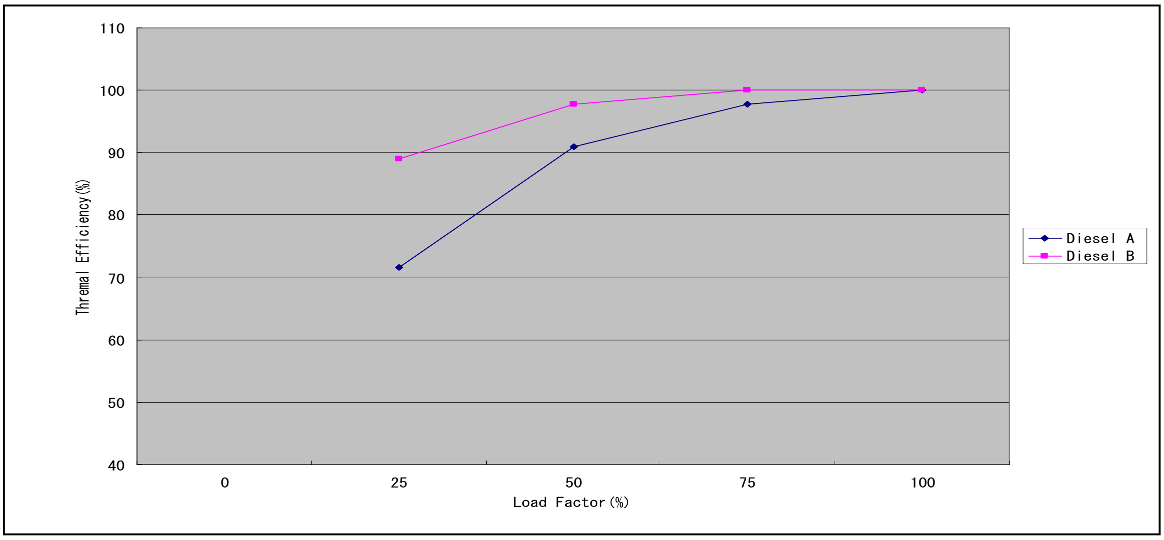


Figure 3.3.6 Relationship between Thermal Efficiency and Load Factor (Example)

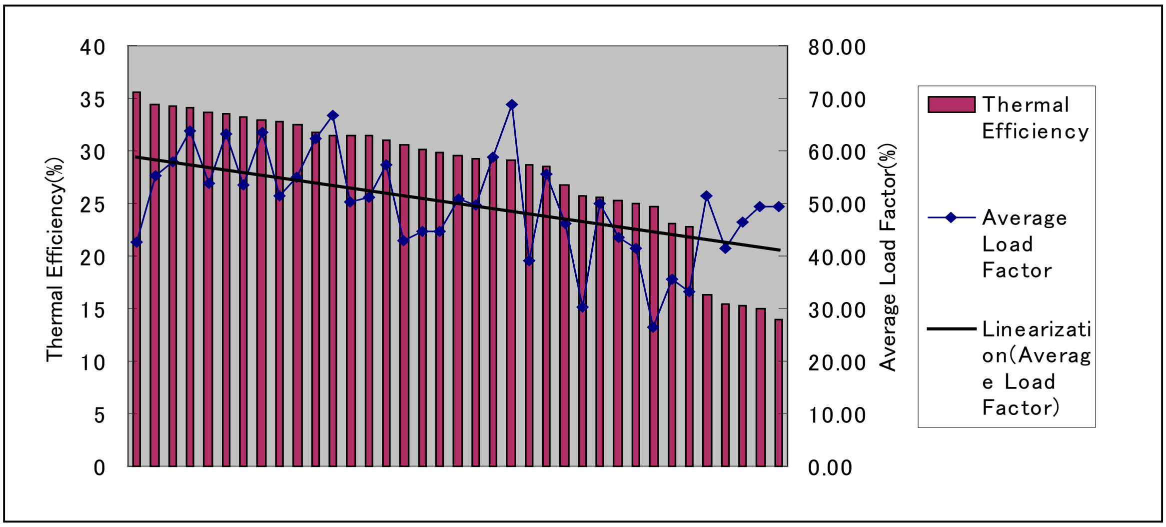


Figure 3.3.7 Thermal Efficiency and Average Load Factor

It turns out that in general, the thermal efficiency tends to fall with the decline of the rate of load. The remarkably low rate of load seems to have influenced the fall of thermal efficiency of the Perkins engines. However, although the rate of load is not necessarily extremely low for Daihatsu and GM engines, thermal efficiency is extremely low. This may be caused by some mechanical problems other than the rate of load.

(4) Operation and maintenance of diesel generators in Palawan (Site survey)

Site surveys were conducted at one IPP plant, five NPC-SPUG plants and one BAPA plant, concerning the operation and maintenance of their diesel generators. The following were the investigation items.

► Is the organization satisfactory?
  - Is there an organization chart?
  - How many shifts are there?
  - Is the number of operators and maintenance personnel adequate?
► Are there appropriate guidelines and documents?
  - Are there appropriate operation guidelines?
  - Are there appropriate maintenance guidelines?
  - Are there appropriate periodical inspection and overhaul schedules?
  - Are there appropriate drawings that are needed to do maintenance and to operate the generator?
  - Are there appropriate operation records?
  - Are there appropriate maintenance records?
► Are there appropriate inventory controls?
► Are there appropriate supplies of fuel, lubricant oil and spare parts?
► Are there appropriate procedures to check the quality of fuel and lubricant oil?
► Is maintenance carried out according to set schedules?
► Are the diesel generators operated according to guidelines?

Generally, the most appropriate guidelines for operation and maintenance are to follow the manufacturer's manuals. The method of operation, the investigation method and the investigation interval varies from manufacturers and generator types. Therefore, the site surveys focused on the actual implementation of the guidelines, rather than the existence of the guidelines themselves.

The plants for the site survey were selected as follows.

► IPP plant

Delta- P

Selected because it is the only IPP in Palawan Province (rated capacity of 16,000kW).

► NPC-SPUG plants

Power Barge106

Selected from among the NPC-SPUG power plants because it is the only large-scale power plant that uses bunker C oil (rated capacity of 14,400kW).

Puerto Princesa City DPP

Selected as a large-scale plant in Palawan Province that supplies electric power to the backbone grid together with Power Barge106 and Paragua plant (rated capacity of 9,000kW)

Busuanga DPP

Selected as a large-scale plant on a mini-grid, with no connection to the backbone grid (rated capacity of 1,620kW).

Roxas DPP

Selected as a middle-scale plant of a mini-grid (rated capacity of 943kW).

El Nido DPP

It is selected as a small-scale plant of a mini-grid (rated capacity of 423kW).

► BAPA plants

Port Barton DPP

Plants managed by BAPAs are mostly the same in terms of scale and operation. This plant was chosen as a good representative plant (rated capacity of 162kW).

(i) Delta-P

This is an IPP plant with four diesel engines made and leased by Wartsila (Finland) with a rated capacity of 4.0MW each. Until January of 2003 this IPP (named Paragua) was managed by three groups. Due to NPC-SPUG's failure to pay the power costs, the IPP has defaulted on the lease payment for the generators. Wartsila seized the plant and brought it under the management of a new company called Delta-P.

Units No. 1, 2, and 4 can be operated at the rated capacity. As for the No. 3 unit, due to significant running time after an overhaul, the dependable capacity has gone down to 3.2 MW. (as of March 2003)

Major overhauls are carried out every 3,000 hours of operation. There are 3,000-hour overhauls, 6,000-hour overhauls, 9,000-hour overhauls and 12,000-hour overhauls. This plant has a maintenance contract with Wartsila, which has an office in Manila, and there is no problem in terms of maintenance. Wartsila is also supplying parts in a satisfactory manner. Inspections and overhauls are conducted by supervisors and a worker that come from Manila.

The operation situation (temperature, pressure) of each unit is supervised on CRT, and the plant is in a good operational condition.

The total number of workers is 27, including a plant manager. The plant is operated under three shifts, covered by four groups with three members each. In addition, there are eight maintenance staff members, six clerks and other positions.

(ii) Power Barge 106

This plant is a power generation ship and has four Daihatsu diesel engines each with a rated capacity of 3.6 MW. Units No. 1 and 2 were operated at the dependable capacity of 3.2 MW as of March, 2003 and Units No. 3 and 4 were operated at the dependable capacity of 2.7 MW. One operator explained that since seawater mixed in the lubricant oil system, an engineer from Daihatsu recommended restricting the dependable capacity to below 2.7 MW after the overhaul. At the time of site surveys, there was no one on site who could explain this in detail. Daihatsu's Manila office later explained that the plant had once been connected to the Mindanao grid. The load fluctuated very often from near no-load to full load. A crankshaft of one unit had been damaged, which had since been replaced. The crankshaft of the other units remained, but it was suspected that they were also experienced significant stress. That was the reason for their recommendation to reduce the dependable capacity.

Three kinds of overhauls are done every 3,000 running hours; a minor overhaul, a semi-major overhaul and a major overhaul. Overhauls are carried out according to the manufacture's manual and it seems that maintenance is carried out pertinently.

The stocks of spare parts were insufficient. In the case of an emergency, parts are often brought from other plants. They said that ordered parts take extremely long to arrive, so that they were not sure exactly how long it takes to get them.

Although there are two boilers for heavy oil heating, they were not in operation because there were no chemicals to be mixed with boiler water. (An electric heater was substituted.)

The plant is operated by three shifts, using four persons per shift. They consist of one Principal Engineer, one Senior Control Operator, and two Equipment Operators.

Records are made every hour using seven sheets. Restriction values are also included, and they are satisfactory. As for maintenance records, only the outlines of inspections or overhauls are recorded, which is not satisfactory. Although failure records exist, they are only kept as records and are not organized for utilization.

The inventory, such as fuel, is reported to the head office every month. A fuel supply request will be carried out ten days beforehand. This does not cause any problems.

Inside the plant it was clean and well arranged although oil leaks were seen at some places due to equipment age. The maintenance room was also sufficiently tidy.

(iii) Puerto Princesa City DPP

This plant is operated by three shifts and they have four groups, which consist of two persons each. The groups that are not in charge of the shift carry out maintenance and other duties. Six people are full time employees and two people are contracted employees.

There had been training programs and training in Manila and other locations before NPC-SPUG was dissociated from NPC. However, OJT is the only training provided now.

The operation record is recorded on one sheet. Scheduled inspection and overhaul records were described in the notes together with the usual repair records. Special mentions are only described and therefore it is hard to tell whether sufficient management is carried out. The styles of recordkeeping vary from each plant.

Quality inspections of fuel and lubricant oil are not conducted at each plant. Inspection records of suppliers are checked. There is no problem in terms of fuel supply.

At the time of the scheduled inspections or overhauls, if no replacement part is available, the part that had been in use until that time will continue to be used.

There are preventive maintenance (scheduled inspections and overhauls) and corrective maintenance (repairs at the time of failure). The No. 2 unit was under corrective maintenance., because the exhaust temperature had risen above the acceptable limit.

Figure 3.3.8 No. 2 Unit Under Corrective Maintenance

(iv) Busuanga DPP

There are 5 groups and a 3-shift system. Of the two groups that are out of the shift, one group will be off. The other one takes charge of maintenance. Each group has two persons, one of which is exclusively assigned to maintenance duty (a total of 11 persons). There is a person in charge of checking records (Results Engineer).

Although two MAN generators (total rated capacity of 1MW) are due to be transferred this year from Nara, the cost for building proper housing for them cannot be financed. 300,000Pesos-500,000Pesos is required for the transportation, and 5-8million Pesos is required for the building construction.

Overhauls can be managed by of the staff at this plant and no support from Manila is necessary (even for major overhauls).

Since the generator of Unit No. 1 was damaged by fire 3 times, it was sent to the factory in Manila 3 times. The bearing wore out and some parts made contact.

CKD engines often broke down, even after repairs using new parts (thus, they are now retired).

Although the designed rating capacity of the MAN engine is 360kW, it is set to 250kW. The temperature of engine cooling water rose unusually and the rated capacity was set to the present value. There was no explanation in detail except for that it was because of the temperature difference between Germany and the Philippines. Since fuel is supplied in drums, the unit price is high. Because the present fuel supply contract may expire in December of 2003, a new supplier will be expected to make a tank at the plant and supply fuel by truck. The drums are loaded outdoors, which is not desirable in terms of safety and quality control.

There was no detailed record for overhauls, such as clearance records and valve timing records, although the engineer of the plant was aware of the usefulness of such records. There is one operation record for each single unit.

(v) Roxas DPP

There is a manager and five groups of 2 persons. The plant is operated by three shifts. In addition, there are three guards and two clerks. The total number of persons is 16. The shift consists of 0-8, 8-16, 16-24, day off, and maintenance.

Operation records are recorded for each unit every hour. Restriction values are not indicated. There are maintenance records for each unit. The records for changing oil and the repair results are filled in for every unit. As for overhauls, there is another record book in which there are descriptions of what was carried out but only for such matters as what was exchanged.

All four units are operated in the evening. The plant is extremely stressed due to increasing demand. Load is restrained when there is a failure in one unit.

The surroundings around the generators were well cleaned, and the inside of the plant was well arranged.

Drums of lubricant oil are kept outdoors, which is not proper storage.

Regarding fuel tanks, there is a storage tank of 230,000L and a daily tank of 1,200L for each unit. Fuel is supplied by truck, at intervals of 1 week to one month.

(vi) El Nido DPP

The organization is the same with SPUG. In addition, there is one cleaning person and three guards. Five persons work in three shifts. The operation time is 12 hours (13:00-1:00). The Daily Operation record is recorded on one sheet. However, the storage situation is not good. Failure records are recorded in another record book. Records of overhauls are not found. According to the explanation from the operator, the maintenance group of Luzon operations carries out overhauls and they keep records. Although people at this plant change the oil and filters, they do not do overhauls including minor overhauls. Oil changes are carried out every 250 hours and valve-gap is measured every 350 hours.

Although there is a fuel storage tank, it has never been used. Since El Nido is in a remote district and the fuel is supplied in drums, a fuel storage tank is unnecessary. They had 124 drums containing fuel (as of October of 2003). 150-200 drums are received once every three months. Lubricant is received in two drums once every six months. The drums are kept in the open air.

Regarding the training, the operator said that he attended seminars 3 times from 1999 to 2000 in Puerto Princesa. Training on overhauls had not been taken. He had not taken the training on maintenance and he had learned only by experience.

Although there was one manual from the manufacturer, it was tattered and unreadable (Figure 3.3.9).

As for Unit No. 1, the cooling-water temperature rose due to leakage from the radiator and the deposited scale in the engine and so continuous operation could not be performed. It was not clear how they would deal with this problem within NPC-SPUG, nor when this problem would be fixed.

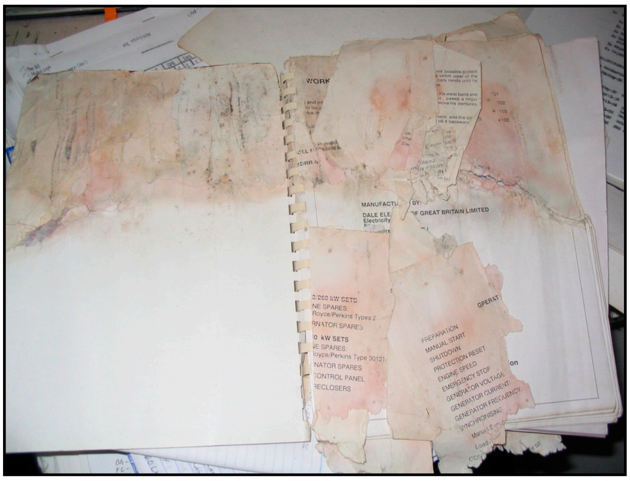


Figure 3.3.9 Manual

(vii) Port Barton DPP

The outline organization chart of Port Barton DDP is shown below.

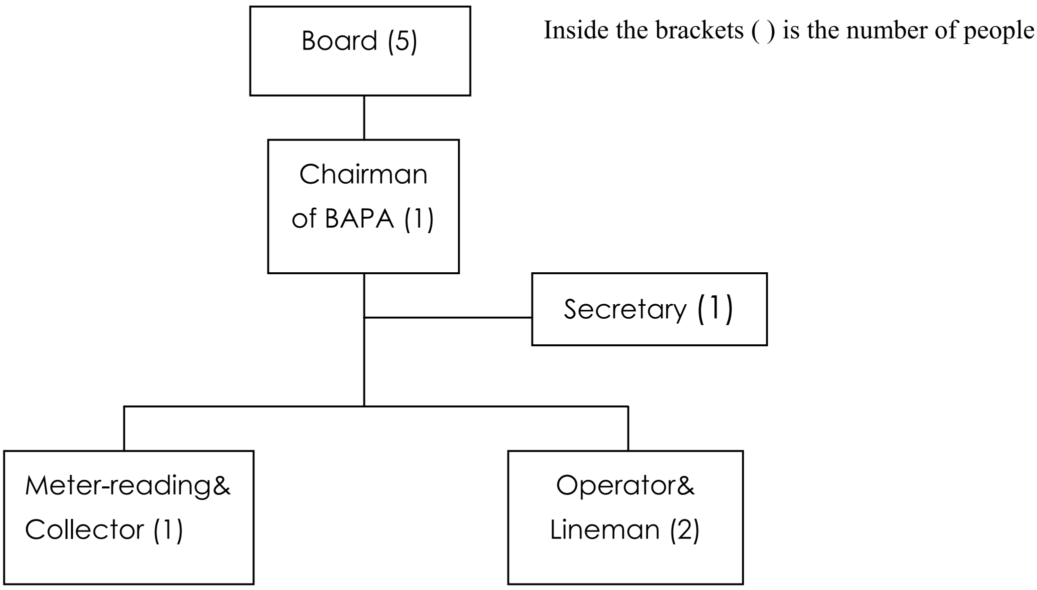


Figure 3.3.10 Organizational Chart for Port Barton DDP

This organization was modified from the initial plan. A guard was omitted and a two line-men system was abandoned so that operators would do the job of the line-men. (Line-men were originally planed to double as meter-readers and charge-collectors.) Since an election has not been carried out yet, there is no board. BAPA partners elect them. Similarly, since an election has not been carried out, the barangay Captain is serving as the Chairman temporarily. PGP explains that the board must be organized immediately after BAPA starts operations and an election has to be carried out, but the election has yet to be held.

The commissioning is May of 2001. There are 151 customers (seven are resort hotels) as of October of 2003. It was only 40 customers immediately after the commissioning. It generates electricity from 6:00 p.m. to 11:00 p.m.

They bought diesel oil at 22.75P/liter from a gasoline station. The price of lubricant oil was 80P/liter.

Until last year, one unit was able to provide all of the electricity needed during operating hours. It became a two-set operation after entering the end of this year, due to increased demand. Dependable capacity is 40kW (54kW of rating).

An operator requests the fuel supply to the chairman and the chairman purchases fuel.

The building looked substantial and engines looked brand-new. The inside of the plant was well organized.

Running hours for each unit was: No. 1 1,945.2 h, No. 2 1,716.8 h, and No. 3 1,945.0 h. Daily operation records only recorded cooling-water temperature and lubricant oil pressure in addition to the values related to the output. The surveillance of engines is the same as that of the cars except what relates to the electricity. This may be enough for this type of engine.

There is no inspection schedule. Filter and oil changes are carried out according to the manual.

The operator who was in charge on that day was employed one year ago and received a briefing from the engine supplier when he started to work. However, there was no training after that. He told us that he was not able to do a 2,000-hours overhaul.

The tools were also inadequate for carrying out overhauls. The content of the manufacture's manual was similar to that for a car, and it was too simple for performing overhauls. The engines' running hours would soon reach 2,000 hours, when the engines must be overhauled. An actual overhaul seems doubtful because there is no skill and no budget for an overhaul.

There had been no failure since commissioning.

They were managing inventory control as the amount of fuel consumption was recorded every day.

These site survey results can be summarized into the following table (Table 3.3.3).

Table 3.3.3 Site Survey Results (Diesel Power)

O: Yes, △: Not enough, X: No

Items	IPP	NPC-SPUG	BAPA
Is the organization satisfactory?	O	O	△
Is the training program satisfactory?	O	△	X
Are there appropriate guidelines and documents?	O	△	X
Are there appropriate inventory controls?	O	O	O
Are there appropriate supplies of fuel, lubricant oil and spare parts?	O	△	△
Are there appropriate procedures to check the quality of fuel and lubricant oil?	O	O	△
Is maintenance carried out according to set schedules?	O	△	X
Are the diesel generators operated according to guidelines?	O	O	O

Regarding the IPP, staff members are disposed properly and Wartsila, which is an engine manufacturer, is engaged in operation and maintenance so that the situation surrounding the equipment itself is very good.

NPC-SPUG has enough employees. It performs Top Overhauls, Intermediate Overhauls, and Major Overhauls as described below. The plant staff conducts Top Overhauls and Intermediate Overhauls. The engineers who carry out Major Overhauls of most plants and are allocated at Workshop, Maintenance & Technical Services, carry out Major Overhauls.

Table 3.3.4 Top Overhauls, Intermediate Overhauls and Major Overhauls

Accumulated Running Hours	Maintenance Works
3,000 - 5,000	Top Overhauls
5,000 - 10,000	Intermediate Overhauls
10,000 - 15,000	Major Overhauls

The staffs of NPC-SPUG carry out all overhauls by themselves, which indicates that the skill level of NPC-SPUG is quite high. However, according to interviews conducted at the plants, it was discovered that the training is not well organized. Although it seems that training had been carried out in the past, they have stopped and the only training today is OJT. In El Nido, the engineers of Workshop and Maintenance & Technical Services carry out all overhauls, and the staff of the plant cannot carry out overhauls.

On the other hand, the staff of the Busuanga power plant carries out all overhauls. The levels of skill vary considerably among plants. Although there may be few problems at present, there is a concern that the skill of NPC-SPUG will deteriorate in the future. Moreover, although the record at the time of overhauls was checked at each plant and at the Workshop and Maintenance & Technical Services office, suitable overhaul records were not available. Without appropriate records, it is difficult to identify what is wrong.

It is considered that BAPA may not be able to continue management. Since the operation time was short, the equipment themselves were performing well. It is, however, impossible for the operator, who only received a short initial briefing from the supplier to carry out, overhauls and other maintenance.

Although the manufacturer's manual is generally used for operation and maintenance of diesel generators, the manuals that BAPA managers have are too simple to be used for overhauls. Moreover, the budget and skill needed to perform the upcoming overhaul was lacking, and therefore there was no overhaul or inspection plan.

(5) Problems of diesel generators in Palawan

Regarding the IPP, the state of the power generation equipment itself seemed to be well maintained. Data cannot be obtained and the team was not allowed to go around generators because of confidentiality issues. The following describes the problems of NPC-SPUG and BAPA.

(i) NPC-SPUG

(a) Insufficient budget for replacement of parts

This problem was heard at most of plants and this can be said to be the root of most of the other problems. Diesel generators require the proper replacement of various parts at the correct intervals. The flowchart below shows the problem produced by the shortage of budget (Figure 3.3.11).

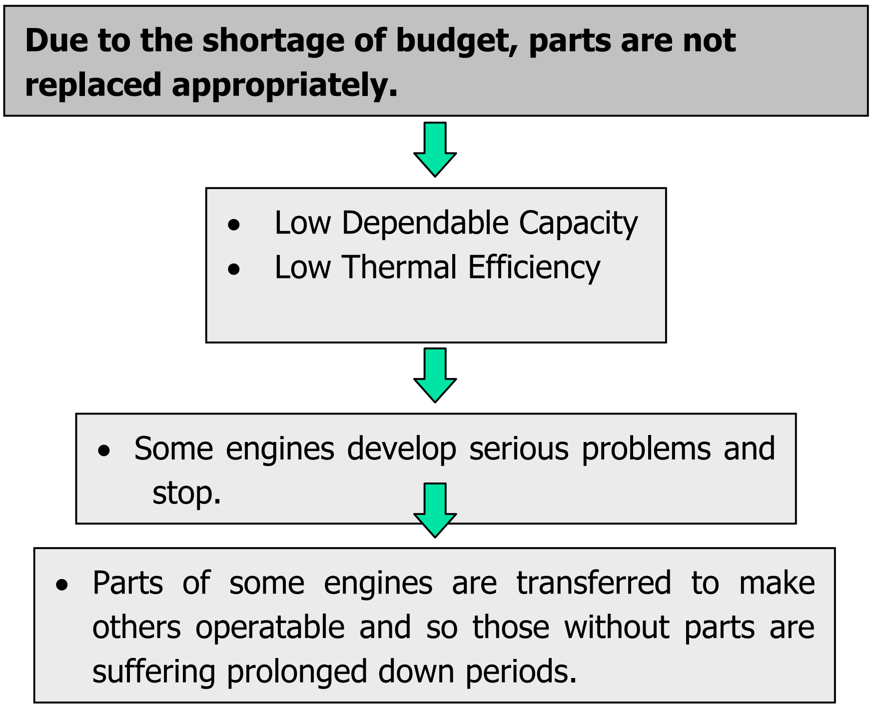


Figure 3.3.11 Problems Caused by the Shortage of Budget

(b) Lack of proper records

Proper records of overhauls were not seen. Moreover, especially at the small plants, since it is difficult to fix the load because the demand changes widely, the performance tests before and after the overhaul are not carried out. Furthermore, most of the commissioning test results were not found. The problem of the lack of proper records is shown in Figure 3.3.12.

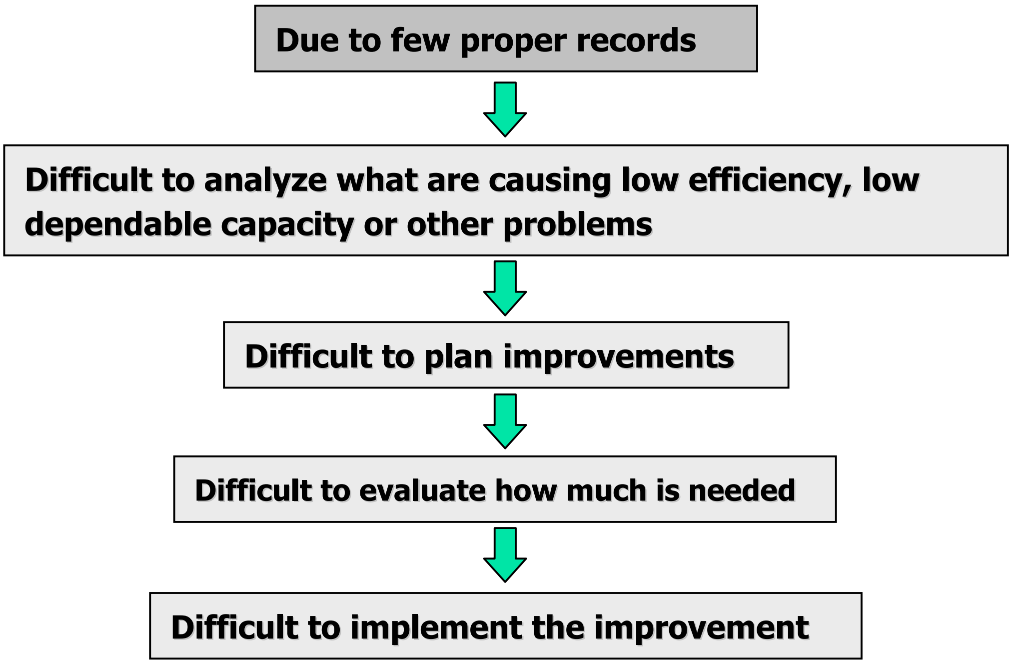


Figure 3.3.12 Problems Caused by the Lack of Proper Records

(c) Retirement of old diesel generators

When diesel generators are superannuated, the frequency of failure tends to increase and thermal efficiency declines. Therefore, it is necessary to plan the retirement of diesel generators by evaluating the reliability and the economical efficiency which comes from the increase of fuel consumption and a maintenance costs.

However, many manufacturers claim that since all parts of a diesel generator are exchangeable, if overhauls are carried out properly and proper parts replacements were made, it should be able to continue operation indefinitely. A large number of middle-speed engines in Japan continue operation for 30 years or more, and are decommissioned only when the manufacturer stops supplying parts.

On the other hand, for the high-speed engines the record is very limited even in Japan. It is generally thought that it is difficult for the high-speed engine to operate for more than 100,000 hours. NPC-SPUG evaluates diesel generator performance by capability of the unit, fuel efficiency, recurrence of engine troubles and availability or non-availability of spare parts, and it decides whether to retire the diesel generator or to undertake rehabilitation. NPC-SPUG's management team is authorized to make this decision.

Although the criteria for the evaluation are not clear, the process of the decision is not problematic. It is sometimes pointed out that the lack of a diesel generator retirement plan may lead to the indefinite use of old generators with low reliability and high operation costs. However, the bigger problem seems to be that the inadequate overhauls caused by the budget shortage may cause the generators to become out of service prematurely.

(d) Transfer of redundant diesel generators in the areas that received transmission line extension

There are plans to transfer redundant diesel generators in the areas that received transmission line extension. Those generators may be used in other un-electrified areas. However, the expected result may not be attained unless the state of the engine transferred is investigated thoroughly. For example, two sets of diesel generators made by MAN at Narra DPP and the GM diesel generator at Brooke’s Point. DPP are currently not used. Their accumulated running hours were long and the acquisition of parts is difficult for the GM engine. Therefore, numerous problems are likely to occur shortly after the transfer.

However, there are already plans to transfer these diesel engines. MAN diesel engines at Nara DPP are due to be transferred to Busuanga DPP. Another two sets of MAN diesel generators are already in Busuanga. By adding two sets of MAN diesel generators, the reliability can be improved because they can share their parts. That, as well as the increase of power generation capacity, is very beneficial. Two sets of GM diesel generators of Brooke’s Pt. DPP are scheduled to be transferred to Roxas DPP, as reserve units. They will be transferred to a plant currently without a spare diesel generator. In these cases the transfer plans for the four units can be justified.

(ii) BAPA

Many problems exist for the BAPAs. Since operation and maintenance manuals vary with the manufacturer and the type of engine, manufacturer's manuals themselves are usually used for operation and maintenance. However, the manual currently offered to BAPA by the manufacturer is too simple for performing an overhaul of the engine. Moreover, BABA does not seem to recognize that continual overhauls are crucial for the diesel generator. There is no preparation of capital, no schedule for overhauls and none of the skills needed for overhauls.

Although there have been no failures in the past three years since the commissioning, some trouble will happen sooner or later, and without proper overhauls, this will lead to other troubles to the extent that the whole unit will become non-operational.

3.3.2 Solar and Wind Power

(1) Existing system

In Palawan a large number of PV systems have been installed. Even though the total amount of installed PV modules and locations of PV systems are uncertain, existing PV systems are summarized by the organizations that support the installations of the PV systems.

(i) SPCP-ANEC

SPCP-ANEC is one of the NGOs that promote the installation of renewable energy in Palawan such as micro hydropower and solar power. They have already installed 246 SHSs in 11 barangays and 14 BCSs in 14 barangays as of October 2003. The total installed capacity of these systems is 19kW. Table 3.3.5 shows the solar power projects installed by ANEC.

Table 3.3.5 SPCP-ANEC Solar Project List

Type	Site	Total capacity	No. of HH	O&M Organization
SHS	Campung Ulay, Rizal	50Wp	1	SPCP-ANEC
	Poblacion, Araceli	150Wp	2	
	Poblacion, Dumaran	75Wp	1	
	Sibaltan, El Nido	75Wp	1	
	ANEC, Aborlan	75Wp	1	
	Catep, Dumaran	1,600Wp	20	BASPA (Barangay Solar Power Association)
	Magsaysay, Dumaran	1,600Wp	20	
	Busybees, Taytay	1,600Wp	20	
	Calaawag, Taytay	1,600Wp	20	
	Cataban, Taytay	1,600Wp	20	
	Pularaquen, Taytay	1,600Wp	20	
BCS	Bacao, Dumaran	900Wp	20	
	Culasian, Dumaran	900Wp	20	
	Danleg, Dumaran	960Wp	20	
	Banbanan, Taytay	960Wp	20	
	Biton, Taytay	960Wp	20	
	Casian, Taytay	960Wp	20	
	Debangan, Taytay	960Wp	20	
	Berong, Quezon	225Wp	10	
	Bonog, Rizal	450Wp	20	
	Campung Ulay, Rizal	225Wp	10	
	Candawaga, Rizal	225Wp	10	
	Sicud, Candawaga, Rizal	225Wp	10	
	Daan, Apurawan, Aborlan	225Wp	10	
	Bubusawin, Aborlan	450Wp	20	

(ii) NPC-SPUG

In the franchise area of BISELCO, NPC-SPUG installed 23 BCS. According to the site survey at Barangay Lajala in Coron, NPC-SPUG installed BCS in 2001 to supply power to 20 households. NPC-SPUG donated PV modules with a 300W (75W x 4) capacity in total, and rented other equipment, such as BOS, batteries and DC lamps to the beneficiaries in the barangay. The monthly payment to NPC-SPUG was PHP 104 per month and each beneficiary pays PHP 30 per day. In return for the monthly payments, beneficiaries can achieve services for the replacement of the equipment. At present, only a few beneficiaries use BCS due to some equipment troubles such as with the battery and light. Table 3.3.6 shows a list of barangays where NPC-SPUG installed BCS.

Table 3.3.6 Locations of BCS installed by NPC-SPUG

Municipality	Location of BCS
Coron	Banuang Daan, Buenavista, Bulalacao, Cabugao, Decabobo, Lajala, Malawig, Marcilla, San Jose, Tara
Busuanga	Panlaitan, Quezon, San Rafael
Culion	Galoc, Luac
Linapacan	Barangonan, Cabunlawan, Calibangbangan, Decabaitot, Maroyogroyog, New Culaylayan, Pical, San Nicolas

(iii) Shell Solar

In Palawan, Shell Solar has five (5) centers in Puerto Princesa City, Taytay, Quezon, and Brooke's Point. Shell Solar has continued to market mainly SHS and established the Shell Solar Supply Center in Palawan. Related direct sales investment costs are basically marketing, servicing and after-sales support costs.

Table 3.3.7 shows Shell Solar installations in Palawan. Shell Solar sold different types of SHS to 15 barangays. Among them the highest system is one in El Nido with 72 SHS in various barangays.

Table 3.3.7 Shell's Solar Installations in Palawan as of October 2003

Municipality/City	SolarMax 240	SolarMax 200	SolarMax 160	SolarMax 180	SolarMax
	Module: 60Wp Battery: 100Ah Light: 6W x 3	Module: 50Wp Battery: 100Ah Light: 6W x 3	Module: 50Wp Battery: 100Ah Light: 6W x 3	Module: 45Wp Battery: 70Ah Light: 6W x 3	
	Qty.	Qty.	Qty.	Qty.	Qty.
Aborlan	1				
Balabac	1	18	9	1	1
Bataraza	12	17	3	2	
Brooke's Point	8	17		1	
Coron	1				
Dumaran	5	5			
El Nido	39	26	4	4	
Narra	2	8	2	1	
Puerto Princesa City	12	8	2	1	
Quezon	4	9	7	1	
Rizal	2	3	3		
Roxas	7	14		1	
San Vicente	3	4			
Sofronio Espanola	3	3			
Taytay	33	20	4	4	1
Total	133	152	34	16	2

(2) On-going renewable energy development projects

(i) Multipurpose pilot PV-wind turbine system for rural electrification

The primary objective of this project is to install sunlight and wind resource-based hybrid renewable energy systems. The proposed project is a pilot project involving a centralized utility-type 5KWp PV/ 10 KW wind turbine hybrid system with a 15 KVA diesel generator as a back-up for the hybrid system. The system will supply power to the 200 farming and fishing households for 24-hours each day in Sitio Sicud, Barangay Candawaga and Rizal.

Contributions for the project fund and the functions of each stakeholder are as follows.

Table 3.3.8 Stakeholders of Multi Purpose Pilot PV-Wind Turbine System Project

Stakeholder	Contribution		Function
	In US$	% Share	
UNDP/Government of Japan	125,000	70.67	The donor and technical assistance /seed capital investment.
GOP-DOE	27,500	15.54	DOE provides the overall supervision and management of the project. SPCP-ANEC implements institution of the project.
Rizal Local Government Unit	12,500	7.07	The Rizal LGU will provide counterpart funds for institutional developments, construction of multi-purpose building, incentive and allowances of assigned SPCP-ANEC and LGU personnel and project management coordination/consultation.
Provincial Government of Palawan	8,928	5.05	PGP will provide counterpart funds for the construction of the multi-purpose building
Beneficiaries/village	2,950	1.67	
Total	176,878	100	

(ii) Palawan new and renewable energy and livelihood support project

This project is in line with GEF Operational Program No.6 – "Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs", which is aimed at reducing the long-term growth of greenhouse gas (GHG) emissions by removing the barriers to commercial utilization of new and renewable energy (NRE) power systems to substitute for the use of diesel generators in Palawan.

Contributions for the project fund and the functions of each stakeholder are as follows.

Table 3.3.9 Stakeholders of Palawan New and Renewable Energy and Livelihood Support Project

Stakeholder	Fund Contribution	Function
UNDP/GEF	US$ 750,000	
UNDP-TRAC	US$ 100,000	
Provincial Government of Palawan	US$ 300,000	Implementation of the technical capability building of internal staff
CRREE		Will be the executing agency and coordinate with provincial government, private sector and local communities
University of the Philippines Solar Laboratory		Will provide the key technical support.
Local Government Unit		Will encompass planning, implementation and assessment through a consultative
NGO and Local Community		Will provide input in assessing awareness campaign of new & renewable energy and assist in identifying the types of productive use of projects
Shell Renewables, Inc. and Community Power Corporation	US$ 1,400,000	Will be working in conjunction in establishing a Renewable Energy Service Company (RESCO)
Rural Electric Cooperatives		Will support RESCO installation of renewable energy systems within their franchise
Department of Energy		Will monitor and document the project, its activities and methodology
Total	US$ 2,550,000	

(iii) Renewable energy village power system in Palawan

This project will involve the implementation of a Community-based/Village Power System (a mini−grid system powered by solar PV systems). It is intended to demonstrate the viability of a small-scale renewable energy service company (RESCO) as a delivery mechanism to off-grid areas and operated on a "fee for service basis". The project aims to improve life and livelihood activities in the community by providing a reliable and clean energy at affordable costs. Based on the tentative PGP plan, 20kW PV mini-grids with 20kW diesel generators set as back up will be installed in Barangay New Ibajay, El Nido and Palawan. The total cost of US$ 314,255 (Php 16,341,276) is required during the first year of implementation of the project to attain the desired output. These will be sourced from various institutions.

(iv) DOE-WESCOM electrification project in Pagasa Island, Kalayaan

The objective of this project is to support the existing diesel units in the military barracks in Pagasa Island, Kalayaan with the installation of SHS and a BCS. In this project, 6 SHSs at 75Wp/module and 1 BCSs at 300Wp will be installed. Project cost is now estimated at Php326,000 allocated by DOE and WESCOM (WESCOM: Western Command). The implementation will begin once WESCOM allocates their contribution.

3.3.3 Mini and Micro Hydropower

(1) Existing hydropower plants and ongoing hydropower project in Palawan

At this time, there are neither existing hydropower plants nor ongoing hydropower development projects in Palawan.

(2) Past study on development of hydropower project in Palawan

Five feasibility studies were conducted by some agencies before. Table 3.3.10 and Figure 3.3.13 show the list and locations of past feasibility studies for hydropower development projects in Palawan (refer to Chapter 4.1.1 details on these feasibility studies).

Table 3.3.10 List of Past Feasibility Studies in Palawan

Project Name	Source	Year	Installed Capacity	Remarks
Babuyan	NPC-SPUG	1992	5,600 kW	Feasibility study
Langogan	NPC-SPUG	1992	6,800 kW	Feasibility study
Cabinbin	DOE[5]	1999	800 kW	Preliminary Engineering Study
Batang Batang	JETRO	2001	6,700 kW	Feasibility study
Candawaga	JICA	1985	6,000 kW	Feasibility study

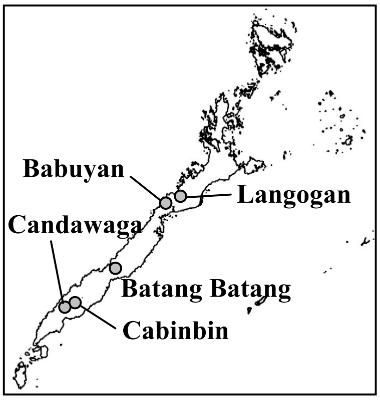


Figure 3.3.13 Locations of Sites for Past F/Ss

(3) Existing plan for mini and micro hydropower development in Palawan

According to Palawan Medium Term Development Plan 2003–2012, which was prepared by Palawan Provincial Development Council in October 2003, four hydropower projects are scheduled to be implemented up to 2007. The schedule for these plans is shown in Table 3.3.11.

However, at the present, financing for these projects have not been concretely secured and it will take more time to conduct pre-implementation studies such as a detailed design study and an environmental impact assessment study. Therefore, it seems that the projects will not be implemented on schedule.

Table 3.3.11 Schedule for Mini-Hydro power Plant Projects in Palawan

Name of Project	Year			
	2004	2005	2006	2007
Babuyan		Construction		◇ Grid Connection
Langogan	Construction		◇ Grid Connection	
Cabinbin			Construction	◇ Grid Connection
Batang Batang	Construction	◇ Grid Connection		

Source: Palawan Medium Term Development Plan 2003-2012

[5] The study was based on the preliminary study conducted by NEA in 1987 and the repot was prepared as material for a presentation in the Mini-Hydro Business meeting held by DOE at Puerto Princesa in 1999.

3.4 Distribution Facilities

3.4.1 Distribution Facilities of PALECO, BISELCO and BAPA

(1) PALECO and BISELCO

(i) Facility

The distribution line consists of a primary 13.2kV line, wooden poles, pole mounted transformers, 230V secondary lines and other components. These facilities are constructed and maintained based on the standards and the methods of detailed in the NEA Engineering Bulletin （hereinafter referred to as “Bulletin”）.

The primary distribution network structure is shown in Figure 3.4.1.

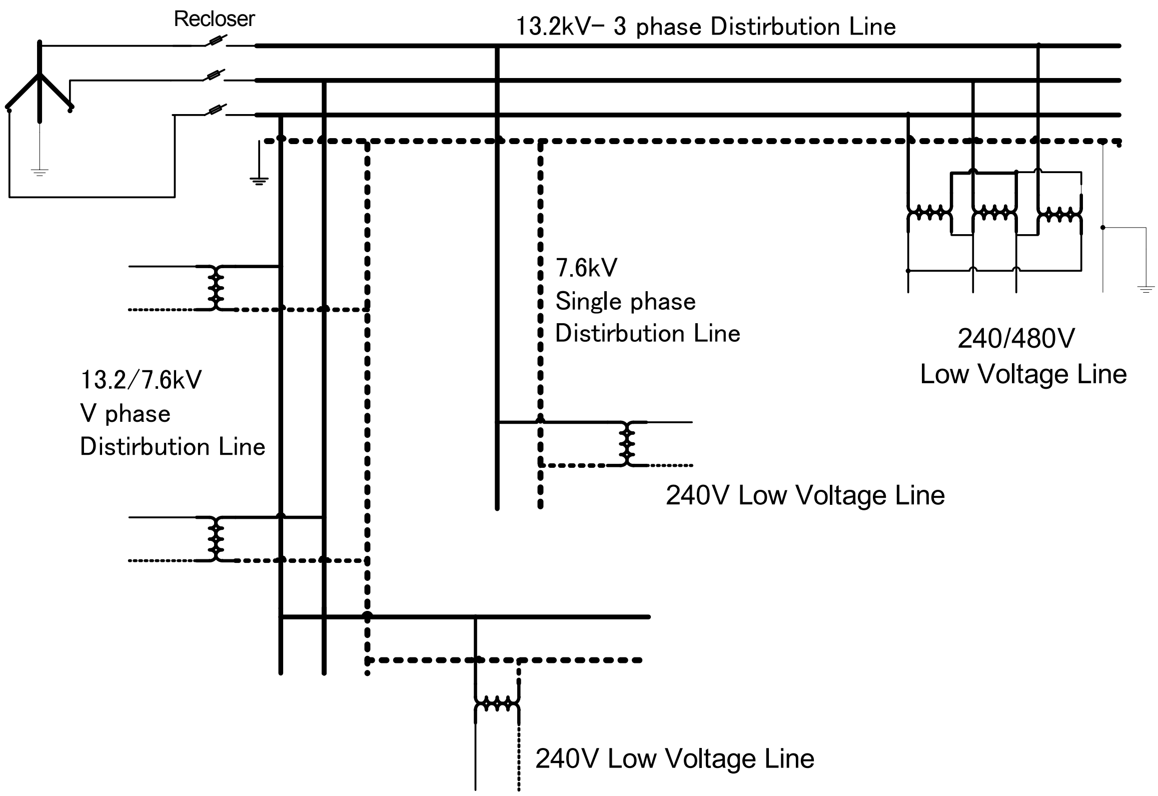


Figure 3.4.1 Distribution Network

Primary distribution lines are connected to power transformers (neutral points are directly grounded) of power stations/substations through automatic circuit re-closers. A 13.2/7.6kV three phase 4 wire system is used in the main line.

Standard equipment for distribution lines is as shown below.

・13.2/7.6kV Primary line	Aluminum Conductors Steel Reinforced(ACSR) Voltage line : AWG#2/0 Neutral line : AWG#1/0
・Pole mounted transformer	Single phase, 7620/230V, Capacity : 15,25kVA
・Pole	Creosoted wood Length : 25,30,35,40ft（7.6,9.1,10.7,12.2m）
・230/400V Secondary line	Aluminum Conductors Steel Reinforced(ACSR） AWG #6～#1/0

The secondary distribution line is installed lower than the primary line in the same pole, or it is installed independently. The former is called UB (Under Built) and the latter is called OS (Open Secondary).

A watt-hour meter for each customer is installed at a lower place on the pole. After the watt-hour meter, a vinyl insulated cable is used as a service drop to supply electricity to each household.

The maximum span length of a service drop regulation in the Bulletin is as below.

*CS210.3 The maximum span length for a service drop installation should be 45 meters measured from the last utility-owned pole to another building.

Generally, it is thought that the span is below the regulation. However, in a high-density housing area, since the distance from a road in which the distribution line is installed to a house is long in many cases, the length of the service drop tends to become very long.

A single phase meter, a 3-phase meter or other such meter is used for the watt-hour meter According to the differences in the electric phase system. Moreover, there are meters that connect electric wires to the lower part of watt-hour meters, and meters connected from the backside using sockets. Single phase two-wire system watt-hour meters are generally used for household supply.

Circuit lengths of each EC and number of diesel power stations/substations are listed in Table 3.4.1.

Table 3.4.1 Circuit kms of Line by EC

	No. of DPP/SS	Name of DPP/SS	Circuit kms of Line
PALECO	7	Puerto Princesa City DPP, Delta-P DPS, Power Barge 106, Narra SS, Brooke's Pt. DPP, El Nido DPP, Roxas DPP, Taytay DPP, San Vicente DPP	1860
BISELCO	3	Colon DPP, Culion DPP, Linapacan DPP	382

*Circuit kms of Line (2002) came from the NEA Fact Sheet.

(ii) Network management

Main distribution lines, or in other words the “trunk” lines, from power station/substation are 3-phase 4wire system. V-phase lines, which consist of 2 voltage lines and a neutral line, or a single-phase line, which consists of one voltage line and neutral line, are used in branch distribution lines. In addition, when branching a V-Phase and a single-phase line from a trunk line, connections are considered to balance the current between 3 phases.

Figure 3.4.2 and Figure 3.4.3 are examples of distribution line diagrams, which EC has used for network management. Figure 3.4.2 shows the distribution network of the Puerto Princesa City area. Connections of each 13.2kV primary line, main customer, demand and connection phase are shown in the diagram. But the lengths of each line are not recorded.

Figure 3.4.3 is a diagram of a network from the Nara substation. It does not include detailed data in Figure 3.4.2. Only the connection of lines and main customer areas are shown.

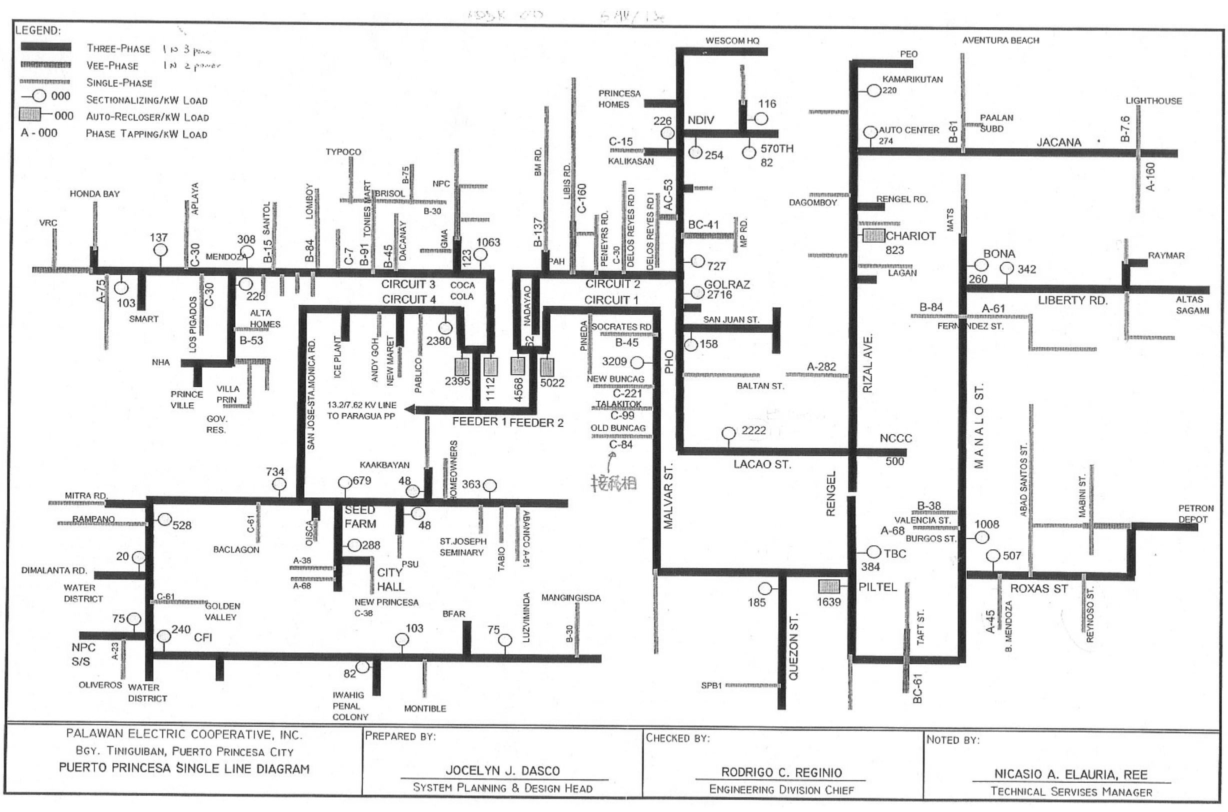


Figure 3.4.2 Distribution Line Network Diagram of Puerto Princesa City Area

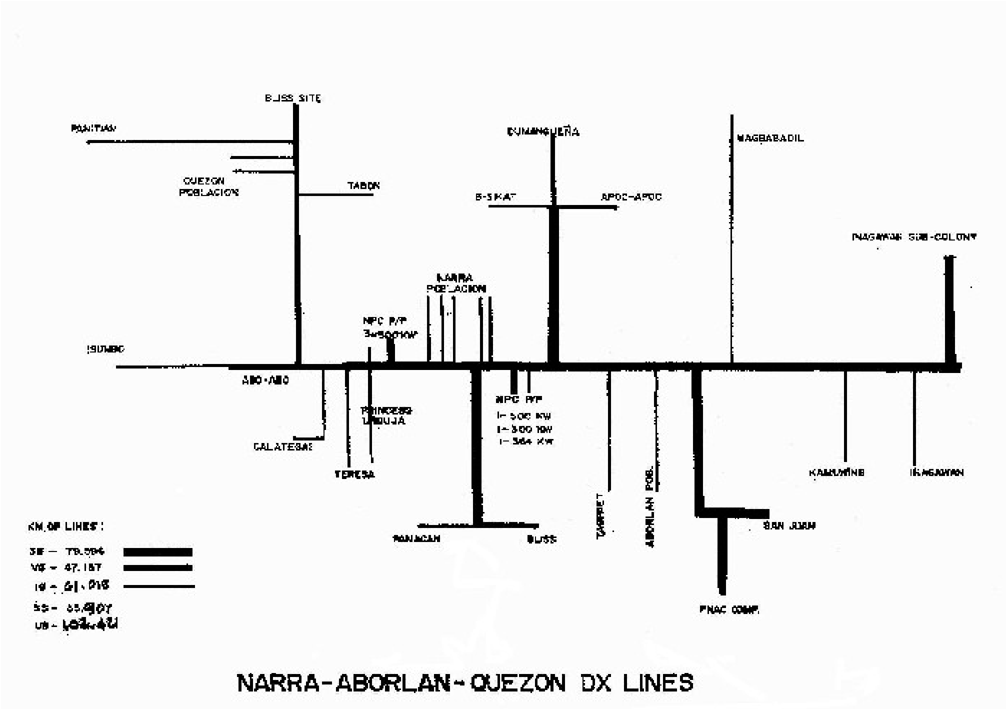


Figure 3.4.3 Distribution Line Network Diagram of Narra

PALECO has considered a new project for an improved facility management system. The project named "Computerization of technical system data & engineering analysis project" is a computer system that can manage distribution networks and customer information in GIS. The project cost is estimated at 5 million Pesos. But the budget has yet to be decided.

Technical data for distribution lines is described in the Bulletin. The conductor resistance is shown in Table 3.4.2 in Bulletin DX3430 System Loss Reduction, those are also used for the calculation of voltage drops and fault analyses.

Fundamental data will be reviewed in this study if needed.

Table 3.4.2 Resistance of NEA Distribution Lines

Conductor Size ACSR	Ohms per Phase pre km of Line		
	Single-phase	V-phase	Three-phase
4/0	0.398	0.398	0.274
2/0	0.584	0.584	0.436
1/0	0.696	0.696	0.550
2	1.019	1.019	0.876
4	1.534	1.534	1.391
6	2.311	2.311	2.180

(iii) Transformer management

In the case of new customer installations, PALECO makes an estimation of power demand for the customer depending on the customer's electric appliances. If the calculation results the possibility of the pole mounted transformer load becoming overloaded when counting these estimated loads, PALECO linemen will measure actual loads. If a transformer is actually overloaded, it must be upgraded or the load must be divided to another transformer.

Pole mounted transformers have a 5-voltage tap. By changing a tap, the supply voltage to a customer can be kept within a relative range.

(iv) Maintenance

Linemen in EC patrol their distribution lines to detect unsafe or damaged equipment and locations. In the case of a primary wire coming into contact with a tree, they will cut branches based on Bulletin DX2340 "Right of Way Maintenance and Acquisition for Primary and Secondary Distribution Lines".

PALECO also has an upgrading plan of some distribution lines that are overloaded.

(2) BAPA

Technically speaking, the distribution facility of BAPA is equal to those operated by EC, because BAPA's distribution line facilities were constructed based on technical advice from PALECO. Operators of the generators also maintain the distribution lines.

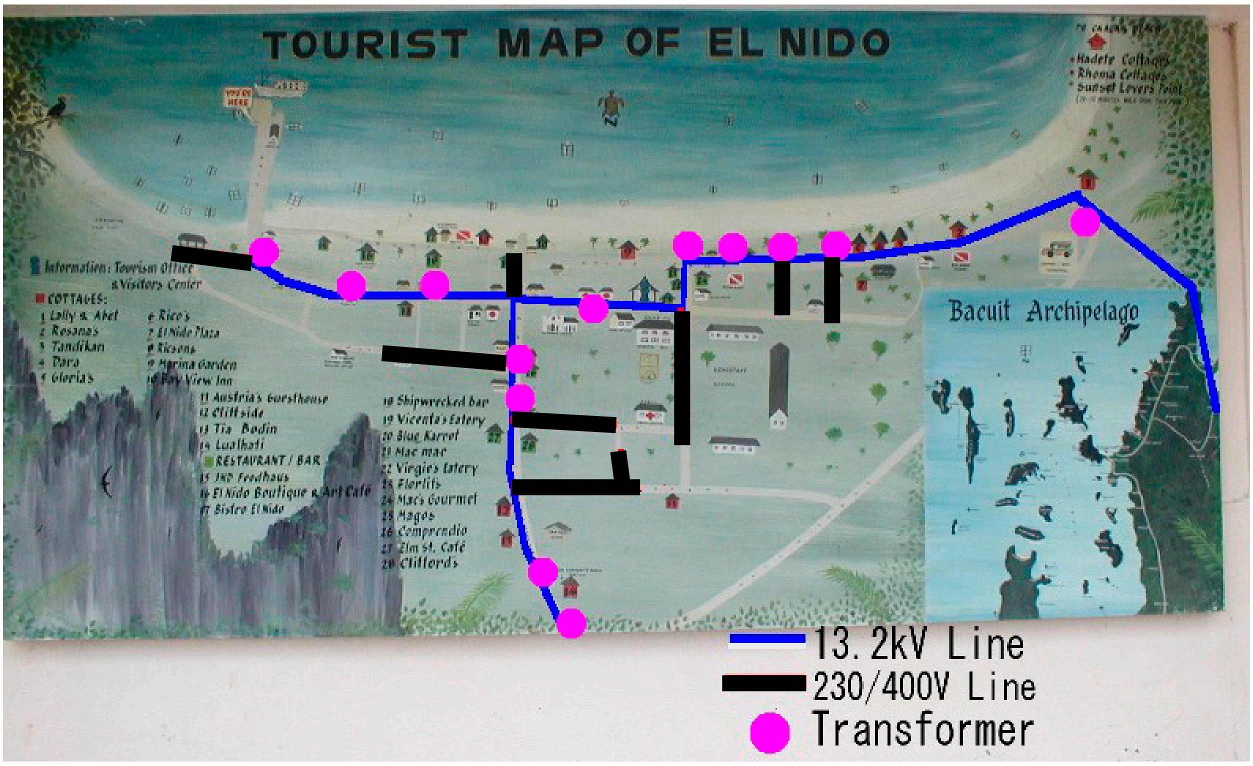


Figure 3.4.4 El Nido Distribution Line Map

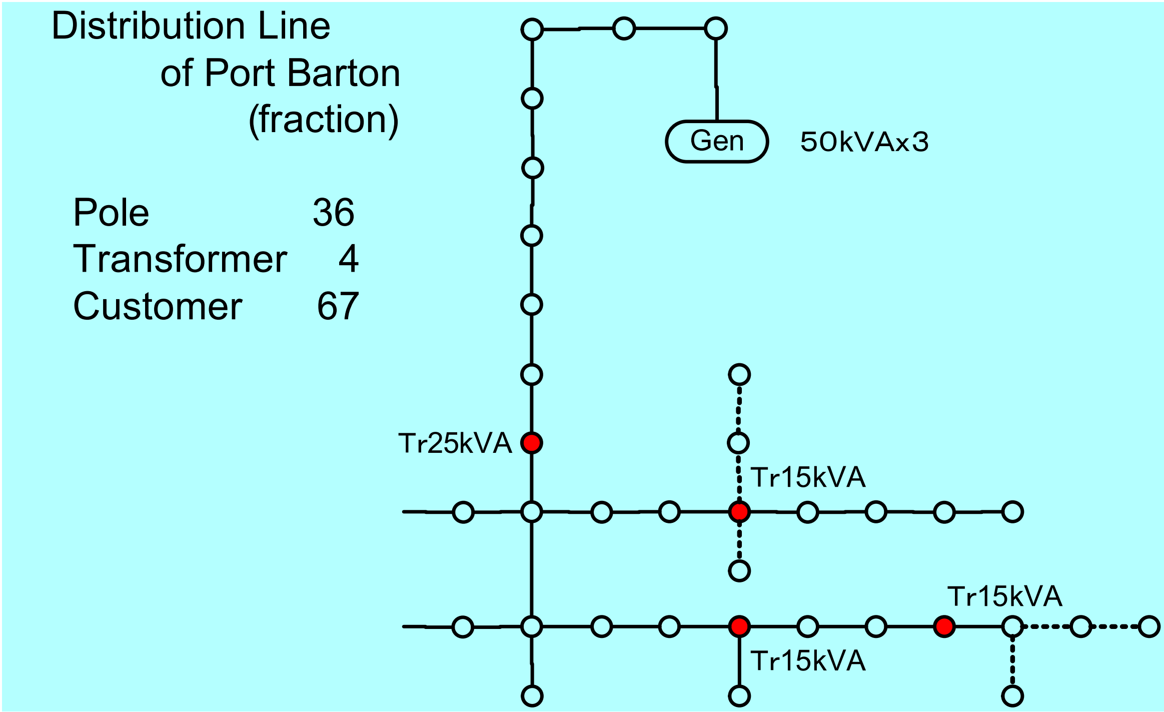


Figure 3.4.5 Port Barton Distribution Line Map

3.4.2 Distribution Facilities of Privately Owned Genset

(1) Facility

Some barangay captains or other persons have their own generators, which electric power capacities are usually about 10kW, and they supply electricity to their neighborhood. These systems are called POPS (Privately Owed Power System). In these cases, distribution networks do not exist.

In most cases, service drop lines are directly connected from a generator to each household, and trees sometimes support these lines.

A tariff system is usually based on the number of appliances for each household. A watt-hour meter is not used.

Examples of a tariff system are shown in Table 3.4.3.

Table 3.4.3 Tariff Systems of POPSs

Barangay	Generator Capacity	Household	Electricity Tariff Php/month
Conception Puerto Princesa City	15kW	66	Php75/20W Fluorescent lamp
Lajala Coron	10kW	42	Php100/20W*2 Fluorescent lamp Only Php200/Other appliance exist

Figure 3.4.6 POPS Service Drop Line

(2) Operation

Maintenance to prevent faults is not performed.

3.4.3 Existing Expansion Plan

The 5-year Distribution Development Plan 2002 of PALECO and BISELCO are summarized in Tables 3.4.4 and Table3.4.5.

Table 3.4.4 DDP of PALECO

		2003	2004	2005	2006	2007
No. of Energized Barangay		101	26	26	19	
Estimated Sales (MWH)		91,352	100,925	122,028	135,921	148,290
Expansion (km)	3 Phase	763.25	339.75	328.5	209.75	
	1 Phase	115.70	37.45	43.30	23.85	
	OS	120.03	48.50	49.18	27.65	
	UB	300.63	151.25	152.45	73.40	
Revamp(km)	3 Phase	3.00	3.00	3.00	3.00	3.00
Upgrade(km)	3 Phase	5.00	3.00	3.00	3.00	3.00
Cost (1000 Pesos)		305,758	134,792	132,186	83,737	2,721

Table 3.4.5 DDP of BISELCO

		2003	2004	2005	2006	2007
No. of Energized Barangay		3	1			
Estimated Sales (MWH)		3,532	3,996	4,560	5,223	6,007
Expansion (km)	3 Phase	10.69				
	1 Phase	8.55	5.31	2.00		
	OS	4.77	2.38	3.00		
	UB	5.13	3.67	1.00		
Upgrade(km)	1 Phase	1.00	1.00	1.00	1.00	1.00
Cost (1000 Pesos)		6,788	2,239	2,094	926	911

The unit cost per km and the price rate of distribution-line equipment are given from NEA every year as the construction cost rate used for the distribution development plan (DDP). Table 3.4.6 shows the unit costs that were used for 2003 planning.

Table 3.4.6 Unit Cost of NEA

	Materials	Labor & Others	Total
Primary 3 Phase (P/km)	255,238	86,781	342,019
Primary V Phase (P/km)	197,672	67,208	264,880
Primary 1 Phase (P/km)	128,893	43,823	172,716
Open Secondary (P/km)	98,702	33,559	132,261
Under Built (P/km)	16,436	5,588	22,024

On the other hand, there is a big difference between the unit cost of the construction projects that PALECO actually carried out and the unit cost of NEA. Table 3.4.7 shows comparisons for project costs calculated by NEA unit costs and actual costs.

Table 3.4.7 Comparison between NEA Cost and Actual Cost

Project	3Phase (km)	1Phase (km)	OS (km)	UB (km)	Project Cost by NEA (Pesos)	Actual Cost (Pesos)
Port Barton	1.52	1.05	2.95	2.57	1,146,172	5,804,337
Teresita	0.71	0.87	0.32	1.38	465,813	1,735,867
Liminangcong	4.00	2.00	1.50	3.00	1,977,972	3,828,900
Dumaran	0.84	1.81	1.46	2.65	851,377	2,608,051
Manamoc	1.34	1.04	1.04	2.11	821,891	2,882,093
Salogon		2.00		2.00	389,480	980,732

PALECO construction unit costs, based on the cost of these five projects, are approximately 2.4 times that of the unit costs of NEA.

The following four points are considered as the reasons for the higher unit costs;

(a) More poles are used because of the short average span length
(b) PALECO is adopting long life, 40 years, and so uses expensive wood poles
(c) Winding distribution routes require much more equipment than straight line routes.
(d) Equipment costs estimated by NEA do not include transport charges, and are costs for bulk purchase.

The average prices for distribution equipment for both the NEA Price Index and PALECO are compared in Table 3.4.8.

Table 3.4.8 Average Equipment Costs

	NEA Index (Pesos)	PALECO Cost (Pesos)	Ratio
Conductor, Bare, ACSR	23.20	30.45	1.3
Insulator	119.50	281.56	2.4
Pole, Wood, Creosoted	3,076.67	10,775.00	3.5

Therefore, the distribution-line construction unit costs used in this Master Plan are the values shown in Table 3.4.9 at about 2.4 times the NEA unit costs.

Table 3.4.9 Unit Distribution Line Costs in the Master Plan

	Materials	Labor & Other	Total
Primary 3 Phase (P/km)	610,019	207,454	817,473
Primary V Phase (P/km)	472,463	160,637	633,100
Primary 1 Phase (P/km)	296,453	100,794	397,247
Open Secondary (P/km)	235,912	80,210	316,122
Under Built (P/km)	39,284	13,356	52,640

3.5 Generation and Transmission Facilities of the EC-Grids

3.5.1 Overview of the Generation and Transmission Facilities of the EC-Grids

At present, the generation and transmission facilities in the EC-grids are owned and operated by NPC-SPUG, except 1 IPP operated by Delta-P.

Generation facilities are installed on 9 islands, and 16 diesel power plants are operational. As of February 2003, the total installed capacity was 48.9MW and dependable capacity was 36.8MW. These numbers mean the available capacity is 25% lower than the designed capacity.

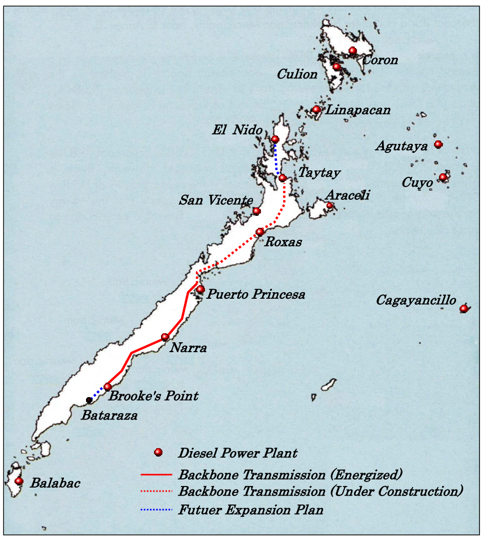


Figure 3.5.1 Overview of the Generation & Transmission Facilities

As for transmission facilities, 69kV transmission system named the Palawan Backbone Transmission is currently under construction. The southern part of the backbone grid from Puerto Princesa City to Brooke's Point was already energized and operated. The northern part of the backbone grid from Puerto Princesa City to Taytay is now under construction and plans call for it to be operational at the end of 2005.

3.5.2 Existing Generation Facilities and Future Expansion Plan

(1) Present situation of the generation facilities

In Palawan most of the generation facilities were installed after 1988, when the missionary electrification business was transferred from EC to NPC-SPUG. In 1997 Palagua DPP, the first IPP in Palawan, started operation. In 2001 Power Barge 106 started operation and it contributed to the sufficient capacity in the backbone grid.

Regarding fuel type, all of the generators in Palawan are diesel-based. Only 2 power plants, Power Barge and IPP, use Bunker C oil, while other power plants use normal diesel oil. Although it is said that Palawan has a potential energy resources of hydropower and wind power, only diesel power has been installed until now.

As for the generator specifications, several types of diesel generators are used, for example MAN, G M, Daihatsu, CKD, Wartsila, Perkins and Pielstick. These generators can be categorized into 2 types; a medium speed type (720-900rpm) designed for constant operation and a high speed type (1800rpm, made by PERKINS) that can operate for less than around 12 hours. The high speed type has been applied to the grid where operating hours are 6-12 hours because of its affordability.

The status of the existing generators as of February 2003 is shown in Table 3.5.1.

Table 3.5.1 Status of Existing Generators as of February 2003

Owner ship	Island	Power Station Name	Unit No	Manufacturer	Fuel	Capacity	Depend. Cap.	Accum. Hour
						kW	kW	Hour
NPC-SPUG	Palawan	Puerto Princesa City	1	PIELSTICK	Diesel	3500	3000	65,720
NPC-SPUG	Palawan	Puerto Princesa City	2	PIELSTICK	Diesel	5500	3000	63,564
NPC-SPUG	Palawan	Power Barge 106	1	DAIHATSU	Bunker C	3600	3000	41,291
NPC-SPUG	Palawan	Power Barge 106	2	DAIHATSU	Bunker C	3600	2300	41,289
NPC-SPUG	Palawan	Power Barge 106	3	DAIHATSU	Bunker C	3600	2200	31,880
NPC-SPUG	Palawan	Power Barge 106	4	DAIHATSU	Bunker C	3600	2700	33,788
Delta-P	Palawan	Delta-P	1	WARTSILA	Bunker C	4000	3600	Unknown
Delta-P	Palawan	Delta-P	2	WARTSILA	Bunker C	4000	3600	Unknown
Delta-P	Palawan	Delta-P	3	WARTSILA	Bunker C	4000	3600	Unknown
Delta-P	Palawan	Delta-P	4	WARTSILA	Bunker C	4000	3600	Unknown
NPC-SPUG	Palawan	Narra	1	MAN	Diesel	500	0	74,848
NPC-SPUG	Palawan	Narra	2	MAN	Diesel	500	0	70,376
NPC-SPUG	Palawan	Narra	5	CKD	Diesel	448	0	21,727
NPC-SPUG	Palawan	Brooke's Point	1	GM	Diesel	300	200	79,913
NPC-SPUG	Palawan	Brooke's Point	2	GM	Diesel	300	200	79,198
NPC-SPUG	Palawan	Roxas	1	DALE-PERKINS	Diesel	260	240	43,505
NPC-SPUG	Palawan	Roxas	2	DALE-PERKINS	Diesel	260	220	46,644
NPC-SPUG	Palawan	Roxas	3	DALE-PERKINS	Diesel	260	240	27,129
NPC-SPUG	Palawan	Roxas	4	DALE-PERKINS	Diesel	163	150	7,736
NPC-SPUG	Palawan	Taytay	1	DALE-PERKINS	Diesel	163	150	13,906
NPC-SPUG	Palawan	Taytay	2	DALE-PERKINS	Diesel	260	250	18,334
NPC-SPUG	Palawan	Taytay	3	DALE-PERKINS	Diesel	163	0	7,198
NPC-SPUG	Palawan	El Nido	1	DALE-PERKINS	Diesel	163	150	11,758
NPC-SPUG	Palawan	El Nido	2	DALE-PERKINS	Diesel	260	250	15,134
NPC-SPUG	Palawan	San Vicente	1	DALE-PERKINS	Diesel	163	150	14,594
NPC-SPUG	Palawan	San Vicente	2	DALE-PERKINS	Diesel	163	0	7,291
NPC-SPUG	Palawan	San Vicente	3	DALE-PERKINS	Diesel	260	250	48,376
NPC-SPUG	Busuanga	Busuanga	1	MAN	Diesel	250	240	63,376
NPC-SPUG	Busuanga	Busuanga	2	MAN	Diesel	250	240	82,223
NPC-SPUG	Busuanga	Busuanga	3	DALE-PERKINS	Diesel	560	400	38,907
NPC-SPUG	Busuanga	Busuanga	4	DALE-PERKINS	Diesel	560	500	24,406
NPC-SPUG	Cuyo	Cuyo	1	DALE-PERKINS	Diesel	243.2	220	45,940
NPC-SPUG	Cuyo	Cuyo	2	CKD	Diesel	448	250	22,193
NPC-SPUG	Cuyo	Cuyo	3	DALE-PERKINS	Diesel	260	215	36,766
NPC-SPUG	Cuyo	Cuyo	4	DALE-PERKINS	Diesel	163	135	15,134
NPC-SPUG	Cuyo	Cuyo	5	DALE-PERKINS	Diesel	260	230	17,244
NPC-SPUG	Cuyo	Cuyo	6	DALE-PERKINS	Diesel	260	0	45,568
NPC-SPUG	Culion	Culion	1	DALE-PERKINS	Diesel	163	150	9,466
NPC-SPUG	Culion	Culion	2	DALE-PERKINS	Diesel	260	250	18,421
NPC-SPUG	Linapacan	Linapacan	1	VISA-PERKINS	Diesel	54	50	7,579
NPC-SPUG	Linapacan	Linapacan	2	VISA-PERKINS	Diesel	54	50	810
NPC-SPUG	Araceli	Araceli	1	DALE-PERKINS	Diesel	163	150	26,283
NPC-SPUG	Araceli	Araceli	2	DALE-PERKINS	Diesel	163	150	13,167
NPC-SPUG	Balabac	Balabac	1	DALE-PERKINS	Diesel	163	150	2,502
NPC-SPUG	Balabac	Balabac	2	DALE-PERKINS	Diesel	163	0	10,988
NPC-SPUG	Cagayancillo	Cagayancillo	1	DALE-PERKINS	Diesel	163	150	8,533
NPC-SPUG	Cagayancillo	Cagayancillo	2	VISA-PERKINS	Diesel	54	50	3,211
NPC-SPUG	Agutaya	Agutaya	1	VISA-PERKINS	Diesel	54	54	6,510
NPC-SPUG	Agutaya	Agutaya	2	DALE-PERKINS	Diesel	163	160	3,172

(2) Future generation expansion plan in the backbone grid

According to the demand forecast, the peak demand will increase and exceed the existing capacity around 2006 or 2007. To cope with this demand increase, NPC-SPUG has a plan to expand the generation capacity. Figure 3.5.2 shows the actual record and the future plan for the peak demand and the generation capacity in the backbone grid.

Although the future expansion plan was studied, the concrete location or the actual developer of these plants has not been confirmed. If there is no private investment in the power development, NPC-SPUG must conduct the power development as the last resort, as defined in EPIRA. Therefore, there is no commitment to develop even the expansion plan in 2006.

From the economical viewpoint, generator expansion must be planed to meet the necessary capacity year-by-year and step-by-step. However, NPC-SPUG plans to expand the capacity once only every 2 or 3 years considering their feasibility of project management.

Thus, although a future generation expansion plan exists in Palawan, it can be said that the concreteness and feasibility of this plan are not clear.

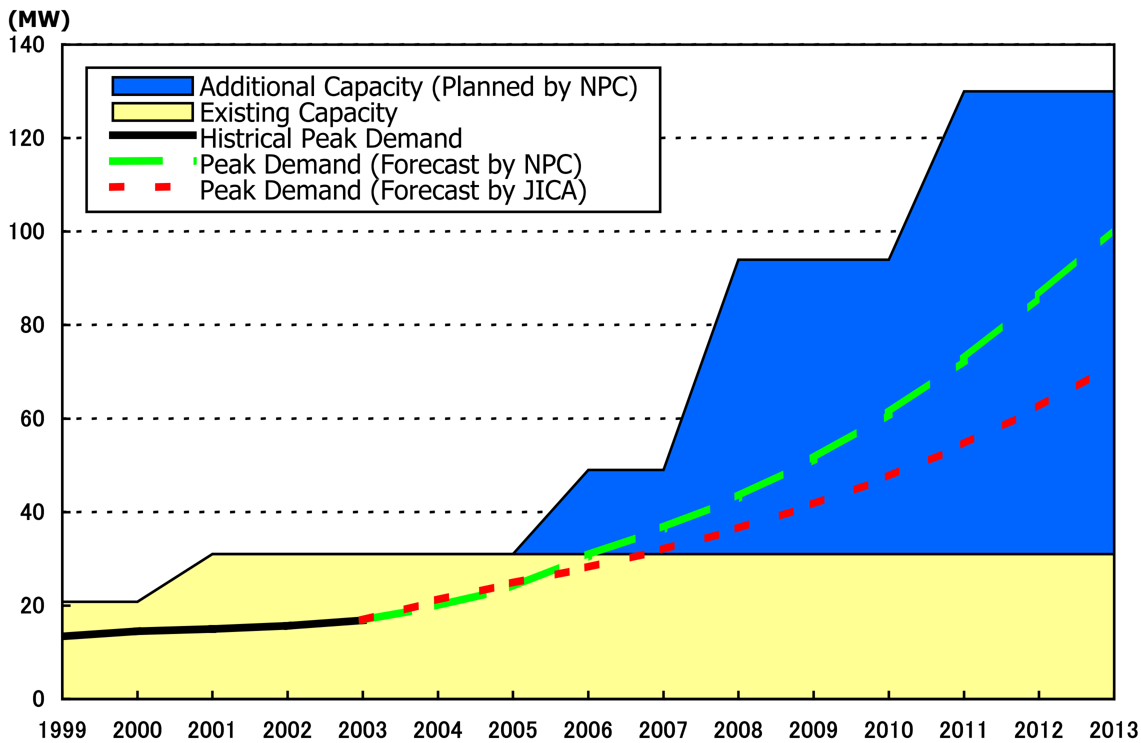


Figure 3.5.2 Peak Demand and Generation Capacity in the Backbone Grid

(3) Future generation expansion plan in the isolated grids

The situation in the other isolated girds is expressed in Figure 3.5.3, using the reliability index. NPC-SPUG applies this reliability index to the generation expansion standard.

The reliability index is calculated by the following formula.

$$Reliability\ Index = \frac{Total\ Dependable\ Capacity - Peak\ Demand}{Dependable\ Capacity\ of\ Largest\ Unit}$$

If the reliability index is below 1.0, this power system cannot withstand trouble with just one generator. Therefore, the value of index should be above 1.0.

From the graph, it is obvious that the generation capacity is not sufficient in some islands right now. On the contrary, the reliability index jumps up in 2004.

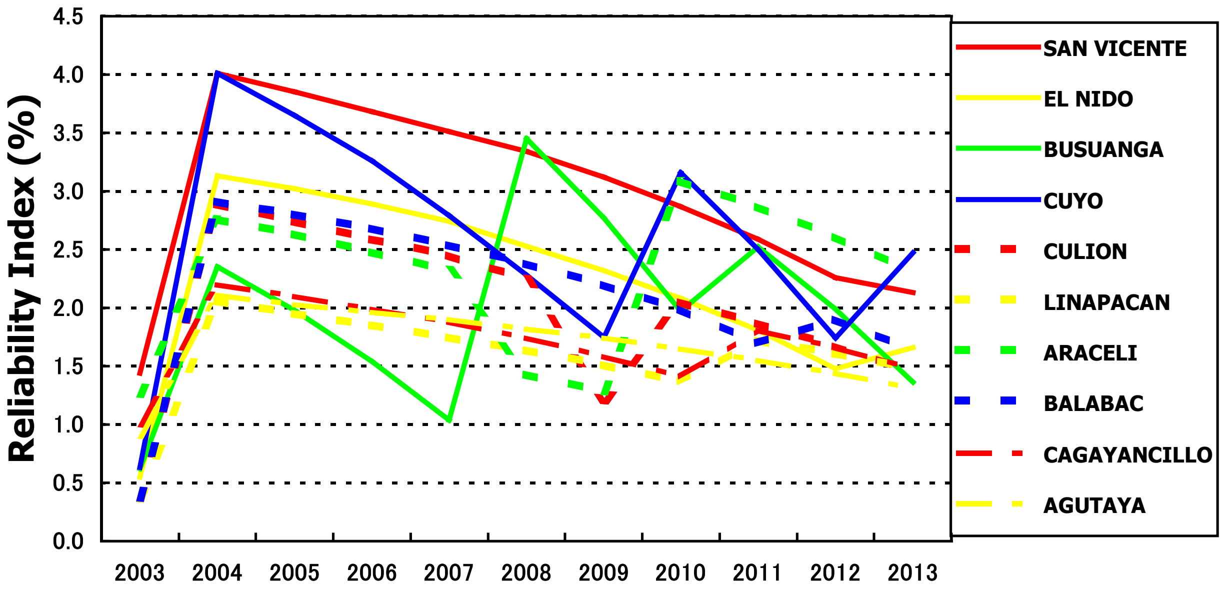


Figure 3.5.3 Future Generation Expansion Plan in the Isolated Grids

3.5.3 Existing Transmission Facilities and Future Expansion Plan

At present, transmission facilities exist only in the Palawan main island, which consists of the 69kV backbone transmission and the 13.8kV sub-transmission systems. These transmission facilities are owned and operated by NPC-SPUG.

In the other isolated systems there is no transmission and the diesel power plants are connected directly to the distribution system.

(1) Outline of Palawan Backbone Transmission Project

In order to improve the efficiency and the reliability of the electricity supply, the Palawan Backbone Transmission Project, which connects between Puerto Princesa City and other main cities, is now on-going.

The project was studied and evaluated in 1992 by NPC-SPUG mainly from the economical viewpoint. In 1993 the project was financed as a Spanish tied-loan and construction was started. The transmission line was energized from Puerto Princesa City to Narra in 2000, and from Narra to Brooke's Point in 2002. At present a transmission line from Puerto Princesa City to Roxas & Taytay is under construction and is supposed to be in commission at the end of 2005.

(2) Present situation of the transmission facility

The backbone grid itself is designed at 138kV for Narra - Puerto Princesa City - Roxas, and at 69kV for Narra - Brooke's Point / Roxas - Taytay. But in the initial construction phase, all of the transmission is operated at 69kV.

The specifications of the transmission facility are as follows.

Table 3.5.2 Transmission Line Specifications of the Backbone Grid

Transmission Line	Designed Voltage	Distance	Type	Remark
Puerto Princesa City - Narra	138kV	86.96km	SC/ST	Energized on May 06, 2000
Narra - Brooke's Point	69kV	76.61km	SC/ST	Energized on June 15, 2002
Puerto Princesa City - Roxas	138kV	111.09km	SC/ST	Planed at the end of 2005
Roxas - Taytay	69kV	65.14km	SC/ST	Planed at the end of 2005

SC: Single Conductor (Size: 336.4MCM), ST: Steel Tower

Table 3.5.3 Substation Specifications of the Backbone Grid

Substation	Voltage	Transformer Capacity	Remark
Puerto Princesa City (Irawan)	72.45-65.55/ 13.8/13.8kV (with 5 taps)	20/20/40MVA	Energized on May 06, 2000
Narra	69/13.8/13.8kV	5/5/5MVA	Energized on May 06, 2000
Brooke's Point	69/13.8/13.8kV	5/5/5MVA	Energized on June 15, 2002
Roxas	69/13.8/13.8kV	5/5/5MVA	Planed at the end of 2004
Taytay	69/13.8/13.8kV	5/5/5MVA	Planed at the end of 2004

Table 3.5.4 Sub-Transmission Specifications of the Backbone Grid

Sub-Transmission Line	Distance	Type	Remark
Delta-P DPP - Puerto Princesa City DPP	7km	DC/WP	
Power Barge 106 - Puerto Princesa City DPP	5.2km	SC/WP	
Irawan Substation - Puerto Princesa City DPP	11km	SC/WP	Energized on June 17, 2001

DC: Double Conductor, WP: Wood Pole

(3) System configuration of the backbone grid

In the backbone grid all of the transformers are designed with 3 circuits. The first one is 69kV, the second one is 13.8kV for the generator and the third one is 13.8kV for the distribution.

At the Irawan substation the 13.8kV circuit for the distribution is not used even though such facilities have been installed. This situation was caused by the change of the location point. Initially, the substation was supposed to be constructed in the area of Puerto Princesa City Diesel Power Plant where the NPC-SPUG system and PALECO distribution are connected. But some environmental problem made the substation transfer to the present location 10km away from the initial location.

As a result, the generators with large capacity are connected to the distribution directly, and the Puerto Princesa City system is interconnected through one 13.8kV sub-transmission line. Furthermore, 3 sub-transmission lines have no circuit breakers at the side of the Puerto Princesa City diesel power plant. This means that any fault occurring in these sub-transmission lines brings about a total blackout.

This configuration makes system reliability worse and so should be improved.

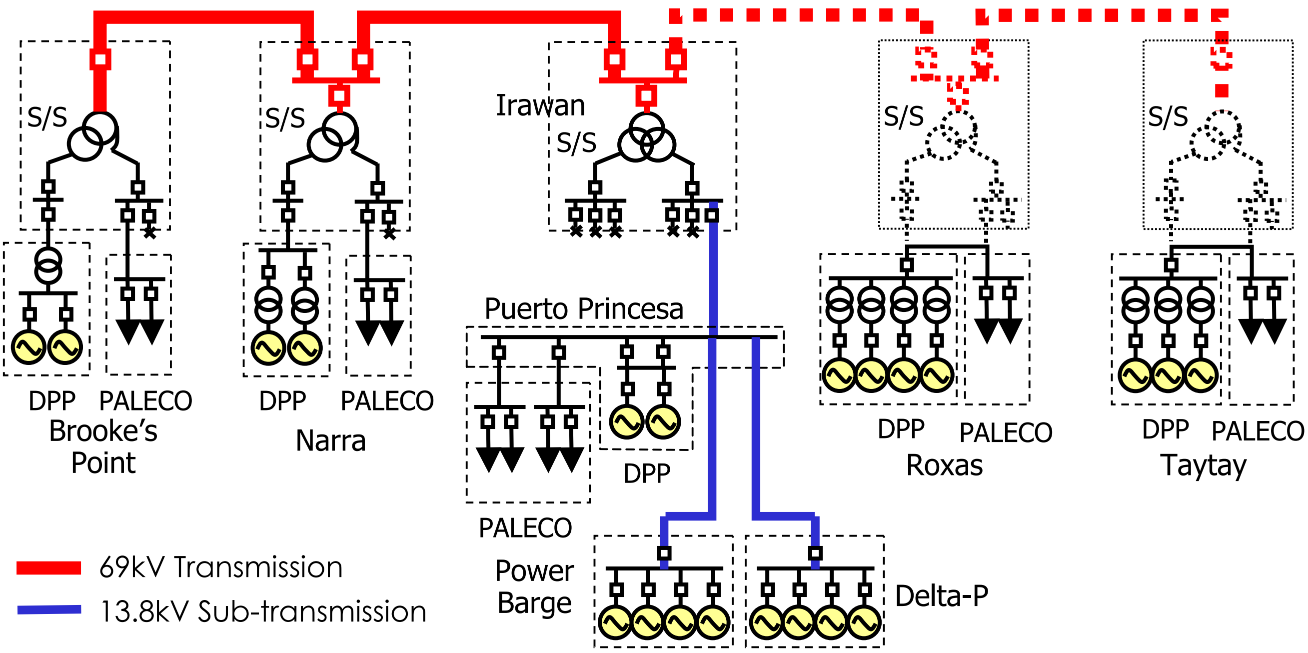


Figure 3.5.4 Power System Diagram of the Backbone Grid

3.5.4 Present Situation of Power System Operations

(1) Outline of power system operations in Palawan

Except for the backbone grid, since each power system has only one generator plant, the operator in the generator plant takes the role of the power system operator for each power system.

In the backbone grid, the operator in the Irawan Substation plays the role of "dispatcher" who manages the whole power system. The dispatcher always grasps the power system conditions such as the demand and supply balance, and switchgear position, and orders the operations of the generators or the substations to maintain the system stability.

(2) Power system operation of the backbone grid

Regarding the communication method for dispatching, the radio equipment shown in Figure 3.5.5 is the only way to collect the information of the generator plants and the substations. There is no SCADA (Supervisory Control And Data Acquisition System) that is usually installed for centralized control in a grid system. Therefore, all of the works of the dispatcher is carried out manually. This includes frequency control, voltage control and the recording of operations.

Figure 3.5.5 Radio Equipment in the Irawan Substation

In the case of a power system fault, the dispatcher makes contact with the operators at the generator plants, the substations and PALECO. The restoration of the power system is carried out based on the instructions from the dispatcher.

(3) Load curve characteristics

The load curve characteristics are different among the grids. The typical load curves in the backbone grid and the Roxas system are shown in Figure 3.5.6.

Both of these curves indicate that the peak demand is at around 7 PM and there is no significant difference in this characteristics by season. The load curve in the backbone grid has a measure of the daytime demand due to the commercial demand.

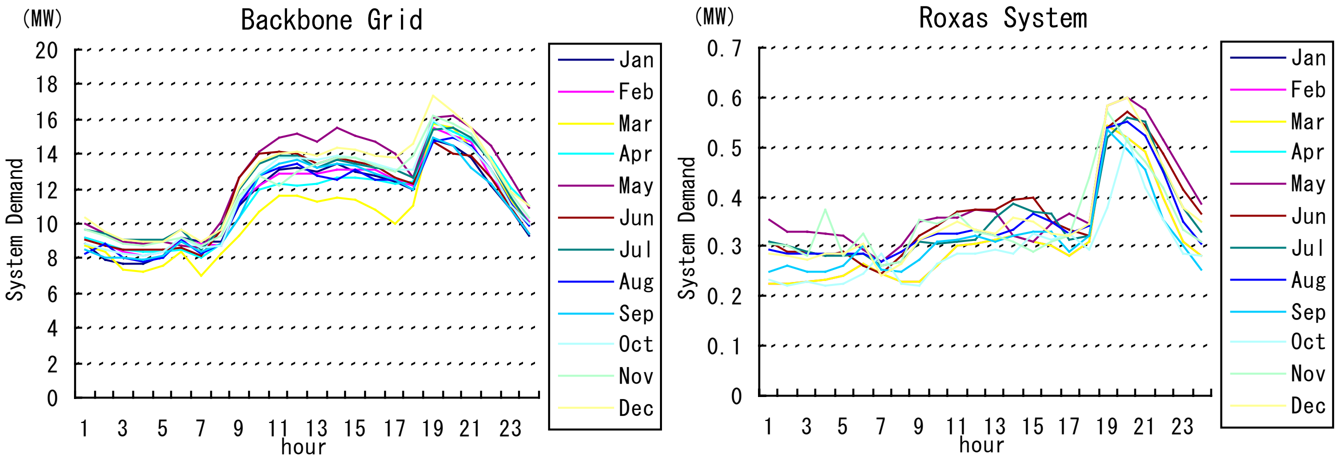


Figure 3.5.6 Typical Load Curves of the Backbone Grid and Roxas System

(4) System reliability in the backbone grid

In order to express the typical condition of reliability in the backbone grid, the actual load curve for the 2nd quarter, from April to June of 2003, is shown in Figure 3.5.7.

It is understandable that a total blackout or a brownout sometimes happens. According to the actual records, a total blackout was observed 26 times in the backbone grid within 9 months in 2003. Some of these total blackouts happened because of scheduled outage in a single line. However, many of those blackouts derived from the inadequate system configuration.

Figure 3.5.8 shows the load duration curves in the backbone grid from January to September of 2003. One curve is the actual record, and another is the estimated curve in the case of no blackouts or brownouts. The difference between these curves corresponds to the lost generation, and its amount is estimated to reach around 2% of total generation. The impact from those blackouts or brownouts is supposed to be not so small.

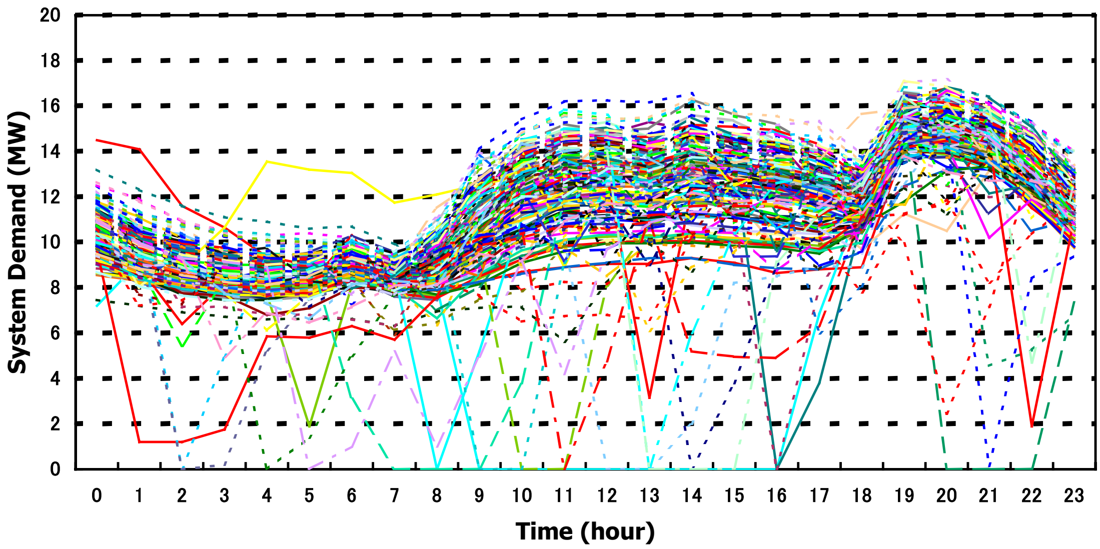


Figure 3.5.7 Actual Daily Load Curve in the Backbone Grid

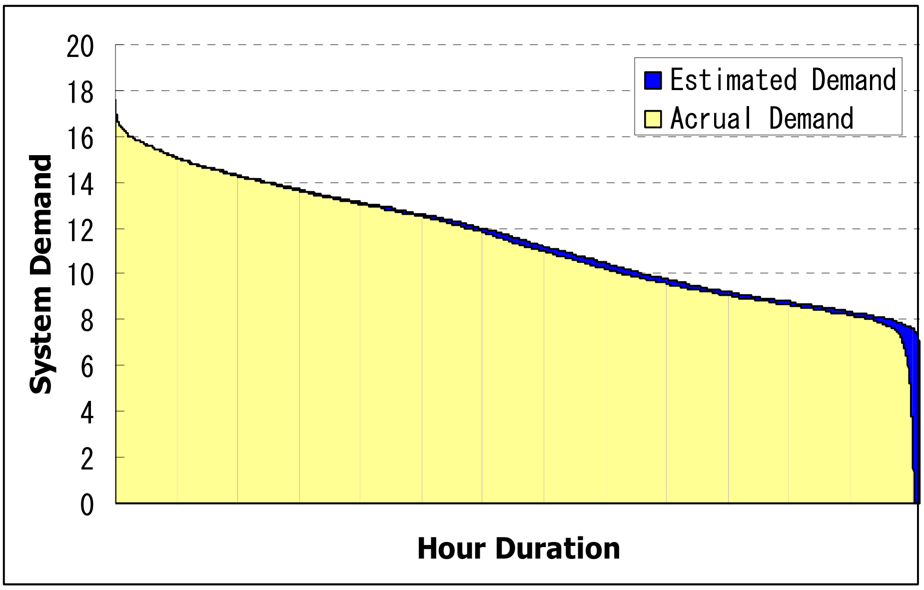


Figure 3.5.8 Load Duration Curve in the Backbone Grid

3.5.5 Major Issues in the Generation Sector

To summarize the present situation in the EC-grids, 4 major issues can be pointed out with regard to the generator development plan.

(1) Brownouts sometimes happens due to the lack of capacity

The situation of brownouts due to a lack of generation capacity is supposed to be much worse in the isolated grids. As explained in the present situation, there are plans to install additional power plants, but the expansion plan in 2004 is expected to be very difficult to achieve because of budget restrictions.

(2) Dependable capacity is much lower than installed capacity

In the case of the Philippine Main Grid, the difference between installed capacity and dependable capacity is 12.2%. It can be said that the difference of 25% in the Palawan Grid is very high. Although a major repair plan has been proposed, it is also restricted by budget limitations as well as the capacity addition.

Moreover, in the case of the Power Barge, insufficient cooling capacity caused by the anchoring location curtails the potential capacity. This issue will be discussed again in the transmission development plan.

(3) Target of reserve capacity is not clear

NPC-SPUG uses a simplified reliability index for the reserve capacity. This index is very useful in a small grid that has only a small number of generators. However, this index cannot reflect real reliability enough, especially in the backbone grid.

In the case of the Philippine Main Grid, the target of the reserve capacity is defined by LOLP (Loss Of Load Probability), and its target figure is 1day/year. The backbone grid is now becoming a "power system" composed of several generators and transmission lines. Therefore, the reliability in the backbone grid should be managed by using LOLP.

(4) National SOx emission standards affects the MP

National SOx Emission Standards are very severe for the Bunker C plant. If the Study team manages to keep this standard, building bunker plants would no longer be possible.

3.5.6 Major Issues in the Transmission Sector

There are 3 major issues currently facing the transmission development plan.

(1) Total blackouts

Total blackouts sometimes happen due to the tripping of a large generator around Puerto Princesa City. This problem was originally caused by the inadequate system configuration where the generation system was not separated from the PALECO system. As a result, this problem has led to another technical issue, namely that protection can't be coordinated between NPC-SPUG and PALECO, and this increases the possibility of total blackouts.

(2) Available capacity of Power Barge DPP is curtailed by sub-transmission capacity

The 13.8kVsub-transmission line from the Power Barge DPP to Puerto Princesa City composed of the wood pole structure and a 336.4MCM single conductor has only 8MW of capacity in constant, while the Power Barge has 10.2MW of dependable capacity at present.

This sub-transmission line originally had around 10MW capacity calculated from the thermal limitation of the conductor. However, the sub-transmission also has a problem in that the connectors at the jumper wire heat up in the condition of the power flow below the thermal limitation of conductor. As a result, the actual available capacity of the Power Barge becomes lower than the sum of its dependable capacity.

(3) Palawan Backbone Transmission Project to the north is delayed

The southern part of the backbone grid is already energized and operational. The northern part of backbone grid is now under construction.

The construction cost for the northern part is estimated at around 410 million Php (Puerto Princesa City - Roxas: 225milion Php, Roxas - Taytay: 135 million Php, Substation: 50 million Php). Material of the transmission was already procured in 1994, but the project was delayed due to construction budget restrictions.

If the project is delayed further, other generation development plans will have to be reconsidered in Roxas and Taytay. After all, there is the possibility that this situation will obstruct the most economical power development.

3.6 Economic and Financial Analysis of Barangay Electrification

Rural electrification in Palawan will be achieved in part through the extension of existing distribution lines, while the remaining part will be realized through the use of mini-grids and stand-alone systems. Among these methods, the extension of the grid will be dependent on the owner/operator of the existing distribution line, the Palawan Electrification Cooperative, Inc. (PALECO). As of the latest interim report, the actual scheme for the grid extension has not been determined. It is, however, rather difficult to conceive a situation where a single grid is operated by several different operators. Therefore, it is safe to assume that PALECO will be involved one way or another.

Also for the mini-grids, PALECO is practically the only entity in Palawan with any knowledge of grid operation. Therefore, it is highly likely that mini-grids will also need to rely on PALECO for technical assistance or the outsourcing the operations. However, for this to happen, the viability of PALECO in terms of its financial operations needs to be assessed in order to determine whether PALECO has the resources to carry out such tasks.

In Palawan, there is another electrification cooperative (EC), BISELCO in Busuanga Island. This, however, is limited to operations in Busuanga Island only. Therefore, its role in the electrification of the main island is limited. It is also important to note that BISELCO is operated under PALECO. Therefore, the assessment of PALECO seems to be sufficient at this point. In this section the financial viability and the operations of PALECO will be considered.

3.6.1 PALECO

(1) PALECO Operations

As mentioned earlier, PALECO is the Electric Cooperative (EC) in Palawan. Its actual operations are to purchase power from NPC-SPUG and sell this power to the cooperative members through the distribution lines. PALECO used to have their own generation capacity, but due to the sector reform in the Philippines, PALECO no longer has any generation capacity except for very limited facilities. Their main assets consist of transmission facilities (distribution lines and transformers).

When a Palawan residents wishes to receive electricity, they will join PALECO. PALECO will assess whether they can provide electricity to that consumer, and decide whether to accept the membership. As of December 2002 PALECO’s membership came to 53,581. Its membership has seen a 6% annual growth rate over the past 5 years.

Along with the membership, electricity sales (kWh) have also steadily increased. The growth of electricity sales is 6%, almost the same as the growth of its members. The total amount of electricity sold was 8.25 million kWh in 2002. Its system loss was 11-13%, which is not particularly high. The maximum system loss that ERC permits is 14%. With the increased membership and sales, distribution lines have been extended at a steady pace. As of 2002, PALECO owned and operated 1,314 km of distribution line, with 30-80 km of new lines added annually (see Table 3.6.1).

Table 3.6.1 Summary and Trend of PALECO Operations

	1998	1999	2000	2001	2002
# of Members	42,940	45,381	47,850	50,367	53,581
KWh Purchased	76,371,502	78,748,350	85,262,223	88,651,664	95,237,344
KWh Sold	66,684,398	69,251,332	75,073,235	78,080,422	82,533,375
Coop Use	519,619	499,098	456,475	382,192	385,281
System Loss	12%	11%	11%	11%	13%
Dist. Line (km)	1,105	1,156	1,186	1,220	1,314

Source: PALECO

PALECO also provides power to shops, industries, public buildings and street lights. In some cases, instead of directly becoming a PALECO member, users may form BAPAs (Barangay Power Association), and receive power supply from PALECO as a BAPA. Looking at the breakdown of the customers, residential use occupies nearly half of all use. Shops account for about 1/4 of the total, and industrial use and public buildings use about 10% each (see Figure 3.6.1). This customer profile occurs because Palawan lacks large-scale industries that use electricity. This structure has remained almost constant since 1998.

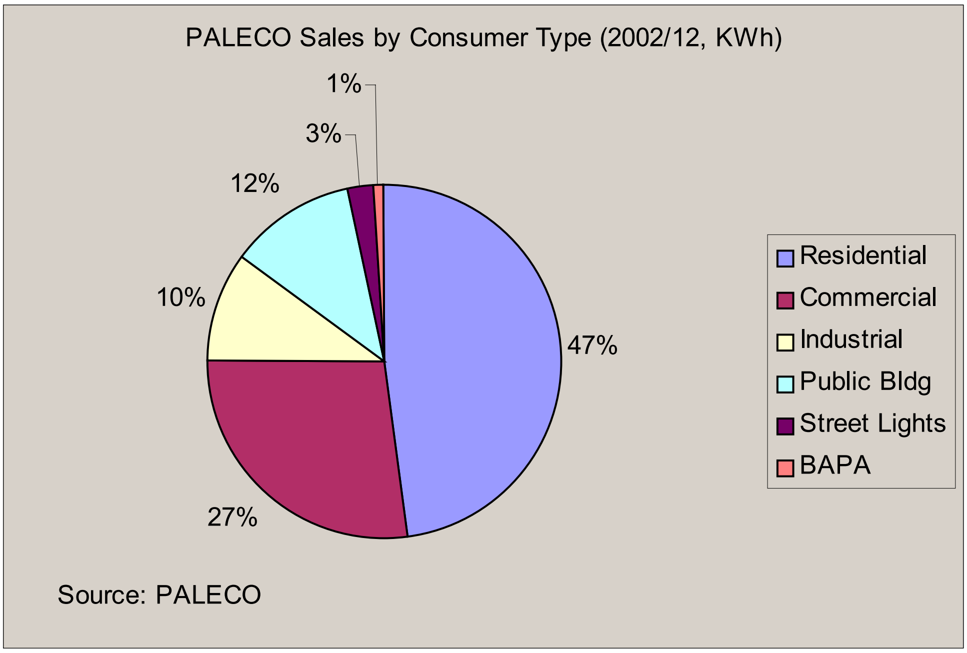


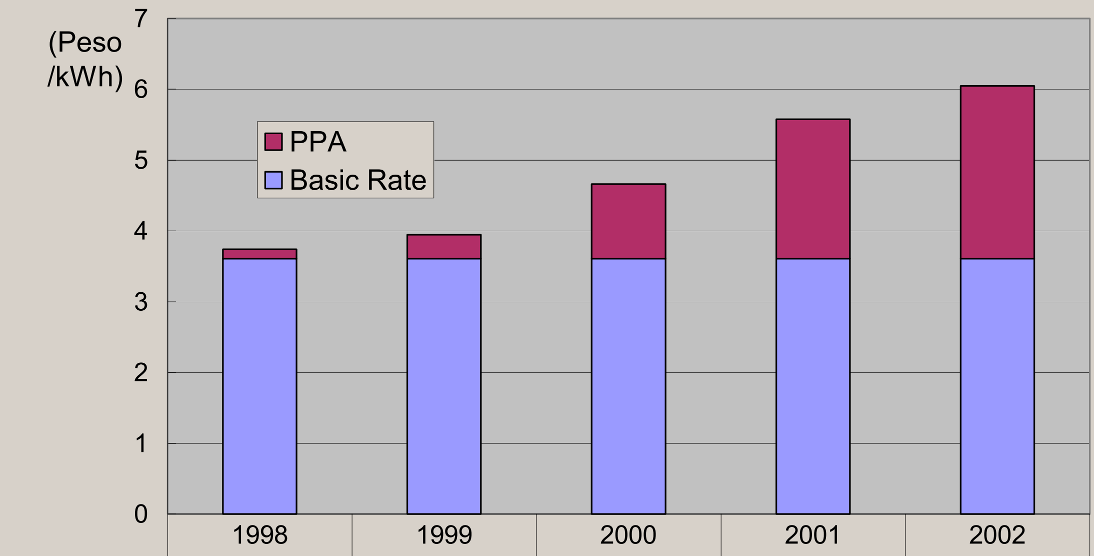
Figure 3.6.1 PALECO Sales by Consumer Type (2002/12, kWh)

(2) Financial Condition of PALECO

(i) Tariff structure

PALECO is an Electric Cooperative, which is not a profit-oriented firm. As such, they are not permitted to make excessive profits. Their tariff is regulated by the ERC, which has great influence over the financial conditions of PALECO.

The tariff in Palawan consists of the Basic Rate and the PPA (Purchased Power Adjustment), as is the case with all EC tariffs in the Philippines. As of 2002 the Basic Rate was about 3.61 Pesos/kWh, and PPA was 2.44 Pesos/kWh. The Basic Rate has remained constant for the past several years, but the PPA has shown a dramatic increase, which has caused a large hike in the overall power tariff (see Figure 3.6.2).



	1998	1999	2000	2001	2002
PPA	0.1318	0.3356	1.0516	1.9686	2.4363
Basic Rate	3.6109	3.6109	3.6109	3.6109	3.6109

Source: PALECO

Figure 3.6.2 PALECO Tariff Trends

The basic rate is determined by the ERC, based on the actual conditions of each EC as of 1991. It consists of the power cost, system loss non-power cost, amortization and reinvestment fund (Table 3.6.2). This, however, was the situation in 2002. In 2003 the introduction of the universal charge, and the liabilities of ECs assumed by PSALM brought some changes in the basic rate. An application to revise this basic rate has been made.

PPA has been introduced afterwards, when ECs were relieved of their generation capacity. Since ECs no longer has any generation capacity, and purchases all its supplies from NPC-SPUG, it has no control over the generation costs. Therefore, the difference between the actual power cost and system lost, and those in the basic rate, can be transferred to the consumers through the PPA.

Table 3.6.2 Breakdown of the Basic Rate for PALECO (2002)

	(Peso)
Power Cost	1.9635
System Loss (12.8%)	0.289
Non-Power Cost	0.9434
Amortization	0.252
Reinvesntment fund	0.163
Total	3.6109

Source: ERC

From this description, it is obvious that PPA only responds to the increase in the power purchase costs. Other cost increases cannot be bore by the PPA. Other unit costs, including funds for new investments, practically remain at the 1991 levels, although the increase in sales volume will cover the increases in total costs. Therefore, it is rather difficult to make large scale investments. It should also be noted that there is no provision for inflation. The current inflation in the Philippines is relatively low at 3-4%, but significant checks on the cost will be required to maintain operations.

When the cost structure of the EC changes and will require additional funds, or if it requires a significant amount of investment above the level that the current basic rate permits, the EC will request a change in the basic rate. However, PALECO has never applied for a change in the basic rate until the reforms in 2003.

(ii) Profit and loss statement

The profit and loss statement of PALECO is shown in Table 3.6.3.

The total sales of PALECO in 2002 were at about 460 million pesos. The sales have increased rapidly, with an average annual increase of 16%. This, however, is a combination of the increase in volume and the tariff increase. Also, these sales include prompt payment rewards from NPC-SPUG, but this has not been explicitly shown in Table 3.6.3.

Table 3.6.3 Profit and Loss Statement of PALECO

Profit & Loss					(Peso)
	1998	**1999**	**2000**	**2001**	**2002**
Operating Revenue	252,769,434	270,367,484	314,806,544	410,123,317	460,248,018
Power Cost					
Fuel&Oil	61,924	444,382	1,077,639	944,898	215,860
Purchased Power	158,743,818	173,900,476	213,201,207	302,554,541	346,394,207
Total	158,805,742	174,344,858	214,278,846	303,499,439	346,610,067
Transmission					
Distribution					
Operation	12,166,261	14,601,652	14,951,148	17,931,729	15,756,755
Maintenance	12,967,597	14,164,062	13,985,550	16,242,401	14,929,384
Total	25,133,858	28,765,714	28,936,698	34,174,130	30,686,139
Consumer Account	18,476,004	18,677,010	18,293,295	19,141,824	20,334,170
Administrative	33,014,511	32,685,756	35,303,276	40,020,200	40,642,738
Total O&M	76,624,373	80,128,480	82,533,269	93,336,154	91,663,047
Operation Margin	17,339,319	15,894,146	17,994,429	13,287,724	21,974,904
Depreciation/Amortization	15,043,727	16,231,159	22,095,288	18,090,901	17,294,654
Interst	1,516,515	1,457,479	1,236,393	700,967	646,633
Other					
Net Operating Margin	779,077	-1,794,492	-5,337,252	-5,504,144	4,033,617
Non-Operating Revenue	6,553,791	4,943,683	8,798,317	6,176,639	3,787,397
Non-Operationg Expense	23,223				
Net Margin	7,309,645	3,149,191	3,461,065	672,495	7,821,014

Source: PALECO

On the cost side, the power purchase cost has shown the most significant increase at an annual rate of 22%. There's not much that PALECO can do about this cost. At present, this cost occupies 70% of the total costs. Although there are some generation costs that remain, they are small and negligible.

For costs that PALECO can do something about, the various O&M has been kept low. As a total, the average growth is only 5%, lower than the sales volume growth, and in recent years, it has even been declining. Considering the effects of inflation, the strong determination to control costs is apparent. In some cases, such cost savings can lead to low maintenance and effort, but in the case of PALECO, considering their level of system loss and collection, this does not seem to be the case.

As a result, the operational profits (margin) remain almost constant at close to zero. The level of profit/loss amounts to about 1% of the total sales, which should be considered as the revenue and costs being almost balanced. Some non-operation revenues can be added to push PALECO slightly into the profit side.

(iii) Balance sheet

Table 3.6.4 shows PALECO's balance sheet.

Table 3.6.4 Balance Sheet of PALECO

Balance Sheet					(Peso)
	1998	1999	2000	2001	2002
Assets					
Utility Plants					
Gross Utility (Bk Value)	184,958,079	207,399,823	230,847,001	276,614,391	288,635,977
Accum. Deprec.	88,171,732	104,657,625	126,843,266	140,509,012	157,803,668
Net Utilituy Plants	96,786,347	102,742,198	104,003,735	136,105,379	130,832,309
Work in Progress	29,578,567	27,132,404	24,530,906	8,014,011	28,097,975
Total Utility Plant	126,364,914	129,874,602	128,534,641	144,119,390	158,930,284
Other Property					
Funds etc.	29,668,792	36,976,983	48,465,969	43,071,728	56,007,586
Cash	36,087,441	31,110,179	43,361,317	31,752,698	41,785,771
Accounts Recievable	24,831,252	33,809,190	45,821,401	62,383,964	73,359,239
Materials & Supply	22,479,532	24,598,670	23,185,063	26,778,484	29,081,896
Other Current Assets	60,734,748	3,440,375	19,244,371	8,493,773	7,896,481
Deferred Debit	2,110,503	1,034,041			
Total Assets	302,277,182	260,844,040	308,612,762	316,600,037	367,061,257
Equity					
Membership	215,655	227,720	240,155	252,980	269,795
Donated Capital	4,992,857	4,992,857	4,992,857	1,792,857	1,792,857
Contribution	42,186,251	26,916,210	49,264,737	32,595,307	34,601,693
Reinvestment Fund	53,785,759	67,268,649	82,852,489	102,918,120	124,661,244
Unappropreated Margin	53,919,734	58,139,159	57,257,042	61,002,653	68,823,668
Total Equity	155,100,256	157,544,595	194,607,280	198,561,917	230,149,257
Liability					
Long term Debt (Construction)	76,436,003	25,817,394	24,166,526	24,903,853	24,903,853
Long term Debt (Nat. Welth)	30,662,783	28,409,785	27,398,787	20,098,716	26,997,946
Short Term Debt	200,000	200,000	200,000	555,955	200,000
Consumer Deposit	11,501,069	13,528,401	15,764,511	18,375,991	21,629,415
Acct. Payable	14,356,955	15,441,953	24,018,294	28,661,782	32,614,241
Other Current Liability	13,711,165	19,391,299	22,386,140	22,571,961	25,162,791
Other	308,951	510,613	71,224	2,869,862	5,403,754
Total Liability	147,176,926	103,299,445	114,005,482	118,038,120	136,912,000
Total Equity & Liability	302,277,182	260,844,040	308,612,762	316,600,037	367,061,257

Source: PALECO

The total assets for PALECO as of 2002 came to about 367 million pesos. The total asset amount stagnated around 1998-99, but since then it has steadily increased. Utility plants have shown steady growth, while the level of cash is steady, without any draw down. One issue may be the ratio of accounts receivable to the total sales, which is rapidly increasing. This often occurs in places where the tariff has been increased significantly. The ratio has increased from 10% in 1998 to 16% in 2002, which may cause problems in the future.

On the equity side, it can be seen that the reinvestment fund is a big source of financing. This can also be confirmed in the following cash flow section. Although only a small portion of the tariff, the total amount seems to be quite large.

The level of debt is very small. This is probably due to the fact that since this is an EC, prospective lenders may be limited. Long term debt is merely 20% of the total equity, and there seems to be no financial problems. Accounts Payable show an increase, but this seems to be a natural result of the increasing power purchase costs. As seen in the P/L statement, PALECO receives discounts from NPC-SPUG for prompt payment, and the increase in the payable does not reflect PALECO's ability to pay.

In 2003, along with the reform of the power sector, all debts of ECs will be assumed by PSALM. This should bring significant changes in the balance sheet of PALECO. However, since it is not under any financial difficulties even with the current level of debt, it is unlikely that reducing it will bring any negative effect on PALECO's financial condition.

(iv) Cash flow

The cash flow statement of PALECO is shown in Table 3.6.5.

The cash flow of PALECO is arranged in a slightly different manner than cash flow statements under GASAP. It is more similar to sources and uses of funds statement. The power sales occupy most of the cash inflow, followed by the re-investment fund. The power purchase cost occupies most of the cash outflow. The total flow of funds amounts to 500 million pesos as of 2002.

As mentioned before, PALECO has a very limited amount of debt due to its nature as an EC. As a result, there are hardly any cash flows from financing save for small amounts of interest.

Capital expenditure is around 5% of the total cash inflow. This ratio shows significant fluctuation, but it usually remains very modest. It is obvious that they are in no hurry to grow very fast. The actual content of the capital expenditure is unclear from the statement, but it is probably safe to assume that most are for extensions of distribution lines.

The level of cash shows a steady increase, with around 11% of the total expenditure reserved at all times. This level somehow showed a significant increase in 2002 to 25%. But in any case, there is no risk of a short term cash shortage.

Table 3.6.5 PALECO Cash Flow Statement

Cash Flow					(Peso)
	1998	1999	2000	2001	2002
Sources					
Power Bill	238,234,943	249,208,078	287,758,792	371,277,329	427,242,840
5% Reinvestment Fund	12,541,026	13,094,418	15,145,240	19,540,284	22,610,942
Other Fee	6,934,575	7,160,510	8,068,445	11,158,351	12,362,960
Interest	197,677	253,379	277,689	300,984	252,944
NPC Prompt Payment Discount	4,638,066	5,077,144	6,185,596	8,959,248	10,226,367
Comsumer Deposit	1,190,176		217,306	1,907,441	1,657,977
Other income	1,824,076	680,169	921,051	70,835	66,288
Terminated Time deposit benefit	1,615,166	14,327,863	8,567,535	8,567,535	8,567,535
Consumer Advances for Construct.	46,536	3,057,012	4,118,947		14,468,198
Total	267,222,241	292,858,573	331,260,601	444,649,551	497,456,051
Uses					
NEA Amortization Payment	3,416,503	3,416,503	3,416,503		
Sinking Fund Retirement	4,798,329	5,041,536	5,041,536	4,892,280	5,000,000
Power Payment	160,196,109	170,099,618	206,662,972	299,481,761	341,264,644
Capital Expenditure	7,195,620	23,048,171	11,787,286	4,686,895	25,110,614
Sinking Fund Reinvestment	11,990,680	10,767,777	14,620,053	12,998,089	21,593,476
Sinking Fund Consumer Deposit	3,005,085	209,795		1,266,055	1,381,403
Sinking Fund Employee benefit		1,500,000	1,000,000	3,500,000	
Sinking Fund CapX		100,000			
CapX Reinvesntment				26,546,162	
Operating Expenses	72,396,906	77,311,561	85,609,862	88,926,848	95,080,550
Others	194,542	0	550,417	26,666,568	0
Total	263,193,774	291,494,961	328,688,629	442,418,496	489,430,687
Change in Cash	4,028,467	1,363,612	2,571,972	2,231,055	8,025,364
Beginning Cash	4,653,137	9,351,120	10,714,732	13,286,704	15,524,206
Ending Cash	8,681,604	10,714,732	13,286,704	15,517,759	23,549,570

Source: PALECO

(3) Summary of PALECO's Finances

Based on its current financial condition, PALECO is demonstrating a relatively good performance. The number of members and sales volume (kWh) both show a steady increase of 6%, and the extension of the distribution grid has been steady at 4% growth on-year, or about 80 km annually. Sales revenue shows a 16% annual increase, although this is mostly due to the tariff increase, caused by the power purchase cost from the NPC-SPUG. The O&M costs for the EC itself have been consistently lower than the growth of membership or sales, which shows a highly conservative operation.

Good operations can also be observed in terms of system loss, which remains relatively low at 11-13%. This is lower than the ERC criterion of 14%. Although not definitive, it seems likely that adequate maintenance and checks against theft are duly in place.

Collection also seems strong, with a collection rate over 90%. There are regional differences within Palawan itself, with low areas only achieving about 70%. Still, the collection rate for Puerto Princesa City where most of the demand exists remains high, which pushes up the overall average. One issue is the increase in the accounts receivable, which may indicate some issues ahead.

These excellent performances seem to indicate that PALECO can be depended upon for various operation outsourcing, or they can be assigned to undertake certain tasks. Obviously, depending on the scale of the new undertaking, considerations for human resources and others need to be taken into account.

Investment, on the other hand, is another issue. It seems unlikely that the current establishment of PALECO can handle much investment. One reason for the good financial performance of PALECO is that they keep investment low, thereby keeping debts low. Under the current tariff structure, it is difficult to undertake large scale investment, since it would be difficult to finance.

Some ECs have joined efforts to form REFC (Rural Electrification Financing Corporation) in order to raise capital in the market. If such new schemes can be introduced in Palawan, the situation may change. But currently, some new methods for fund raising need to be devised in order to advance rural electrification. It seems unreasonable to expect PALECO to do the necessary investment.

3.6.2 BISELCO

BISELCO is the EC in charge of distribution in the Busuanga area. Although its organization is separate from that of PALECO, it is under supervision from PALECO, which provides approval for their financial statements.

Its operations are similar to those of PALECO, purchasing power from NPC-SPUG and distributing it to the members. Operation trends are shown in the following table.

Table 3.6.6 Summary and Trends for BISELCO Operation

General Operation	1998	1999	2000	2001	2002
# of Consumers	3,568	3,900	4,038	4,297	4,532
KWh Purchased	2,996,687	3,330,707	3,593,135	3,668,805	4,139,135
KWh Sold	2,268,086	2,546,431	2,984,937	3,132,261	3,518,514
Coop Use	157,493	39,910	21,592	18,451	24,437
System Loss	19%	22%	16%	14%	14%
Dist. Line (km)		198		199	199

The number of consumers is about only 9% and kWh sold is about 5% compared to PALECO. Their scale is rather small, and the power demand from each member is also small. Numbers of connections and power sales have both shown steady increases over the past five years, with 3-5% annual growth for the number of members. The power sales trend is rather erratic, but they show an 8% growth on average. This growth, however, does not reflect any significant capital investment. The length of distribution lines remains almost constant at 199 km, which indicates that the new consumers are connecting to the existing distribution network.

System loss used to be remarkably high, peaking at 22% in 1999, but since then it has drastically declined to 14%, which is well within the system loss limit imposed by ERC. This indicates significant efforts to improve operations.

Table 3.6.7 BISELCO Profit and Loss Statement

Profit & Loss					(Peso)
	1998	1999	2000	2001	2002
Operating Revenue	13,741,980	14,587,210	16,629,741	20,122,398	24,845,228
Power Cost					
Purchased Power	6,989,829	7,372,664	8,993,225	12,430,300	14,964,414
Total	6,989,829	7,372,664	8,993,225	12,430,300	14,964,414
Transmission					
Distribution					
Operation	988,796	955,792	1,060,531	1,016,257	963,576
Maintenance	945,977	964,737	1,097,588	1,119,106	1,263,515
Total	1,934,773	1,920,529	2,158,119	2,135,363	2,227,091
Consumer Account	859,979	1,332,247	918,463	903,126	1,737,461
Administrative	1,505,145	2,193,679	2,102,850	2,027,133	1,680,033
Total O&M	4,299,897	5,446,455	5,179,432	5,065,622	5,644,585
Operation Margin	2,452,254	1,768,091	2,457,084	2,626,476	4,236,229
Depreciation/Amortization	629,025	706,130	907,382	913,000	1,335,296
Interest	540,598	586,279	508,823	1,033,482	955,668
Other					
Net Operating Margin	1,282,631	475,683	1,040,879	679,994	1,945,265
Non-Operating Revenue	135,994	46,838	104,637	140,360	175,730
Non-Operating Expense		230,197	4,021		
Net Margin	1,418,625	292,324	1,141,495	820,354	2,120,995

Source: BISELCO

As the sold power increases, their sales have also increased. Annual growth of sales after 2000 has been around 20%, which is a result of both the tariff increase and the power demand increase.

As for cost, the power purchased from NPC-SPUG is the largest cost item at 60% of sales. Power purchase costs are rising rapidly, but there is little that BISELCO can do about it. On the other hand, other operational costs that used to be over 30% of sales have been brought down to 25% of sales, which seems to reflect some effort to improve operations.

As a result, the operational margin is 13-17% of sales. This ratio is significantly higher than PALECO. The net margin is also high, especially after 1999. Considering the drastic decrease of the system loss at the same period, there must have been significant efforts at that period.

Table 3.6.8 BISELCO Balance Sheet

Balance Sheet					(Peso)
	1998	1999	2000	2001	2002
Assets					
Utility Plants					
Gross Utility (Bk Value)	20,794,013	21,629,864	23,692,207	26,603,357	28,514,542
Accum. Deprec.	5,181,627	6,034,977	6,927,028	8,536,856	9,713,563
Net Utility Plants	15,612,386	15,594,887	16,765,179	18,066,501	18,800,979
Work in Progress	3,851,310	4,105,634	3,069,049	3,901,490	8,171,751
Total Utility Plant	19,463,695	19,700,521	19,834,228	21,967,991	26,972,730
Other Property					
Funds etc.	30,539	28,366	1,046,126	2,192,293	1,720,042
Cash	295,774	1,112,268	1,333,466	1,128,104	4,241,961
Accounts Recievable	5,269,557	5,038,222	5,966,689	5,241,110	7,734,112
Materials & Supply	3,999,810	3,666,123	3,770,124	2,010,015	2,529,825
Other Current Assets	24,415,025	23,906,142	23,956,142	50,605	138,146
Deferred Debit	6,202,319	6,315,363	6,517,541	2,772,050	2,472,624
Total Assets	59,676,720	59,767,005	62,424,316	35,362,168	45,809,440
	38%	35%	36%	26%	31%
Equity					
Membership	12,586	13,476	14,241	14,721	15,576
Donated Capital	1,681,641	1,681,641	1,681,641	1,681,641	1,681,641
Contribution	10,581,549	10,833,530	12,159,555	14,312,434	18,647,710
Other Capital accounts	8,889,626	8,889,626	8,889,626		
Unappropriated Margin	−8,595,527	−9,535,066	−8,970,767	−5,118,614	−3,302,692
Total Equity	12,569,876	11,883,207	13,774,296	10,890,182	17,042,235
Liability					
Long term Debt (Construction)	12,726,079	12,277,614	11,709,344	12,005,785	11,731,139
Long term Debt (Restructured	3,989,806	4,220,611	4,201,465	1,286,912	5,066,583
Long term Debt(OECF)	14,000,000	1,206,760	661,908	338,647	335,921
Long Term Debt(Logistical OEC	2,300,000	13,997,717	14,023,400	78,918	430,406
LongTerm Debt- National Weal	6,003,274	6,003,274	6,003,274	6,003,274	6,003,274
Short Term Debt					
Consumer Deposit	1,259,505	1,435,623	1,567,841	1,581,889	1,544,589
Acct. Payable	1,968,547	1,192,847	1,128,528	1,852,863	2,803,732
Other Current Liability	2,801,171	4,603,241	6,518,308	1,323,698	811,661
Other	2,058,462	510,613	2,835,950		
Total Liability	47,106,844	45,448,300	48,650,018	24,471,986	28,727,305
Total Equity & Liability	59,676,720	57,331,506	62,424,314	35,362,168	45,769,540
Source: BISELCO		2,435,499			

The balance sheet shows that the amounts of equipments are increasing steadily. However, between 2000 and 2001, "Other Current Assets" have decreased significantly, causing a 40% decrease of total assets. Also, the balance sheet didn't balance in 1999. There must have been some changes in 2000.

One point to notice is the large amount of debt, compared to PALECO. Whereas PALECO had 60% equity, BISELCO had only 20% equity, with a high reliance on debt. This, however, should change, due to the debt takeover by PSALM. The actual effects have not been clear at the time of writing this report.

Table 3.6.9 BISELCO Cash Flow Statement

Cash Flow					(Peso)
	1998	1999	2000	2001	2002
Sources					
Power Bill	10,621,134		15,699,806	18,109,379	20,995,132
5% Reinvestment Fund	397,162		642,501	927,189	1,140,418
Universal Charge					
Other Fee	384,258		193,163	136,091	118,826
Interest	13,525		31,289	70,418	82,792
NPC Prompt Payment Discount				337,835	437,582
Comsumer Deposit				57,495	307,699
Other income	561,697		539,694	672,094	666,571
Subsidy fund from NEA					3,095,375
Adjustment	187,406				
Consumer Advances for Construct.					
Total	12,165,181		17,106,453	20,310,501	26,844,395
Uses					
PowerCost	4,080,747		8,792,485	11531845	13,378,175
Debt Service	2,600,809		423,487	2,108,215	3,666,389
Capital Expenditure	1,352,593		1,879,560	1,022,370	2,266,207
Sinking FundReinvestment	-19,465		764,293	905,112	-723,484
Sinking Fund Membership			514	887	1,450
Sinking Fund Retirement Benefit			252,953	224,165	3,718
Sinking fund NEA				7,080	246,066
Sinking Fund PSALM					
Operating Expenses	4,166,322		4,771,962	4,716,189	4,892,017
Others					
Total	12,181,006		16,885,254	20,515,863	23,730,538
Change in Cash	-15,826		221,199	-205,362	3,113,857
Beginning Cash	311,599		1,112,268	1,333,467	1,128,105
Ending Cash	295,774		1,333,467	1,128,105	4,241,962

As with the conditions in the profit and loss, and the balance sheet, the cash condition of BISELCO is steadily growing. Capital expenditure gradually increased, which continued into 2003. This corresponds with the growth of the utility plants, and the work in progress, that appears in the balance sheet. However, the expenditure doesn't amount to much, which is consistent with the constant length of distribution lines. Obviously, the capital expenditure mainly corresponds with the maintenance and overhaul of existing equipments.

With the relatively good financial condition in the recent years, it is probably possible to increase the amount of this capital expenditure. Some extension of the distribution line can be undertaken by BISELCO. However, the possible level would be incremental at best. It does not have the capacity to make large additional investments. Also with the large debt, it would have been difficult to increase investment through borrowing, which have become even more difficult with PSALM. Therefore, it is unlikely that BISELCO can foot the bill for large scale investment.

From a financial point of view, the overall operation of BISELCO seems to be sound, with a proper cap on costs and with decreasing system loss. Their operational ability itself seems to be quite good. However, their ability to make new investment is limited. If there are any needs for future large scale investment, the initial investment cannot be borne by BISELCO.

Also, according to interviews with related parties, the largest problem with BISELCO at the moment is not their operation, but the power supply. Due to low supply, blackouts and brown outs are rampant, causing dissatisfaction among members. This is a problem with NPC-SPUG. Therefore, the ability of BISELCO to expand will rely heavily on the ability of NPC-SPUG to provide them with adequate generation capacity.

3.6.3 BAPA

Barangay Power Associations (BAPAs) are organizations that are formed by the residents to create a mini-grid for power supply. Currently, the generation capacity of BAPAs are provided virtually free of charge by PGP, with some technical support from PALECO. Within the barangay, people who wish to have power create an organization to provide daily maintenance, fuel purchase, generator operation and tariff collection. However, the ownership of the generators remains with PGP, and large scale overhauls are not considered at the moment. The replacement after the useful life of the generators has passed still remains to be an issue.

In the current plan, electrification using a mini-grid system needs to be utilized widely. These grids will need to be operated more or less similarly with existing BAPAs. Therefore, it is important to look at their current operations.

There is insufficient data for the financial performance of BAPAs. Although BAPAs are required to report to PGP about their monthly operations, only four actually fulfilled that requirement. They are Liminangcong (Taytay), Poblacion (Dumaran), Port Barton (San Vicente) and Sta. Teresita (Dumaran). Also, these BAPAs are still young. Even the oldest, Port Barton has only 2.5 years of operation records, and the other BAPAs have only a year of operational records, which is rather limited for making any judgments.

However, judging from the data at hand, the operations seems to be stable for most BAPAs, which show that BAPA-style operations do have some feasibility.

(1) Demand

BAPAs with proper records show that each has about 100 member households, but this can range from 80 to 150 households. In all of the BAPAs, except Port Barton, the number of connections is increasing.

The monthly tariff for each user seems to be about 300-400 pesos, which corresponds with the energy payment that was revealed in the socio-economic study. The actual collection is not clear, but looking at Poblacion where collection data is available, there seems to be significant seasonal fluctuation. However, since BAPAs do not maintain complicated accounting methods and generally focus on cash flow, this doesn’t seem to pose much problem for the data.

(2) Cost

The reporting of costs varies, from BAPAs that provide itemized costs to BAPAs that provide a single aggregated cost. Overall, except from Liminangcong, the total cost seems to occupy 85-90 % of the total sales.

The fuel cost is the largest cost item, accounting for 65-75% of the total sales. This figure is not constant, and there are strange cases where sales go down but fuel cost goes up, or vice versa. It is unclear whether this represents a problem with the operations, or whether it represents an increase/draw down of the fuel reserves. In the long term, however, they seem to balance out.

Labor cost is the next largest item. Liminangcong, with continuing losses, has labor costs of 30% of sales, which is unusually high. This figure is 25% for Port Barton. On the other hand, in Sta. Teresita, the monthly labor cost is only 1,500php. Whether this amount of salary can attract someone with good technical capability is not clear.

(3) Profit

BAPAs except Liminangcong more or less make some profit every month. The level of profit fluctuates, but it seems to be 6-9% of the sales. Port Barton, with the longest record of operation and a generally high level of operation in terms of data management and equipment use showed 7% for the past year. The financial statement for Port Barton is shown below.

Table 3.6.10 Port Barton Financial Statement

Port Barton, San Vicente Barangay Power association
Monthly Financial and Statistical Report
Nov 2002– November 2003

	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03
Number of Connections	140	144	148	148	147	149	147	150	150	151	151	151	152
Minimum Users	41	35	27	43	55	40	42	54	49	41	43	37	24
Over minimum	99	109	121	105	92	109	105	96	101	110	108	114	128
KWH Sold	4379	4898	6221	5188	4176	4984	4971	4030	4216	4324	4375	4337	4822
KWH	291	266	205	323	395	296	292	416	376	321	333	281	203
KWH	4088	4632	6016	4865	3781	4688	4679	3614	3840	4003	4042	4056	4619
Operating Revenues:													
Residential Sales	51,430	56,110	69,510	59,650	50,100	57,600	55,650	48,690	50,260	51,080	51,830	51,410	55,840
Total Operating Revenues	**51,430**	**56,110**	**69,510**	**59,650**	**50,100**	**57,600**	**55,650**	**48,690**	**50,260**	**51,080**	**51,830**	**51,410**	**55,840**
Operating Expenses													
Honoraria/Salaries	12,000.00	16,000.00	12,000.00	854.00	12,000.00	12,000.00	12,000.00	12,000.00	12,000.00	17,920.00	12,000.00	12,000.00	12,000.00
Miscellaneous	2,647.00	931.00	4,368.00	0.00	1,800.00	4,240.00	1,400.00	4,578.00	5,700.00	2,169.50	1,005.00	685.00	860.00
Transportation	29,200.00	32,850.00	0.00	40,109.00	0.00	0.00	558.00	0.00	0.00	0.00	0.00	0.00	0.00
Supplies	0.00	0.00	46,849.00	12,000.00	34,064.00	38,251.00	34,719.00	33,855.00	32,769.00	33,086.50	35,618.00	38,249.00	39,048.00
Fuel, oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Operating Expenses	**43,847.00**	**49,781.00**	**63,217.00**	**52,963.00**	**47,864.00**	**54,491.00**	**48,677.00**	**50,433.00**	**50,469.00**	**53,176.00**	**48,623.00**	**50,934.00**	**51,908.00**
BAPA Net Income (Loss)	**7,583.00**	**6,329.00**	**6,293.00**	**6,687.00**	**2,236.00**	**3,109.00**	**6,973.00**	**-1,743.00**	**-209.00**	**-2,096.00**	**3,207.00**	**476.00**	**3,932.00**
TOTAL NET INCOME(LOSS)	**7,583.00**	**6,329.00**	**6,293.00**	**6,687.00**	**2,236.00**	**3,109.00**	**6,973.00**	**-1,743.00**	**-209.00**	**-2,096.00**	**3,207.00**	**476.00**	**3,932.00**
CASH FLOW													
Cash Beginning Balance	**-6,140.00**	**1,443.00**	**7,772.00**	**14,065.00**	**20,752.00**	**22,988.00**	**26,097.00**	**33,070.00**	**31,327.00**	**31,118.00**	**29,022.00**	**32,229.00**	**32,705.00**
INFLOW:													
Cash Sales	51,430.00	56,110.00	69,510.00	59,650.00	50,100.00	57,600.00	55,650.00	48,690.00	50,260.00	51,080.00	51,830.00	51,410.00	55,840.00
TOTAL	**45,290.00**	**57,553.00**	**77,282.00**	**73,715.00**	**70,852.00**	**80,588.00**	**81,747.00**	**81,760.00**	**81,587.00**	**82,198.00**	**80,852.00**	**83,639.00**	**88,545.00**
OUTFLOW:													
Honoraria/Salaries	12,000.00	16,000.00	12,000.00	854.00	12,000.00	12,000.00	12,000.00	12,000.00	12,000.00	17,920.00	12,000.00	12,000.00	12,000.00
Miscellaneous	2,647.00	931.00	4,368.00	0.00	1,800.00	4,240.00	1,400.00	4,578.00	5,700.00	2,169.50	1,005.00	685.00	860.00
Transportation	29,200.00	32,850.00	0.00	40,109.00	0.00	0.00	558.00	0.00	0.00	0.00	0.00	0.00	0.00
Supplies	0.00	0.00	46,849.00	12,000.00	34,064.00	38,251.00	34,719.00	33,855.00	32,769.00	33,086.50	35,618.00	38,249.00	39,048.00
Total	**43,847.00**	**49,781.00**	**63,217.00**	**52,963.00**	**47,864.00**	**54,491.00**	**48,677.00**	**50,433.00**	**50,469.00**	**53,176.00**	**48,623.00**	**50,934.00**	**51,908.00**
Cash Ending Balance	**1,443.00**	**7,772.00**	**14,065.00**	**20,752.00**	**22,988.00**	**26,097.00**	**33,070.00**	**31,327.00**	**31,118.00**	**29,022.00**	**32,229.00**	**32,705.00**	**36,637.00**

(4) Problems

Under the current BAPA operation, only simple daily maintenance is performed. Large scale overhauls and reserves for reinvestment are not prepared at all. Clearly, the current system cannot be sustained in the long run, since once the generator breaks down, there will be no resources available to replace it.

Currently, PGP is considering charging BAPAs for the use of their generators, in order to prepare for maintenance and replacement. The actual method, however, has not been established.

The general idea, however, is not unrealistic. As mentioned, the BAPA with the long and stable operation, Port Barton, has 7% profit. Since BAPAs are not profit oriented, this amount can be used for future reinvestment and maintenance. It seems probable to charge about 5% of the sales, in order to account for a 1% maintenance fee and reinvestment after 15 years. In order to achieve this, there needs to be a way to manage long-term cash resources, and a way to monitor the operations of BAPAs.

3.7 Environmental Impact Survey

3.7.1 Environmental Considerations in Palawan

(1) ECAN Zoning

Republic Act No.7611 was approved on June 19, 1992 adopting the Strategic Environmental Plan (SEP) for Palawan, a comprehensive framework for the sustainable development of Palawan compatible with protecting the natural resources and endangered environment of the province. The Environmentally Critical Areas Network (ECAN) was provided for the establishment of a graded system of protection and development control over the whole province. The ECAN shall serve as the main strategy of the SEP.

Two guidelines were adopted by the Palawan Council for Sustainable Development (PCSD). One is the guidelines for implementing the ECAN (PCSD Resolution No.94-44) and the other is the implementing guidelines for making ECAN operational for Coastal/Marine Component (PCSD Resolution No.99-144). The processes, criteria and methodologies in implementing the ECAN are prescribed in these guidelines.

ECAN has been implemented in the following manners:

Forest conservation and protection through the imposition of a total commercial logging ban in all areas of maximum protection and in such other restricted use zones provided by PCSD.

- ►Protection of watersheds
- ►Preservation of biological diversity
- ►Protection of tribal people and the preservation of their culture
- ►Maintenance of maximum sustainable yield
- ►Protection of rare and endangered species and their habitats
- ►Provision of areas for environmental and ecological research, education and training
- ►Provision of areas for tourism and recreation

First of all, the whole province is classified into the following three main components: "Terrestrial Component", "Coastal/Marine Area" and "Tribal Ancestral Lands". Each component shall be divided into several zones. The management scheme and zoning of each component are as follows:

(i) Terrestrial Component

(a) Core Zone

Fully and strictly protected and maintained free of human disruption. Tribal communities may be allowed entry into the core zone to enable them to gather forest products for ceremonial and medicinal purpose.

(b) Buffer Zone

Surrounding area of the core zone and the buffer area between the core zone and human disruption area. The buffer zone shall further be subdivided into the following three sub-zones.

1) Restricted Use Zone : Only limited and non-consumptive activities are allowed.
2) Controlled Use Zone : Controlled forest extraction, like collecting of minor forest products and strictly controlled logging and mining are allowed.
3) Traditional Use Zone : Traditional land use is already stabilized or being stabilized.

(c) Multiple Use Zone

The land is already used, such as for intensive timber extraction, grazing and pastures, agriculture and infrastructure development.

The outline of the criteria in delineating the ECAN of the Terrestrial Component is shown in Table 3.7.1.

Table 3.7.1 Outline of the Criteria in Delineating the ECAN by Terrestrial Component

Zone	Elevation	Slope Gradient	Vegetation, Land Classification
Core Zone	>1,000m	>50%	▶Virgin forest or first growth forest ▶Endangered habitats and habitats of endangered and rare species
Restricted Use Zone	500 -1,000m	36-50%	▶Habitats of wildlife species ▶Critical watershed ▶A 10km belt surrounding the core zone
Controlled Use Zone	100-500m	19-35%	▶Secondary forest ▶In areas where there is a community within or immediately adjacent to a restricted use zone
Traditional Use Zone	<100m	>18%	▶Open, bush land or grassland areas that are still classified as timberland or public land
Multiple Use Zone		<18%	▶Landscape has been modified ▶Development activities have been undertaken

(ii) Coastal/Marine Area

(a) Core Zone

Fully and strictly protected and maintained free from human disruptions including general navigation, snorkeling and diving, except for emergency situations such as taking emergency navigational routes to save life and property.

(b) Multiple Use Zone

The activities that may be allowed shall be governed/determined by resource distribution patterns, appropriate uses and management strategies. It shall be further subdivided into the following two sub-zones.

1) Buffer Zone : Restricted recreation activities such as swimming/snorkeling and non-motored boating are allowed.
2) General Use Area : Communal fishing grounds, tourism development area, visitor use areas and sustainable development areas correspond to this area.

The outline of the criteria in delineating the ECAN of Coastal/Marine areas is shown in Table 3.7.2.

Table 3.7.2 Outline of the Criteria in Delineating the ECAN of Coastal/Marine Area

Zone	Feature
Core Zone	►Portion of contiguous or aggregation of small patch of reefs with the best representative coral cover and with highest fish diversity ►Coral reefs and small islands ►Sea grass beds serving as link habitat of the coral core zones ►Coastal/marine habitat of endangered species ►Primary growth mangrove areas which serve as protection against storm erosion, flood, etc. ►Uninhabited islands or undeveloped portions thereof not subject to private rights shall be classified as core zones except identified ancestral coastal/marine waters ►Protected coastal/marine areas forming part of declared parks and sanctuaries ►Areas identified as contributing to important ecological processes such as spawning, nursery areas, breeding/feeding grounds and nutrient sources
Buffer Zone	►Variable areas surrounding the core zone. ►The transition between the strictly protected core zone and the general use zone
General Use Area	►The development area of the coastal/marine area ►The different compatible and sustainable development activities may be carried out

(iii) Tribal Ancestral Lands

These areas shall be treated with the same system of control and prohibition in the terrestrial and coastal/marine components but special cultural considerations shall be applied to the traditional inhabitants using consultative processes and cultural mapping.

The ECAN zoning map, which was revised after 1994 and is available at present, is shown in Figure 3.7.1.

The core zones are widely distributed around the central part of the Palawan Island. Also the mangrove forest zones are distributed along a part of the coastal lines. This mangrove forest is classified into the core zone of the coastal/marine area.

This zoning map is utilizing the GIS and is made for each municipality. The four main criteria; elevation, slope gradient, vegetation and land classification are overlapping on the maps. The elevation and the slope gradient are obtained from the DEM and the vegetative cover analyzed by NAMRIA is applied. These data were not considered in the preliminary ECAN zoning map of 1994.

Now the field verification to check the ECAN maps made by using analytical data is on going in each municipality. The ECAN map will be updated by the PCSD using the results of the field verification.

Also ECAN mapping for the coastal/marine areas has been on-going for some municipalities. The present ECAN zoning maps have yet to be completed and they will be revised or improved with more information and will include the results of the field verification from now on.

As a result of the meeting with the PCSD about development within the ECAN zoning, it was confirmed that no development activities are allowed in the core zone, the restricted use zone or in the mangrove forest. In these three zones, it is impossible to cut down even one tree. Therefore, in the ECAN zoning system, only three zones, namely the controlled use zone, the traditional use zone, and the multiple use zone are available for development activities. Therefore, the locations of newly developed power plants, the extension routes for transmission and distribution lines should be considered as being within controlled use zones, traditional use zones and multiple use zones in the Master Plan.

In the study of the Barangay Electrification Plan, three electrification methods such as the grid extension, the mini-grid and the stand-alone method were compared. In the case that most of the barangay area is classified into the core zone or the restricted use zone and there are no existing roads from surrounding barangays to the barangay center, it is considered that extension of the transmission or distribution line and development of the new powerhouse in the barangay are impossible. According to the ECAN zoning map, only the stand-alone method will be appropriate for the following four barangays;

San Jose, Minapla in Taytay

New Pagdanan, Marufinas in Puerto Princesa City

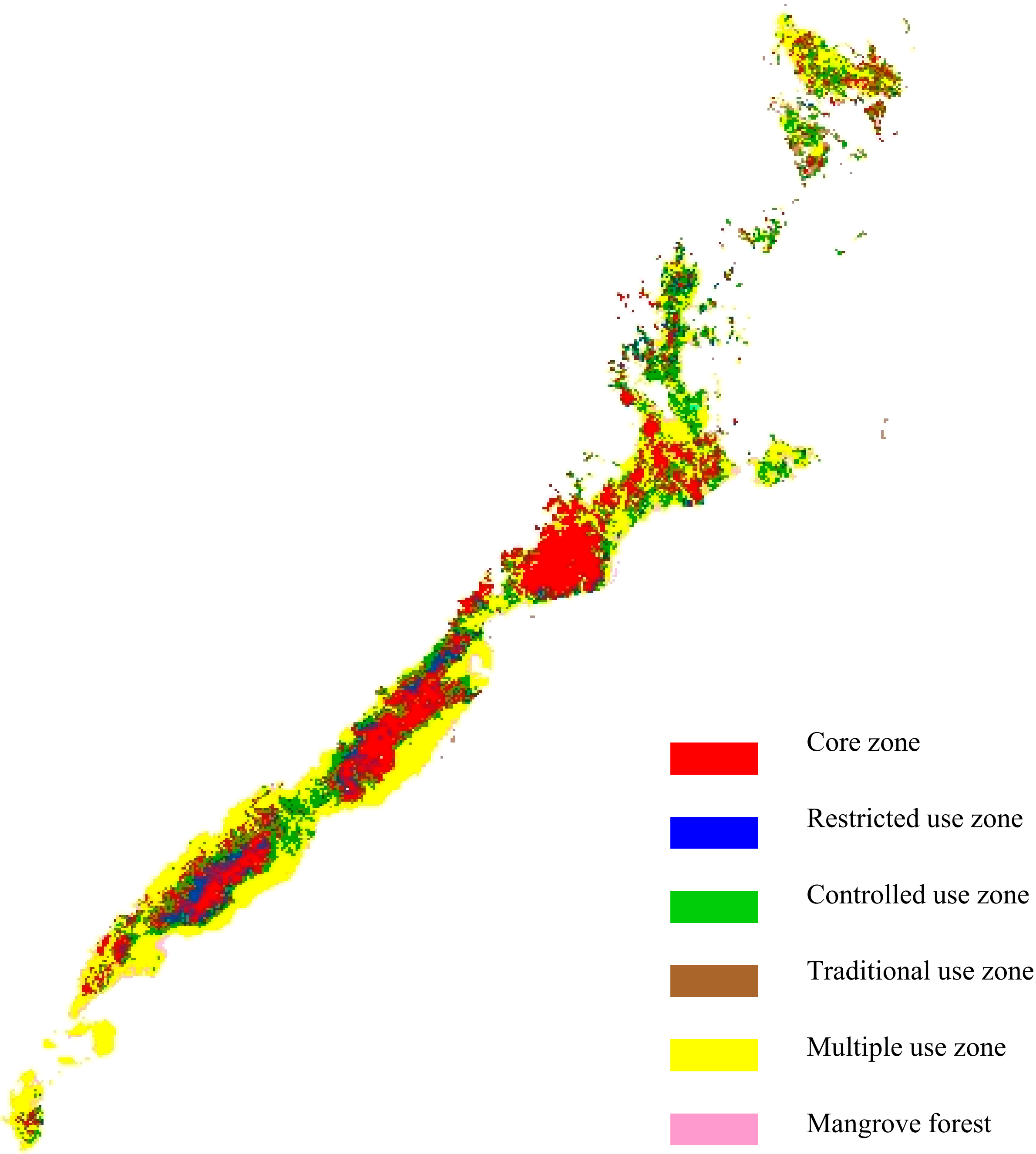


Figure 3.7.1   ECAN Zoning Map

(2) PCSD clearance

In order to implement the Strategic Environmental Plan (SEP) for Palawan, a Memorandum of Agreement (MOA) was entered into by and between DENR and PCSD on December 29, 1994. The role assignment between DENR and PCSD is described in the MOA. It is also described that PCSD shall ratify and confirm all plans and projects prior to the implementation by DENR.

The concrete procedure and the relationship between DENR and PCSD are defined by PCSD Administrative Order No.00-06, Series of 2002 (Revised Guidelines in the Implementation of the SEP Clearance System). According to this guideline, the evaluation process of the SEP clearance system is integrated with the Philippine Environmental Impact Statement System being implemented by the DENR and permitting procedures being implemented by other government organizations. The schematic flow of SEP clearance is shown in Figure 3.7.2.

In the case of heavy industries such as cement manufacturing plants and the power plants, the requirements for evaluation of applications required in the initial evaluation procedure of Figure 3.7.2 consists of the following:

(i) Environmental Impact Statement (EIS) (refer to DENR DAO 96-37 Series of 1996, for contents of EIS)

Additional requirements to be attached to the EIS:

- ►Location map/Project site plotted on the Topographic map with 1:50,000 scale
- ►Site Development Plan/Map noting adjacent water bodies (scale 1:10,000)

(ii) Proof of Status of Land and Land Ownership/Land Claim

- ►Certification/evaluation from DENR-CENRO: Community Environment and Natural Resources Office / DENR-PENRO: Provincial Environment and Natural Resources Office
- ►Land Title/Tax Declaration/Stewardship Contract/Other Instruments

(iii) Zoning Clearance from the Municipality/City Zoning Officer

(iv) Endorsement from the following LGU with resolution including a copy of the documentation of the consultation process

- ►Sangguniang Pambarangay
- ►Sangguniang Bayan
- ►Indigenous tribal communities in the case that the area falls within a certified ancestral land/domain

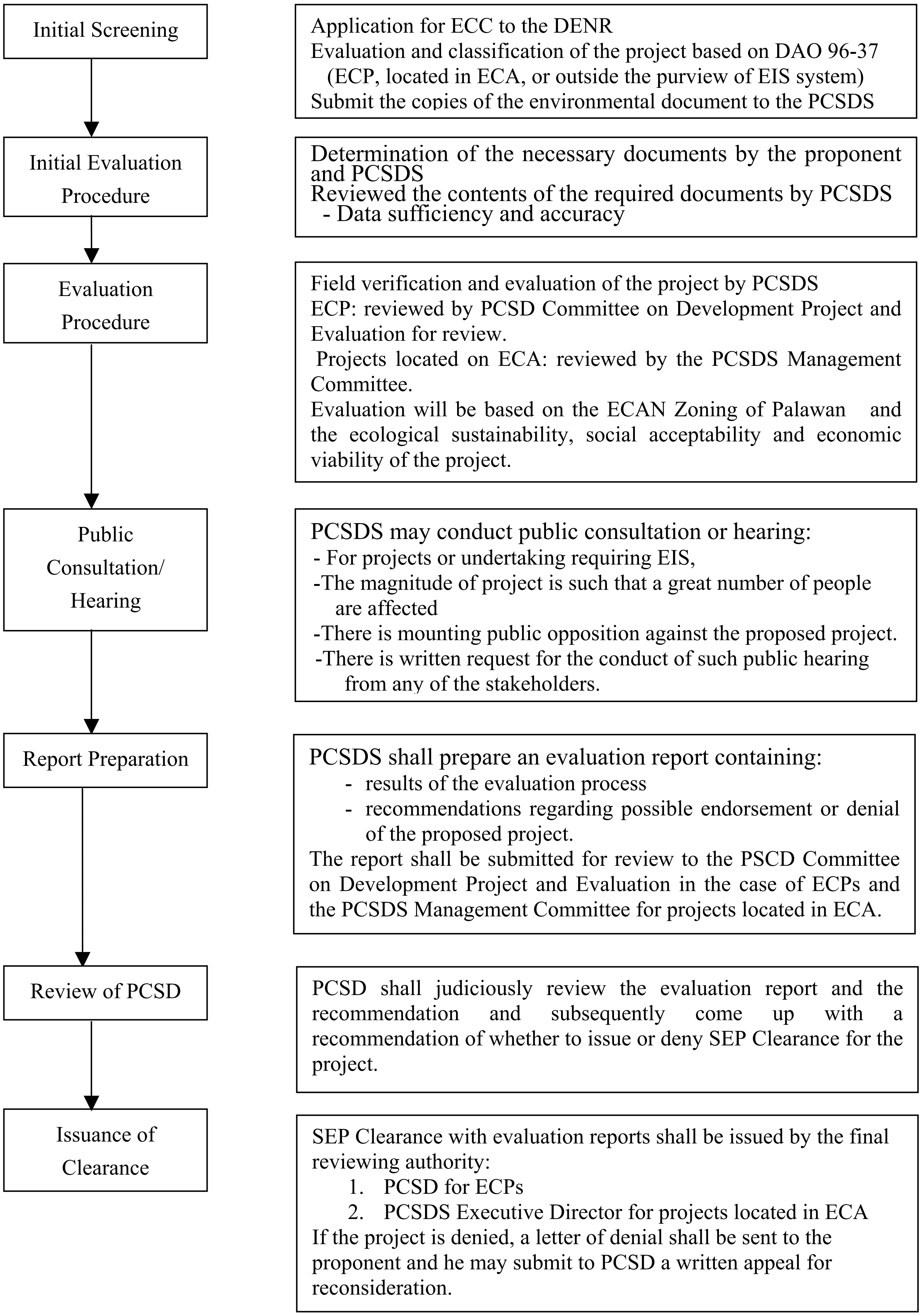


Figure 3.7.2 Schematic Flow of PCSD Clearance

(v) In the case of renewal and expansion, environmental accounting for previous operation

The PCSD does not have the criteria to define as to which document is required, EIS or IEE, for the power facilities such as small-scale power plant, transmission lines and distribution lines. But they say most probably EIS is for large-scale industries like a power plant exceeding 10MW and IEE is for small to medium industries like secondary distribution lines.

According to the revised guidelines in the implementation of the SEP clearance system, first of all, the proponent has to submit the application for ECC. Then the DENR will classify the project into ECP, ECA or non-coverage during the initial screening within the scope of the Philippines EIS system. So it should be discussed with the DENR as to which document will be necessary, EIS or IEE. During the initial evaluation the PCSD together with the proponent will initially determine the necessary documents for the project evaluation by the PCSD.

Upon receipt of the SEP clearance issued by the PCSD, the DENR and other concerned agencies shall proceed with the processing of the ECC, issue a certification of non-coverage, permit, license and other documents. The DENR shall not issue an ECC without the SEP Clearance issued by the PCSD.

(3) Protected area

According to the Republic Act No.7586 (National Integrated Protected Areas System: NIPAS Act), outstanding remarkable areas and biologically important public lands in the Philippines that are habitats of rare and endangered species of plants and animals, bio-geographic zones and related ecosystems shall be designated as protected areas. The protected area will be managed to enhance biological diversity and protected against destructive human exploitation. In Palawan province the following seven areas are designated as protected areas. Especially, the Tubbataha Reef National Marine Park and the Puerto Princesa Subterranean River National Park are designated by UNESCO as World Heritage Sites. The protected areas of Palawan and those features are shown in Table 3.7.3, and the location map of the protected areas of Palawan is shown in Figure 3.7.3, respectively.

Table 3.7.3 Protected Areas of Palawan and their Features

The Protected Area	Feature
Ursula Island Game Refuge and Bird Sanctuary	It is located near Brooke's Point and holds the habitats of threatened Gray Imperial Pigeon or Scops Owl. The shoreline is a migratory and wintering ground for shorebirds and the surrounding waters are valuable feeding grounds for seabirds.
El Nido-Taytay Managed Resource Protected Area	There are 21 barangays inside the protected area, 18 from the municipality El Nido and 3 from Taytay. It is governed by the principle, "Sustainable Resource Use and Development that Benefits Local Communities". This is to address the threats/pressing problems like illegal fishing, land conversion and illegal logging.
Tubbataha Reef National Marine Park	It is located in the middle of the Central Sulu Sea, 180km southeast of Puerto Princesa City. It is composed of two large reef platforms enclosing a sandy lagoon. Nearly 400 fish and bird species inhabit the area.
Puerto Princesa Subterranean River National Park	It is considered one of the longest navigable underground rivers in the world with a length of 8.2km. Several threatened species, including threatened and restricted range birds such as the Palawan Pheasant Peacock and the Philippine Cockatoo are regularly seen in the extensive lowland forests.
The Malampaya Sound Land and Seascape Protected Area	There are 22 barangays inside the protected area, 18 from the municipality Taytay and 4 from San Vicente. It is ecologically and economically important both as a watershed and as a rich fishing ground. The area abounds with flora and fauna including species endemic to Palawan.
Coron Island Protected Area	It is located in the south of the Busuanga island. It is famous for seven lakes, including the Kayangan Lake considered the cleanest lake in the Philippines. It also has a number of islands with white beaches. And the endemic mammals, birds, reptiles and amphibians inhabit this area.
Calauit Game Preserve and Wildlife Sanctuary	It is located in the north end of the Busuanga island. Many kinds of African wildlife species such as giraffe and zebra were transmigrated experimentally. The endemic and endangered Philippine wildlife such as the Calamian Deer and the Palawan Pheasant Peacock mingled with the exotic animals of Africa.

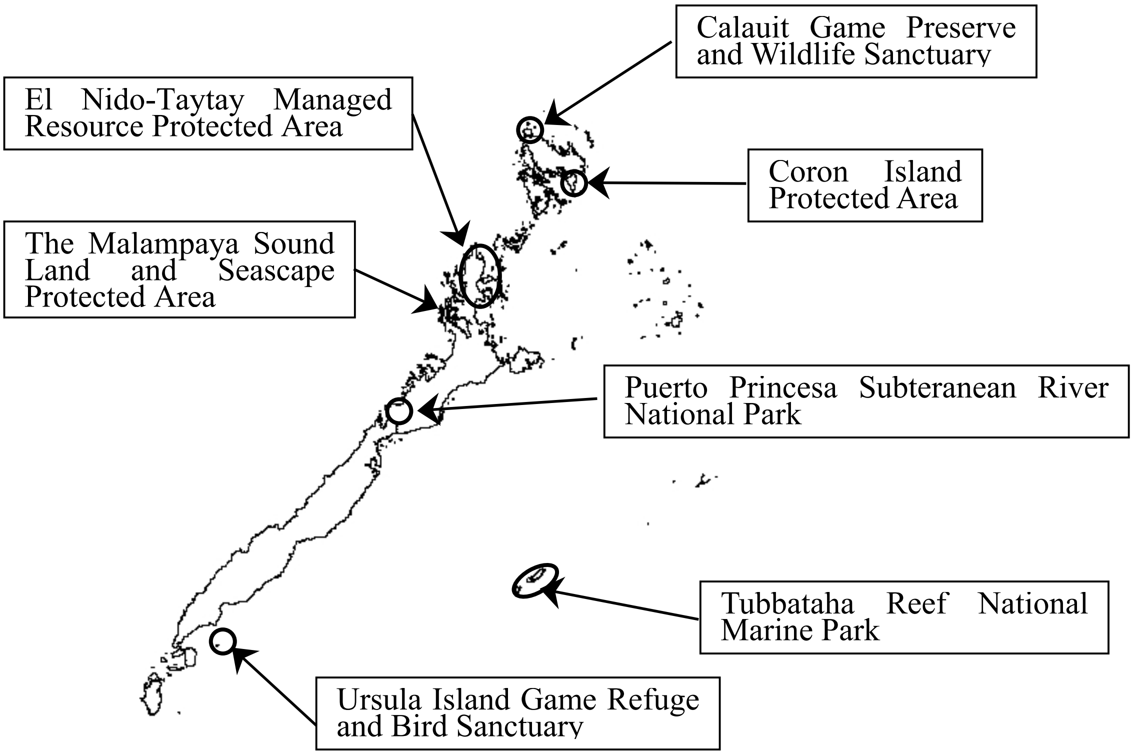


Figure 3.7.3 Location Map of the Protected Areas in Palawan

NIPAS is placed under the control and administration of the DENR. For this purpose, the Protected Area and Wildlife Division is created in the regional offices of the DENR in regions where protected areas have been established and the division is in charge of the protected area management.

To carry out the NIPAS Law, the Secretary of the DENR is empowered to perform many acts, especially those regarding the development activities. The following two acts were defined.

- ►To determine the specification of the class, type and style of buildings and other structures to be constructed in protected areas and the material to be used;
- ►Control the construction, operation and maintenance of roads, trails, waterworks, sewerage, fire protection, sanitation systems and other public utilities within the protected area;

Also the Protected Area Management Board was established for each of the protected areas. This board is composed of the representatives from the following agencies; provincial government, municipal government, each barangay within the protected area, each tribal community, non-government organizations and other departments or national government agencies involved in protected area management.

The board decides the allocation for budget, approves proposals for funding and determines matters related to planning. The following acts are prohibited within the protected areas without a permit from the Management Board;

- ►Hunting, destroying, disturbing, or mere possession of any plants, animals or products derived there from;
- ►Use of any motorized equipment;

As mentioned above, all of the human exploitation and development activities are not prohibited in the protected area. But in the case of power facility development within the protected areas, it is necessary to obtain the required permit after discussions with the Protected Areas and Wildlife Division in the regional office of the DENR and the protected area management board. Since many barangays are included especially in the El Nido-Taytay Managed Resource Protected Area and the Malampaya Sound Land and Seascape Protected Area, the considerations for the protected areas are required to perform barangay electrification.

In the case of the construction of the backbone transmission line, since a part of the transmission line route passes through the inside of the Malampaya Sound Land and Seascape Protected Area, the NPC and the owner of the project discussed the handling of the cutting trees with the Protected Area Management Board.

(4) Indigenous people

According to the Republic Act No. 8371（Indigenous People Rights Act of 1997), the following four rights were secured for the Indigenous People.

- ►Right to Ancestral Land/Domain
- ►Right to Self-Governance and Empowerment
- ►Right to Cultural Integrity
- ►Social Justice and Human Rights

The "Right to Ancestral Land/Domain" recognizes and protects the rights of ownership and possession of Indigenous Cultural Communities/Indigenous Peoples to their ancestral domains.

Moreover, according to the rules and regulations for implementing the Indigenous People Rights Act of 1997, NCIP Administrative Order No. 1 series of 1998, in the case of development, utilization or exploitation within ancestral lands/domains, the proponent shall submit to the NCIP, through the concerned regional office, a culture-sensitive Environmental Conservation and Protection Program (ECPP). The proponent has to state in detail the environmental impact of such activities or projects proposed, control and rehabilitation measures and financial resource allocations, implementation schedules, compliance guarantees and evaluation and monitoring schemes.

In the case of the hydropower development, it is assumed that some of the potential hydropower sites may be located in the ancestral lands. It is necessary to check whether or not the planning sites for the power facilities are located in the ancestral land by referring the following table. A list of tribes and their locations is shown in Table 3.7.4. This table is based on the data and the information from NCIP provincial office, non-government organization NATRIPAL and PGP-PPDO. Also the report of "The Study on Environmentally Sustainable Tourism Development Plan for Northern Palawan", which was funded by JICA is available to understand the distribution of the ancestral lands of the northern area.

Table 3.7.4 List of Indigenous Peoples Tribes and their Locations

Name of Tribe	Location	
	Municipality / City	Barangay
Tagbanua	Puerto Princesa City	Bagong Sikat, Santa Lourdes, Manalo, Maruyogon, Maoyon, San Rafael, Concepcion, Simpocan, Tagabinit, Buenavista, Napsan, Lucbuan, Salvacion, Bahile, Langogan, Kamuning, Irawan, Marufinas,
	Aborlan	Tagpait, Cabigaan, Iraan, Isaub, Sagpangan, Barake, Apurawan, Magbabadil,Poblacion, Mabini, Gogognan, San Juan, Culandanum, Plaridel, Ramon Magsaysay
	Balabac	Bugsuk, Malaking Ilog, Mangsee, Salang
	Bataraza	Buliluyan, Malihud, Malitub,
	Brooke's Point	Calasaguen
	Busuanga	Cheey, Concepcion
	Coron	Barangay V, Bintuan, Buenavista, Bulalacao, Decabobo, Decalachao, Lajala, Malawig, Marcilla, San Jose, San Nicolas, Tagumpay, Tara, Turda
	Dumaran	San Juan, Sta. Maria
	El Nido	Masagana Pob., Teneguiban
	Linapacan	Pical (Iloc), Calibangbangan, Decabaitot, Maroyogroyog, Nangalao, New Culaylayan, Pical, San Miguel(Pob)
	Narra	Antipuluan, Aramaywan, Bagong Sikat, Batang batang, Caguisan, Dumaguena, Estrella Village, Malinao, Princess Urduja, Sandoval, Teresa, Tinagong Dagat
	San Vicente	Alimanguan, Binga, Caruray, Kemdeng, Port Barton, San Vicente(Pob)
	Taytay	Baras (Pangpang)
	Rizal	Bunog, Campung Ulay
	Quezon	Berong
Palawan	Narra	Aramaywan, Bagong Sikat, Batang batang, Burirao, Caguisan, Calategas, Dumaguena, Estrella Village, Ipilan, Narra (Pob), Tacras, Taritien
	Quezon	Malatgao, Alfonso XIII, Tabon, Kalatagbak, Aramaywan, Panitian, Isugod, Sowangan, Pinaglabanan, Berong, Maasin, Calumpang, Tagusao
	Balabac	Pandanan, Sebaring
	Bataraza	Bono bono, Culandanum, Igang Igang, Inogbong, Iwahig, Malihud, Malitub, Marangas, Ocayan, Riotuba, Sapa, Sarong, Tagnato, Tagolango, Taratak, Tarusan
	S. Espanola	Isumbo, Pulot Center, Labog, Pulot II Interior, Panitian, Abo abo, Pulot Shore, Iraray, Punang
	Rizal	Bunog, Campung Ulay, Candawaga, Culasian, Iraan, Punta Baja, Latud, Ransang
	Brooke's Point	Aribungos, Malis, Saraza, Imulnod, Pangobilian, Barong Barong, Mambalot, Maasin, Ipilan, Amas, Samariniana, Mainit, Salogon
	Taytay	Liminangcong
	San Vicente	Alimanguan, Binga, Caruray, Port Barton, San Vicente(Pob)
	El Nido	Bebeladan
	Roxas	Barangay IV
	Cagayancillo	Sta. Cruz, Lipot North

Name of Tribe	Location	
	Municipality / City	Barangay
Bataks	Puerto Princesa City	Tagabinit, Langogan
	Araceli	Concepcion
	San Vicente	Kemdeng, Port Barton, Poblacion
Panimusan/ Molbog	Aborlan	Iraan
	Araceli	Concepcion
	Bataraza	Bono bono, Bulalacao, Buliluyan, Malihud, Malitub, Ocayan, Riotuba, Sarong, Tagnato, Tagolango, Taratak
	Brooke's Point	Amas, Aribungos, Barong barong, Pangobilian,
	Busuanga	Concepcion
	Linapacan	Calibangbangan, Maroyogroyog, Nangalao, San Miguel
	Roxas	Poblacion1-6, Rizal
	San Vicente	Caruray
	Rizal	Culasian, Iraan
	Balabac	Agutayan, Bancalaan, Catagupan, Indalawan, Malaking Ilog, Melville, Pandanan, Pasig, Poblacion1-6, Rabor, Ramos

3.7.2 Environmental Impact Survey on Existing Power Facilities

(1) Survey method

In order to survey the environmental impact from the existing diesel power plants in Palawan and the Palawan Backbone Transmission Line Project, interviews were held with the related agencies of the power company and the DENR. Through the interviews related data and information were obtained. The visited agencies are as follows:

Power Company : NPC-Environmental Management Department (EMD),
NPC-Power Barge 106, NPC-SPUG, Delta-P,
NPC-Palawan Backbone Transmission Project Office

DENR : Environmental Management Bureau (EMB) Region IV Office,
Provincial Environment and Natural Resources Office: PENRO

(2) Implementation of environmental monitoring

The results of the survey made clear that the environmental monitoring was based on the Environmental Compliance Certificate (ECC) monitoring report, the Pollution Control Officer (PCO) quarterly report and the hazardous-wastes generation report from the diesel power plants and the ECC monitoring report from the backbone transmission line. Those specific contents are as follows:

(i) Diesel power plant

(a) ECC monitoring report

Based on the Environmental Impact Assessment system, ECC is issued to the proponent by the region four office of the DENR in reply to the application. In the ECC there are more than ten or twenty conditions that the proponents have to comply with during the construction stage and the operation stage. Usually the compliance conditions are related to some standards or the proper handling of waste during the operations. In the case of a relatively large-scale diesel power plant like the Delta-P (transferred from Palagua), the compliance conditions during the construction and before the start of operations are also described in detail.

As an example, Table 3.7.5 shows the comparison of the concrete contents of the ECC conditions between NPC-SPUG's Linapacan diesel power plant and the Delta-P diesel power plant. The ECCs of these two power plants were issued almost at the same time. Although the actual output capacity of the Linapacan power plant is 54kW, it is described as 300kW in the ECC. And in the case of Delta-P, ECC is issued for an 8MW power plant of the 1st phase construction. Another ECC for an 8MW power plant of the 2nd phase is issued separately in the following fiscal year.

Table 3.7.5 Comparison of ECC Conditions

NPC-SPUG Linapacan diesel power plant	Delta-P diesel power plant
1. This certificate is valid only for the installation and operation of 300 kilowatts diesel power plant; OPERATION: 2. That construction and operation activities shall not cause emission of dust/suspended particulates that would exceed the standards set by the DENR: 3. That construction and operation activities shall not cause noise emissions that would exceed the DENR Ambient Noise Standards: 4. That the quality of wastewater and air/gaseous emissions shall conform with the DENR Standards: 5. That proper handling, storage and disposal of sewage, waste oil and sludge shall be implemented: 6. That proper disposal of solid wastes shall be conducted; 7. That monitoring of air quality shall be conducted and the result of which shall be submitted to this Office semi-annually; 8. That safety precautionary measures shall be implemented to protect the workers at all times; 9. That contingency measures in the case of fire, oil spill, accidents and the like shall be implemented;	1. That this ECC is valid only for the construction and operation of a land-based 8 megawatt power plant; PRE-OPERATION; 2. That all excavated areas shall be refilled to their original configurations prior to project implementation; 3. That greening and clearing of debris within the areas and vicinity shall be undertaken prior to project implementation; 4.That appropriate storage area for the construction materials shall be provided; 5. (Same as to No 2. in left column) 6. (Same as to No 3. in left column) 7. That a baseline information on the air quality site to include, but not limited to, carbon monoxide (CO) carbon dioxide (CO2), nitrogen oxide (NOx) and suspended particulates prior to operation phase and to be submitted to the Regional Office; OPERATION PHASE; 8. That baseline data on the water quality of rivers where liquid effluents shall be discharged prior to construction. The parameters to be measured shall include, but not be limited to pH, color, temperature, oil/grease, total suspended solids, biological oxygen demand, dissolved oxygen (DO) and total caliform;

Table 3.7.5 Comparison of the ECC Conditions (Continue)

10. That in the event the quality of effluents and the emissions exceeds prescribed standards, operation shall be temporarily suspended until such time that this is remedied/properly addressed; OTHERS: 11. That an Environmental Guarantee Fund (EGF) shall be initiated thirty (30) days upon receipt hereof; 12. That the DENR can conduct monitoring anytime without prior noticed in coordination with concerned groups; 13. That all other mitigating measures cited in the submitted documents shall be implemented; 14. That all necessary permits/clearances from other government agencies shall de secured prior to project implementation; 15. That Bio-data of your Pollution Control Officer(PCO) must be submitted to this office fifteen (15) days upon receipt hereof; 16. That any misrepresentation or falsehoods in the submitted documents shall be sufficient cause for cancellation or suspension of this ECC; 17. That any expansion from the approved operations shall be subjected to a separate EIA requirement; and 18. That the transfer of ownership of this project caries the same conditions in this ECC for which a written notification shall be made by herein grantee to DENR-Region IV within fifteen (15) days from such transfer.	9. That a periodic monitoring of date air and water quality data shall be submitted every quarter of the month during the operational phase of the project; 10. (Same as to No 6. in left column) 11. That a drainage system design indicating the receiving water body where liquid effluents or runoffs shall be discharge; 12. That an installation of treatment ponds shall be provided; 13. (Same as to No 7. in left column) 14. (Same as to No 8. in left column) 15. (Same as to No 9. in left column) 16. (Same as to No 10. in left column) OTHERS: 17. (Same as to No 11. in left column) 18. (Same as to No 13. in left column) 19. (Same as to No 14. in left column) 20. (Same as to No 16. in left column) 21. (Same as to No 17. in left column) 22. (Same as to No 18. in left column)
Given on 04 Dec.1996	Given on 03 Dec.1996

According to the ECCs for both power plants, in the case of non-compliance with any of above stipulations, a penalty within PHP 50,000 for every violation will be charged.

A power company submits the ECC monitoring reports that describe the status and party performing the action for each ECC conditions to the DENR EMB region IV office through the CENRO and PENRO of the DENR.

A Pollution Control Officer (PCO) is assigned to every power plant. A PCO is in charge of making the ECC monitoring reports, the PCO quarterly reports and Hazardous Wastes Generator reports, which are mentioned later.

Besides the monitoring by the power company, inspections by DENR are also conducted on an irregular basis. Usually the inspection by DENR is carried out only once a year. If a complaint from the local residents is submitted, inspections will also be conducted by DENR each time. DENR will make inquiries of a PCO and give advice to improve conditions.

(b) PCO quarterly report

A power company submits the PCO quarterly report that describes the status of water and air pollution control results from the operations of the power plant to the DENR EMB region IV office through the CENRO and PENRO of the DENR.

Especially the air quality is monitored in accordance with the DENR Administrative Order No. 2000-81, implementing rules and regulations of the Republic Act No.8749 (Philippine Clean Air Act of 1999).

Monitoring items and other contents of the PCO quarterly report are shown in Table 3.7.6.

Table 3.7.6 Monitoring Items and Contents of PCO Quarterly Report

Item	Content
A. General Information	・Name of Firm/ Establishment; ・Plant Address/Location; ・Nature of Business; ・Plant Operation; ・Amount of raw materials processed and finished products during this period;
B. Water Pollution Control Source of Wastewater Wastewater Treatment Processes Sludge Management Elaboration Watershed Characteristics	 ・Quantity from each source ・Type, design capability of WTP, schematic diagram, No. of hours of operation, etc ・Quantity of produced, method for thickening, treatment, disposal, frequency of disposal ・Breakdown of equipment, problems encountered in the operation/improvements under taken ・Color, temperature, pH, suspended solids, BOD (mg/l), oil/grease
C. Air Pollution Control Elaboration Air Pollution Source Installation Operation Condition Air Pollution Control Device Air Contaminants estimated	 ・Breakdown of equipment, problems encountered in the operation/improvements under taken ・Output capacity, type ・No. of hours of operation, amount of fuel consumed ・Type, No. of hours of operation ・Contaminant, concentration, means of disposal

In the case of the land-based diesel power plant owned by NPC-SPUG, regarding the estimated air contaminants for air pollution control, the values of concentrations for particulate matters, sulfur dioxide, carbon monoxide, and nitrogen dioxide are reported. These values are theoretically calculated considering the amount of the consumed fuel and the ingredient composition of the emission gas and the fuel. In the case of the Power Barge 106, so long as the PCO quarterly reports for the 3rd and the 4th quarter of 2002 and the 1st quarter of 2003 will be referred, there are no data about the estimated air contaminants and the concentrations of them. Air pollution monitoring of the NPC-SPUG's land-based diesel power plant and power barge is performed by the NPC-EMD. Only self-monitoring is performed. If there are no problems such as complaint from residents, air pollution monitoring will not be performed by the DENR.

In the case of Delta-P, since they don't have the environmental monitoring equipment, monitoring is performed by the DENR as shown in Table 3.7.7. According to the PCO quarterly report for the 3rd quarter of 2003, the names of the air contaminants are listed, but the values of concentrations obtained from the results of the measurement are not recorded. It was explained that the Delta-P is waiting for the results from the DENR.

Table 3.7.7 Air Quality Monitoring of Delta-P

Agency	Frequency	The contents of monitoring
DENR-EMB Region IV	Quarterly	Air Ambient Test: The atmosphere that penetrates the filter is investigated at the monitoring point installed on four points around the power plant. It measures only particulate matter.
DENR-EMB National Capital Region & Region IV	Annually	Stack (Emission) Air Quality Test Collected emission gas from the smoke stack is analyzed. It measures particulate matter, sulfur dioxide and nitrogen dioxide.

(c) Hazardous Wastes Generator report

A power company submits the Hazardous Wastes Generator report quarterly to the DENR EMB region IV office through the CENRO and PENRO of the DENR.

It is based on the DENR Administrative Order No.92-29, implementing rules and regulations of the Republic Act No. 6969 (Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990).

Monitoring items and contents of the Hazardous Wastes Generator report are shown in Table 3.7.8.

Table 3.7.8 Monitoring Items and Contents of Hazardous Wastes Generator Report

Item	Content
A. General Information	Name, Location, etc.
B. Waste Generated at the Premise	Waste Class, Hazardous Waste No., Waste Generated (ton/month)
C. On-Site Waste Treatment, Storage and Disposal	Quantity, Method
D. Off -Site Waste Treatment and Disposal	Quantity & Date Transported, Transporter Name, Quantity Treated Off-site, Quantity Disposed Off-Site, Name of Treatment or Disposal, Treatment Disposal Method
E. On-Site Self-Inspection of Storage Area	No. of Inspection and Dates, Premise Area Inspected, Finding & Observation (spill, leaks, etc.), Corrective Actions Taken
F. Accident and Emergency Records	Date Occurred, Area of the Premise Involved, Nature of Emergency, Actions Taken
G. Personnel Training	Date Occurred, Course Description, No. of Personnel Trained
H. Waste Minimization Activities	Pollution Management Appraisal, Waste Minimization Programs

In the case of the land-based diesel power plant owned by NPC-SPUG, according to the hazardous wastes generator report for the 4th quarter of 2000 obtained in this survey, the target waste is only used oil. Usually storage and disposal are performed using drums, except for the storage method of the Brooke's Point power plant, which has a pool with the dimensions of 7m x 7m x 2m. Moreover, self-inspections of the storage area is conducted once a week.

In the case of the Power Barge 106 and the Delta-P plant, the installed capacities are relatively large, and they use the bunker C fuel during normal operations and the diesel fuel at the time of starting and stopping. It is different from other NPC-SPUG land-based power plants using only diesel fuel. Therefore, the target waste consists of used oil and an oil-water mixture. Self-inspections of the storage area is also conducted in these plants every day.

(ii) Backbone transmission line

(a) ECC monitoring report

Regarding the environmental considerations in the case of a construction of a backbone transmission line, the ECC conditions and the status for each condition are shown in Table 3.7.9 as examples. These are derived from the ECC monitoring report submitted from NPC-SPUG to DENR for the 4th quarter of 2002.

Table 3.7.9 ECC Conditions and Status

ECC condition	Status
1.That this certificate is valid only for construction of five (5) substations, two (2) 130 KV Transmission lines of 154 Km for Palawan Backbone Transmission Line Project, five (5) substations shall be located in Puerto Princesa City (40 MVA), Narra (5MVA), Brooke's Point (5 MVA) and Taytay (5 MVA);	1. Complied as stated in the above findings
2.That measures to mitigate noise emanating from vibration of transformer shall be effected and that the circuit breakers and other electrical appurtenances of the substation shall be installed and shall meet the equipment specification/standard on noise;	2. Complied
3.That the construction of steel structures, towers and poles for the substations and overhead transmission lines shall be in conformance with sound engineering designs. The foundation shall be set on firm ground and shall have the capability to withstand earthquakes similar to the one on July 16, 1990. Clearances between the line parts and grounded structure shall be in accordance with the Philippine Electrical Code. The use of high poles for the appropriate level of voltage concerned shall be observed and/cutting or trimming of trees that caused obstruction to the line shall be minimized;	3. In Conformance with the specification
4.That PCB type oil with high flash point shall be used so that environmental hazards will be eliminated in the case of oil spills. That substations shall be provided with an oil pit and adequate canals to contain any soil spillage. Furthermore, measures to control fire and oil ignition shall be made available anytime;	4. Complied

Table 3.7.9 ECC Conditions and Status (Continue)

5. That preventive maintenance and checks of transformers and equipment including the protective devices shall be undertaken periodically. This is to ensure the efficiency and reliability of the project to provide power service to consumers;	5. Complied
6. That fences, gates, warning signs for safety and security guards shall be provided to keep unauthorized personnel from entering the substation;	6. Complied as per design
7. That traffic shall not be disrupted by any related activities of the project during the construction period;	7. Complied
8. That the substation shall not be used as storage areas for any toxic and hazardous materials or junked electrical supplies. Any leaks of SF6 shall be mitigated immediately;	8. Agreeable/Complied
9. The measures to mitigate noise, and heavily silted water resulting from construction, digging and excavation of heavy equipment operations and filling works shall be effected;	9. Complied
10. That should damage to life, property or displacement of residents result from project development, the NPC-SPUG shall pay just and reasonable compensation to the aggrieved parties;	10. Complying
11. That the right of way and other permits from government agencies concerned shall be first secured prior to implementation. This is to facilitate transport of materials to the project site. Any trees that will be cut shall be replaced, and areas that will be exposed or denuded shall be established either by rip-rapping vegetation or reforestation;	11. Complied/Agreeable
12. That all trees cut in this project shall be deemed government property and shall be transferred and kept according to relevant rules and procedures. The Project Proponent shall secure all other permits related to this and coordinate the proper implementation of this condition;	12. Strictly complying this condition NPC-SPUG conducted 2.5 Has. Reforestation project at Bgy. Isuob, Aborlan, Palawan.
13. That on the spot monitoring and inspections can be initiated by the EMB-DENR Region IV anytime in coordination with concerned groups;	13. Agreeable/Complied.
14. That the transfer of ownership of this project carries the same conditions in this ECC for which written notification shall be made within fifteen (15) days from such transfer.	14. Not yet applicable.

Regarding the environmental issues, the prevention of the noise and silted water that result from construction, the prevention of hazardous materials leaks and the prevention of the influence to social environment are all taken into consideration. Especially trees cut in the project were fully considered. It is reported that 5,232 trees will be affected along the transmission line route from Puerto Princesa City to Brooke's Point via Narra. Per agreement between NPC-SPUG and DENR, for every tree cut or damaged during the implementation of the project, NPC-SPUG will provide ten seedlings for the replacements. The status report, included in the ECC monitoring report, describing such reforestation project is attached.

(3) Environmental problems of the existing power facilities

Based on the above mentioned results of the survey of the present situation, environmental problems involving the existing diesel power plants are discussed from the viewpoint of air quality, hazardous wastes and noise.

(i) Air quality

Concentrations of contaminants from three typical diesel power plants, namely the Puerto Princesa City power plant, the Power Barge 106, and the Delta-P, are shown in Table 3.7.10. The sources of these data are the PCO quarterly reports and the summary of the emission tests provided from the DENR region IV office. The national emission standard applied to the diesel power plant is also shown in Table 3.7.10.

In the case of the Puerto Princesa City power plant, there is no concentration of contaminant that exceeds the national emission standard. Although all of these concentrations were theoretically calculated values, the smoke stack emission test was not described.

In the case of the Power Barge 106, since no information about the air pollution is described in the PCO quarterly report, it is impossible to judge whether the concentrations are complying with the national emission standards.

Table 3.7.10 Concentrations of Contaminants from Typical Power Plants and Emission Standard

Unit: mg/Nm^3

Power Plant	Puerto Princesa City Unit #1	Power Barge 106	Delta-P Unit #1	National Emission Standard
Data Source	PCO report 1st quarter 2003	PCO report 1st quarter 2003	Measurement Result June 2002	DENR AO No. 2000-81
CO	388.4339	N/A	-	500
Particulate Matters	127.5739		287	150 (Urban & Industrial area) 200 (Other area)
NO2	1786.0432		1,710	2,000
SO2	119.5767		1,642	1,500 (Existing source) 700 (New source)

In the case of Delta-P, the concentrations of particulate matter and sulfur dioxide are above the national emission standards. Regarding the particulate matter, it is considered that the values of the concentrations will be reduced to within the national emission standards if the maintenance of the smoke stack is performed properly and the smoke stack is cleaned up. Regarding the sulfur dioxide, according to the interview with Delta-P, the reason why the concentration is above the standard is because the bunker C fuel is used. Since the cost of bunker C fuel is cheaper than that of diesel oil, the large-scale diesel power plant usually uses bunker C fuel. The sulfur content of the bunker C fuel that is available in the market now is about 3%. The sulfur will not disappear and go through the engine. And it is exhausted from the smoke stack into the atmosphere. In order to comply with the emission standards for sulfur dioxide, it is necessary to use the bunker C fuel with a sulfur content of about 1% or less according to the theoretical estimation.

On the other hand, the sulfur content of the diesel oil is relatively low and it is about 0.3%. So if a power plant uses only diesel fuel like the Puerto Princesa City power plant, the concentration of sulfur dioxide is low and there will be no problem. A power plant using bunker C fuel generally has a sulfur dioxide problem. In the case of the Power Barge 106, it is supposed that the concentration of sulfur dioxide is also above the standard. Moreover, it is considered that this problem is not particular in Palawan, but common to all diesel power plants using bunker C fuel in the Philippine.

In the case of a new diesel power plant, the maximum permissible limit for sulfur dioxide is much stricter at 700mg/Nm3. It is considered that the necessary fuel to satisfy the emission standard should be studied in any future power development planning.

(ii) Hazardous waste

As long as the hazardous waste generator report collected in this survey is studied, there is no description about accidents and emergencies. According to the interview with the DENR PENRO, at the Narra diesel power plant some years ago the waste oil stored in the drum leaked and it was effluent outside of the power plant. One of the reasons considered was that there was no roof at the storage area. The storage drums were directly exposed sunshine and rainstorms. After that the roof was installed in the waste storage area and there is presently no problem.

(iii) Noise

Although ECC indicates in its constraints that the noise should be less than the DENR standards, no numerical noise data that was obtained from field measurement among the collected data and information in this survey.

According to the Delta-P, noise measurements have been performed only once a long time ago. Since the noise measurement result was within the DENR standard and the power plant is located in the industrial-use area where no residences are located around the power plant, the noise measurement using the monitoring equipment has not been performed after that.

Moreover, according to the DENR PENRO, their noise measurements are performed without using the monitoring equipment. They judge only with their own ears.

From the viewpoint of complying with the standard, it is desirable that noise measurements using proper monitoring equipment be performed periodically

Chapter 4 Basic Data for Power Development in Palawan Province

4.1 Renewable Energy

4.1.1 Mini and Micro Hydropower Potential Survey

(1) Definition of mini and micro hydropower

Generally, there is no single globally accepted classification of hydropower in terms of unit capacity. Each country has its own classification. In the Philippines, according to RA7156 (Republic Act No. 7156; An Act Granting Incentives to Mini-Hydro-Electric Power Developers and for Other Purposes), the words, "Mini hydropower plant" is defined as "an electric-power plant which (a) utilizes kinetic energy of falling or running water to turn a turbine generator producing electricity; and (b) has an installed capacity of not less than 101 kilowatts nor more than 10,000 kilowatts". On the other hand, according to the "Guide on Mini-Hydropower Development in the Philippines", which was published by DOE in cooperation with GTZ, hydro resources for power generation are classified into 4 categories by installed capacity, and one category, Micro Hydro, is defined as a power unit with up to 100kW installed capacity. Therefore in the Study, the words "Mini" and "Micro" are defined as shown in Table 4.1.1.

Table 4.1.1 Definition of Mini and Micro Hydropower

Words	Installed Capacity
Micro hydropower	- 100kW
Mini hydropower	101kW - 10,000kW

(2) Characteristics of topographic conditions in Palawan

Palawan Province consists of a main island "Palawan Island" and many small islands. In the smaller islands, there are generally no rivers. Even when there are rivers, they tend to be short and have little water, which makes them unsuitable for hydropower in these islands.

Palawan Island is approximately 390km in length and 8km in width at the narrowest point. There are backbone mountains at the center of the island from the north to south and a series of mountains taller than 1,000 m (see Figure 4.1.1). These mountains determine the directions of most of the rivers in Palawan, which mainly flow toward the northwest on north side and toward the southeast on south side (see Figure 4.1.2).

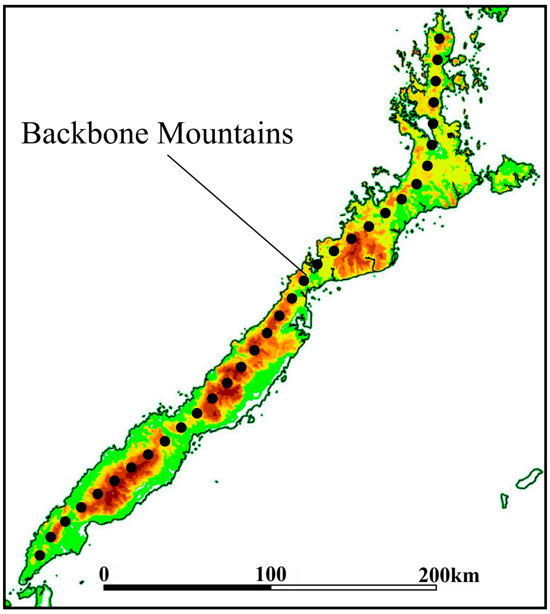


Figure 4.1.1 Topographic Conditions in Palawan

As a result, the lengths of most of rivers in Palawan Island are relatively short and also the catchment areas of rivers are small. However some rivers have relatively big catchment area.

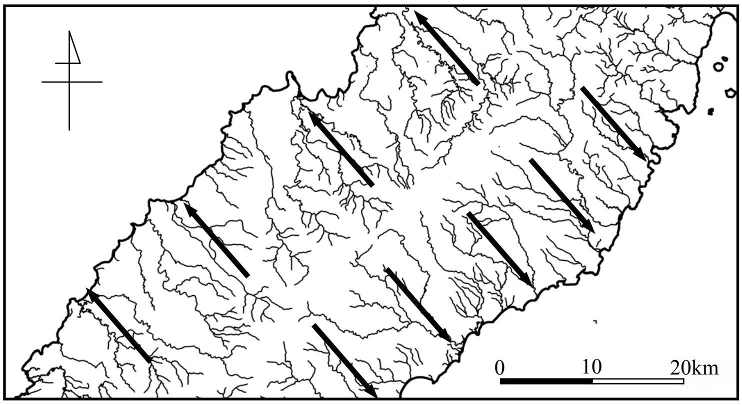


Figure 4.1.2 Directions of River Flows in Palawan

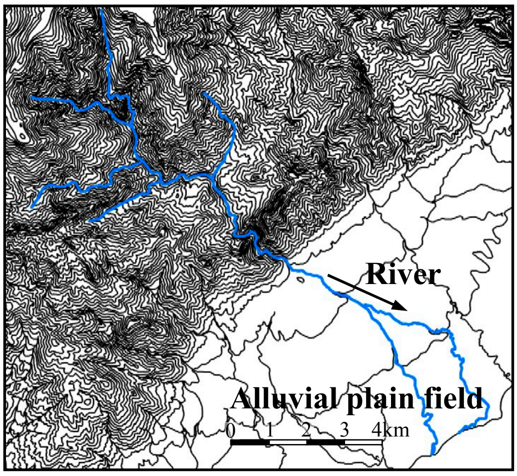


Figure 4.1.3 Typical River in Palawan

Figure 4.1.3 shows an example of a typical river in Palawan. In this case, the river flows from the northwest to the southeast. Around downstream of the river, there is an alluvial plain field. At the midstream of river, the topography suddenly becomes mountainous. In the figure, almost half of the river flows in the plain field.

An appropriate site for hydropower is generally located in the mountain area. Therefore, a candidate site for hydropower is limited by the characteristics of the river location as in this example.

(3) Precipitation in Palawan

Palawan has a tropical monsoon climate with a distinct rainy season and a dry season. PAGASA has a series of past rainfall data that was gauged at the 3 gauging stations of Cuyo, Coron and Puerto Princesa City in Palawan. All of these stations are located on the eastern coast side (see Figure 4.1.4).

The gauging period for the data that was collected in the Study is from 1961 to 2000. Although some data are missing, they have been interpolated using averaging data in each month. Table 4.1.2 shows the average annual amount of rainfall, which shows that the average annual rainfall of Puerto Princesa City is 1,521mm.

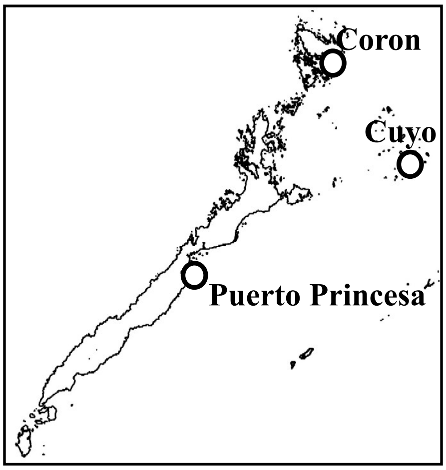


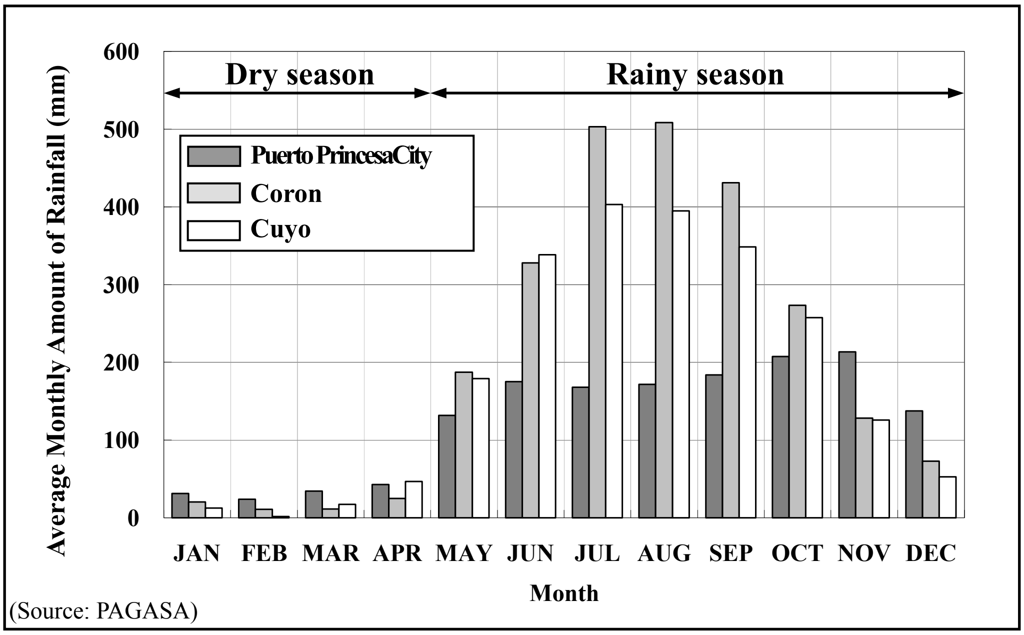
Figure 4.1.4 Locations of Rainfall Gauging Stations

Most of the rainfall occurs in the period from May to December. The period from January to April is the dry season in Palawan and there is a trace of rainfall in the dry season (see Figure 4.1.5).

Table 4.1.2 Average Annual Rainfall

Name of Gauging Station	Average Annual Rainfall
Puerto Princesa City	1,521 mm
Coron	2,500 mm
Cuyo	2,177 mm

Source: PAGASA



(Source: PAGASA)

Figure 4.1.5 Average Monthly Rainfall

(4) Survey of mini and micro hydropower potential in Palawan

For the formulation of a power development plan in Palawan, it is necessary to first grasp the amount of available capacity of candidate power plants for development. In the case of the development of a mini and micro hydropower plant, available capacity for development generally depends on topographic conditions and river flow conditions, because the hydropower technology is highly site-specific.

In the Study, to grasp the available capacity for hydropower development in Palawan, the Study team conducted map studies to find appropriate potential sites for the development of mini and micro hydropower. Figure 4.1.6 shows the flow diagram of the work for finding hydropower potential sites. The details of each work will be explained in the Annex.

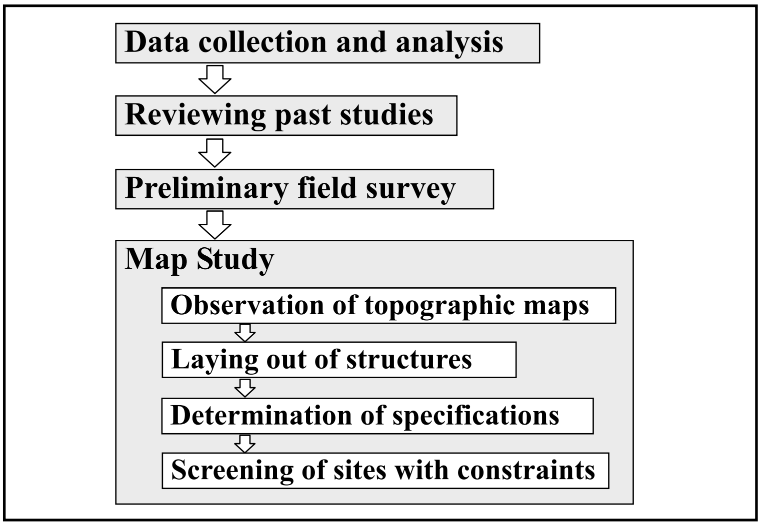


Figure 4.1.6 Flow Diagram of the Survey for Potential Mini and Micro Hydropower

(i) Data collection and analysis

The Study team collected plenty of data for the survey of potential mini and micro hydropower from various organizations and agencies. Table 4.1.3 shows the list of collected data in the Study.

Table 4.1.3 List of Data Collected for the Survey of Potential Mini and Micro Hydropower

Item	Source Agency	Specification	Remarks
Topographic Maps	NAMRIA	Scale 1:50,000, approx. 90 sheets	
Geological Maps	MGB	Scale 1:50,000	Northern part
Rainfall Data	PAGASA	Puerto Princesa City , Cuyo, Coron	40 years
	PIADPO	14 sites	1 to 9 years
Discharge Data		16 sites	2 to 5 years
ECAN Maps	PGP	All of Palawan	GIS DATA*
Barangay Base Maps	PGP	All of Palawan	GIS DATA*
Past study on potential sites	DOE	47 sites	Desk study
	NPC		
	NEA		
	PGP		
F/S Report	DOE	Cabinbin, Langogan, Babuyan, Batang Batang, Candawaga	Feasibility study

*Note: Only shape file for GIS data is available for use.

(a) Topographic maps

The topographic maps on the scale of 1:50,000 only are available for Palawan.

(b) Geological maps

The geological maps on the scale of 1:50,000 for around the municipalities of Puerto Princesa City and Busuanga Island only are available.

(c) Rainfall data

Rainfall data is not used for estimations of the amount of river flow for each river, because the data from PAGASA is limited by the number of the gauging stations and the data from PIADPO is limited by the gauging periods.

(d) Discharge data

Locations of gauging stations for discharge data are shown in Figure 4.1.7.

The data from 2 stations is limited in the gauging period (2years) and the data from 1 other station is not applicable. As a result, data from 13 stations is available. The data from the gauging stations is daily discharge data. There are some areas in which data is lacking, so these data have been interpolated by the averages of other existing data of the same day in other years in the Study.

These data would be used for the estimation of the river flows for rivers other than the gauge-set rivers.

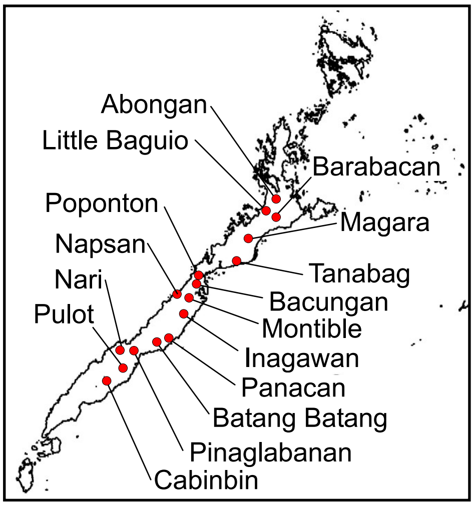


Figure 4.1.7 Locations of Gauging Stations for River Flow

(e) ECAN maps

There are six environmentally categorized zones in Palawan defined by PCSD. Development is prohibited in these zones. These categories would be used for screening potential sites (for details, refer to section 3.7.1).

(f) Barangay base maps

The locations of barangay centers, barangay boundaries, existing roads and rivers are all shown on the maps. The maps are used for measuring the length of needed transmission line or distribution line, and the distance between the end of an existing road and the proposed power station.

(ii) Reviewing past studies

(a) Past desk studies

In 1995, DOE compiled the results of past potential studies into the "Water Resource Inventory Project". NEA and NPC-SPUG, also conducted the desk studies for finding potential sites in Palawan. In total, 47 potential sites for mini and micro hydropower in Palawan have been found from the past desk studies (see Table 4.1.4).

As shown in Table 4.1.4, only 9 sites have location maps. For some sites the available information was too scant. This made it impossible for the Study team to identify their actual locations.

Table 4.1.4 List of Potential Sites found by Past Desk Studies

No.	Name of Site	Location	Name of River	Head (m)	Catchment Area (km^2)	Discharge (m^3/s)	Capacity (kW)	Data from	Location Map	Remarks
1	Talakaigan	Cabigaan, Aborlan	Talakaigan	80	25.45	1.32	840	DOE	○	
2	Baraki	Baraki, Aborlan	Aborlan	60	38.05	2.02	960	DOE	○	
3	Batang-Batang	Urduja, Narra	Batang-Batang	80	100.50	5.46	3,590	DOE	○	Refer to F/S
4	Malatgao (1)	Estrella Village, Narra	Malatgao	70	100.45	5.60	3,130	DOE	○	
5	Malatgao (2)	Taretien, Narra	Malatgao	50	85.00	5.00	1,645	PGP		
6	Iwahig (1)	Bagong Bayan, Puerto Princesa City	Iwahig	50	38.00	2.05	820	DOE	○	
7	Iwahig (2)	Montible, Puerto Princesa City	Iwahig	6	-	4.50	20	DOE		
8	Iwahig (3)	Montible, Puerto Princesa City	Iwahig	35	96.00	5.00	1,310	PGP		
9	Inagawan (1)	Inagawan, Puerto Princesa City	Inagawan	60	76.00	4.00	870	PGP		
10	Inagawan (2)	Inagawan, Puerto Princesa City	Inagawan	50	103.60	5.80	2,320	DOE PGP	○	
11	Isaub	Aborlan	Isaub	30	-	0.20	80	DOE		
12	Balsahan	Simpucan, Puerto Princesa City	Balsahan	12	-	0.10	15	DOE		
13	Bontong	Puerto Princesa City	Bontong	10	-	0.10	8	DOE		
14	Lake Manganao	Taytay	-	10	-	1.20	100	DOE		Not identified
15	Barong Barong	Aribungos, Brooke's Point	Barong Barong	15	-	0.10	12	DOE		
16	Sinabayan Falls	Busuanga	-	23	-	0.40	80	DOE		Not identified

No.	Name of Site	Location	Name of River	Head (m)	Catchment Area (km^2)	Discharge (m^3/s)	Capacity (kW)	Data from	Location Map	Remarks
17	Cabinbin	Brooke's Point	Lala	-	-	-	800	NPC	○	Refer to F/S
18	Estrella falls	El Vita, Narra	Estrella	10	-	1.00	15	DOE		
19	Iraan	Aborlan	Iraan	-	-	0.50	-	DOE		
20	Babuyan (1)	Puerto Princesa City	Babuyan	20	-	-	-	DOE		
21	Babuyan (2)	Puerto Princesa City	Babuyan	43.7	172.00	15.40	5,600	NPC	○	Refer to F/S
22	Ilian	Taytay	Ilian		-	-	-	DOE		
23	Langogan	Roxas	Langogan	91	59.00	8.90	6,800	DOE PGP	○	Refer to F/S
24	Rizal	Roxas	Rizal	20	-	-	-	DOE		Not identified
25	Irahuan	Puerto Princesa City	Irahuan	12	-	0.20	20	DOE		
26	Tarabanan	-	-	-	-	-	2,200	NEA		Not identified
27	Aborlan	Cabigaan, Aborlan	Aborlan	-	-	-	1,400	NEA		
28	Maoyon	Puerto Princesa City	-	-	-	0.20	-	NEA		
29	Tanabag	Puerto Princesa City	Tanabag	60	-	-	-	NEA		
30	Tiga	Aribungos, Brooke's Point	Tiga Plan	120	-	-	-	NEA		
31	Lara	Mainit, Brooke's Point	Lara	100	-	-	-	NEA		
32	Imulnod	Imulnod, Brooke's Point	Imulnod	60	-	-	-	NEA		
33	Filantropa	Maasin, Brooke's Point	Filantropa	40	-	-	-	NEA		
34	Bulalakao	Milihud, Bataraza	Bulalakao	80	-	-	-	NEA		
35	Pangbilian	Brooke's Point	Pangbilian	60	-	-	-	NEA		
36	Sabsaban Falls	Brooke's Point	-	5	-	-	-	NEA		Not identified
37	Turao	Taytay	Turao	40	-	0.10	30	NEA		
38	Turung Falls	Taytay	-	10	-	0.06	4	NEA		Not identified
39	Bakungan	Puerto Princesa City	Bacungan	23	60.00	1.00	500	PGP		
40	Nicanor Zabala	Roxas	Tulariquin	120	15.00	2.10	1,700	PGP		
41	Caruray	San Vicente	Caruary	120	3.50	0.49	60	PGP		
42	Sto. Nino	San Vicente	Erawan	160	1.00	0.14	150	PGP		
43	Poblacion	San Vicente	Inandeng	80	2.00	0.28	20	PGP		
44	Bulalakao (1)	El Nido	Bulalakao	140	2.40	0.34	50	PGP		
45	Bulalakao(2)	El Nido	Bulalakao	280	1.60	0.22	60	PGP		
46	Pasadena	El Nido	Nagcalitcalit	120	4.00	0.14	20	PGP		
47	Villa Paz	El Nido	Batacalan	150	1.02	0.14	20	PGP		

Source: DOE, NPC, NEA, PGP

(b) Past feasibility studies

As mentioned in section 3.3.3, feasibility studies for 5 sites in Palawan already exist. These sites are also considered as potential sites for hydropower in Palawan.

Babuyan mini hydropower project

The feasibility study of Babuyan mini hydropower project was conducted by NPC-SPUG in 1992. Table 4.1.5 shows the outline of the project.

Table 4.1.5 Outline of Babuyan Mini Hydropower

Item		Description
Location		Bgy. Tagabinat, P. Princesa
Installed Capacity		5,600 kW
Annual Generation		24.18 GWh
Max. Discharge Water		15.4 m^3/sec
Effective Head		43.7 m
Type of Operation		3 hrs peaking operation
Reservoir Area		172 ha
Civil Structure		
	Dam	H: 12 m, L: approx. 600m
	Headrace Tunnel	L: 1,280 m, D: 2.5m
	Penstock	L: 210 m, D: 1.98m
Generation and Turbine		
	Number of Units	2 units
	Type of Turbine	Horizontal Francis
Transmission line		
	Voltage	69 kV
	Length	25 km
Total Project Cost*		17.7 million US$

Source : NPC, Small Hydroelectric Projects of The VISAYAS Islands , Volume IV
*Note: Cost in 1992

Through the review of the project, it seems that the project is technically viable. However, since the study had been conducted in 1992, which preceded the ECAN Zoning determination in 1994, the study did not take the constraints of ECAN (refer to section 3.7.1) into account. Because the site for the surge tank and its surroundings are in a Restricted Use Zone, alternative plans such as a change of location for the penstock and modification of all waterways will be needed.

River water flowing into the reservoir is stored there and is discharged to another river system through the power station. Therefore, as mentioned in the report of the study, a more detailed survey for water users along the river should be conducted because the amount of river flow will be reduced at the area downstream from the dam.

Additionally, since the power plant will be connected to the proposed backbone grid, for implementation of the project, completion and operation of the proposed backbone transmission line between Puerto Princesa City and Roxas is an essential prerequisite.

Langogan mini hydropower project

The study was also conducted by NPC-SPUG in 1992. Table 4.1.6 shows the outline of the project.

Table 4.1.6 Outline of Langogan Mini Hydropower

Item		Description
Location		Bgy. Langogan, P. Princesa
Installed Capacity		6,800 kW
Annual Generation		27.12 GWh
Max. Discharge Water		8.9 m^3/sec
Effective Head		91.2 m
Type of Operation		3 hrs peaking operation.
Civil Structure		
	Dam	H: 9.5 m, L: approx.34 m
	Headrace Pipe	L: 1,430 m, D: 2.2 m
	Penstock	L: 590 m, D: 2.00 m
Generation and Turbine		
	Number of Units	2 units
	Type of Turbine	Horizontal Francis
Transmission Line		
	Voltage	69 kV
	Length	17 km
Total Project Cost*		15.6 million US$

Source : NPC, Small Hydroelectric Projects of The VISAYAS Islands , Volume IV
*Note : Cost in 1992

Topographic conditions at the site seem to be more suitable for hydropower development than the Babuyan project, because the valley is narrow and the river slope is steep around the site.

All structures for the proposed Langogan power plant are located in the Core Zone of ECAN.

The power plant needs to be connected to the proposed backbone transmission line. Therefore, the operation of the proposed transmission line is an essential prerequisite.

Because of these reasons, especially from the viewpoint of environmental-friendliness, the Study team will omit the Langogan project in the Master Plan.

Cabinbin mini hydropower project

The preliminary engineering study for the Cabinbin mini hydropower project was conducted in 1999, based on an earlier study conducted in 1987. Table 4.1.7 shows the outline of the project.

The proposed power plant will be connected to the existing distribution line.

Maximum discharge water of the plant is 1.86 m^3/sec corresponding to operations 60% of the time and the capacity factor of the power plant is 72%. Therefore, the generation planning of the project seems to be appropriate from the viewpoint of effective use of river water.

As for ECAN constraints, the proposed site of the project is located in a Controlled Use Zone and there are a few constraints for development.

Table 4.1.7 Outline of Cabinbin Mini Hydropower

Item	Description
Location	Bgy. Mainit, Brooke's Point
Installed Capacity	800 kW
Annual Generation	5.08 GWh
Max. Discharge Water	1.86 m^3/sec
Effective Head	56.9 m
Type of Operation	Run of river
Civil Structure	
Dam	H: 4 m, L: 20.5 m
Headrace Pipe	L: 1,800 m, D: 1.3 m
Penstock	L: 330 m, D: 0.85 m
Generation and Turbine	
Number of Units	2 units
Type of Turbine	Horizontal Francis
Transmission Line	
Voltage	13.2 kV
Length	5 km
Total Project Cost*	1.15 million US$

Source : DOE, Preliminary study of Cabinbin Mini-Micro Project, 1999
*Note : Cost in 1999

Batang Batang mini hydropower project

The study was conducted by JETRO in 2001. Table 4.1.8 shows the outline of the project.

The water for generation is gathered from both the main river and the branch river.

The Batang Batang project is a kind of a series generation type of hydropower plant. The water gathered from the branch river is used for generation at a power station located along the branch river and the water flows into the head tank for another power station, into which the water is gathered from the main river.

Proposed sites for development such as the weir and the power station are located in a Controlled Use Zone, Traditional Use Zone and Multiple Use Zone and there are some constraints for development.

The power plant will be connected to the existing backbone transmission at the Narra substation and a 69kV TL bay will be added to the Narra substation.

Table 4.1.8 Outline of Batang Batang Mini Hydropower

Item		Description
Location		Bgy. Princess Urduja, Narra
Installed Capacity		5,500 kW
Annual Generation		27.4 GWh
Max. Discharge Water		15.5 m^3/sec
Effective Head		41.3 m
Type of Operation		Run of river
Civil Structure		
Dam	Main Dam	H: 5.5 m, L:55.0 m
	Branch Dam	H: 4.5 m, L: 35.0 m
Headrace	Tunnel sec.	L: 730 m, D: 2.5-3.4 m
	Channel sec.	L: 4,770 m, W: 1.0-5.0 m
Generation and Turbine		
Number of units		2 units (1,290kW, 4,420kW)
Type of Turbine		Horizontal Francis
Transmission line		
Voltage		69 kV
Length		13 km
Total project cost*		20 million US$

Source : JETRO, The Feasibility Study on Batang Batang Hydropower Project in The Philippines
*Note: Cost in 2000

Candawaga mini hydropower project

The study was conducted by JICA in 1985. Table 4.1.9 shows the outline of the project.

This project, which was designed as a grant aid from Japan, would cover increasing electricity demand in the mines and would send electricity to neighboring residents for co-prosperity with three diesel generators planned by the company. The electricity would also be distributed to the southern part of Palawan through PALECO.

The project has a river basin diversion since the weir and the intake were planed to be set in the Candawaga river and the outlet was to be set in the Culasian river.

In addition that the environmental impact assessment was not studied in the Feasibility Study, the weir site, the penstock site, the power station site and a part of the headrace are designed within the Core Zone.

Table 4.1.9 Outline of Candawaga Mini Hydropower

Item		Description	
Location		Bgy. Candawaga, Rizal	
Installed Capacity		6,000 kW	
Annual Generation		32.1 GWh	
Max. Discharge Water		3.85 m^3/sec	
Effective Head		185.1 m	
Type of Operation		Run of river	
Civil Structure			
	Dam	Main Dam	H: 13.5 m, L:51.0 m
	Headrace	Tunnel sec.	L: 300 m, D: 2.5 m
		Channel sec.	L: 7,400 m, W: 1.50m
Generation and Turbine			
	Number of units	2 units	
	Type of Turbine	Horizontal Francis	
Transmission line			
	Voltage	69 kV	
	Length	38 km	
Total project cost*		35.9 million US$	

Source : The Infrastructure Survey for Rio Tuba Nickel Mine (Candswaga Hydropower Scheme), JICA, 1985

*Note: Cost in 1985

Detailed reviews of these feasibility studies are discussed in the Annex.

(c) Past desk study on micro-hydropower potential in Palawan

In October 2000 a report titles "Assessment of Micro-hydro Resources in the Philippines" was submitted by USAID to DOE. The report is a part of the project report for "Task 7Ba Report Philippine Renewable Energy Project", which was conducted in cooperation with USAID for promotion of investments in the development of micro hydropower in the Philippines.

In the study, the potential for micro hydropower in the whole Philippines is indicated on maps. However, there is only information about maximum capacity and no information about specifications for each micro hydropower plant such as gross head and discharge water. The study also lacks any financial discussions.

The details of micro-hydro potential in Palawan are not described in the report. According to the potential map for Palawan, approximately 50 rivers are described. Most of the rivers have a potential of over 100kW, 34 rivers for over 500kW and 23 rivers for over 1,000kW.

After reviewing the potential data on the map by using GIS software, the sum of the maximum potential in each river was estimated to be approximately 36,000kW for all of Palawan, with the largest one being approximately 3,700kW.

This map may prove to be useful for making preliminary assessments for site surveys in order to find appropriate hydropower sites in Palawan.

However, as mentioned in the report, potential evaluated in the study is based on calculations using the mean of the annual rainfall. It is essential for planning of hydropower to estimate the amount of stream water during the dry season, especially when developing hydropower with installed capacity of less than 100kW, because they are often developed for electrification of rural areas that are far from the grid system and should be designed on the premises of providing electricity almost every day of the year.

Additionally, the study does not consider topographic conditions for laying out civil structures because the objective of the study is to evaluate the amount of potential for micro-hydropower. So there are some rivers along which maximum potential sites are indicated around estuaries (see Figure 4.1.8). Generally, a hydropower weir for diverting water cannot be constructed around estuaries because of the difficulty in securing enough river head and width.

As a result, the Study team does not use the potential sites from this desk study for subsequent work.

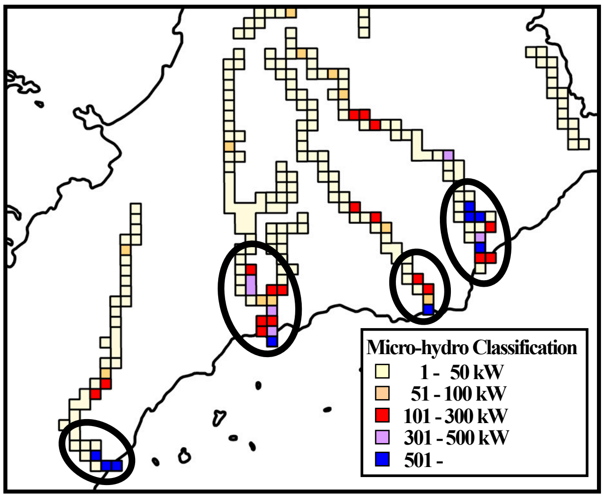


Figure 4.1.8 Potential Sites around Estuaries

(iii) Preliminary field survey

The Study team conducted a preliminary survey in February 2003.

The main objective of the survey was to set a criterion for the screening of potential site in consideration of the existence of river flow during the dry season. The Study team conducted the survey for 3 rivers, and conducted interviews with villagers living along the river. The results of the interviews are shown in Table 4.1.10.

Table 4.1.10 Results of Preliminary Field Survey

Name of river	Catchment Area (km^2)*	Results
Balsahan river	17.55	Does not dry up during dry season
Bonton river	6.70	Dries up during dry season
Irahuan river	31.65	Dries up during dry season

*Note : Catchment area indicated the area of the place where interviews were conducted

The results of the survey do not make it clear whether the catchment area has enough water during the dry season. However, from the viewpoint of “finding more candidate sites”, the Study team defined a criterion for the catchment area of $10km^2$ for screening of the sites.

(iv) Map study

There are two main ways of finding the potential hydropower sites in a map study, namely (1) Map Study from a site that is "to determine a capacity from an appropriate site" and (2) Map Study from demand that is "to determine an appropriate site from an electricity demand in the nearest barangay center." It is said that the Map Study from a site is to find potential sites for mainly grid connections, and that the Map Study from demand is to find potential sites for mini-grid connections. These two have different approaches for locating potential hydropower sites.

(a) Map Study from Site

1) Observation of topographic maps

At first the Study team put the potential sites found from past studies on the topographic maps.

As shown in Table 4.1.4, some sites do not have information to identify their locations. Therefore, the Study team searched appropriate sites for them using limited data.

Additionally, the Study team observed all rivers in Palawan on the maps and found new potential sites for mini and micro hydropower.

Points of concern for finding potential sites on topographic maps in the Map Study from Site are as follows:

- Topographic conditions
  (suitable condition are narrow valleys, steep river slopes, big catchment areas, others)
- Geological conditions
- Distance from existing or proposed grid system
- Type of power generation
- Existing infrastructures

The Study team found 47 new appropriate sites and listed a total of 98 candidate sites for mini and micro hydropower in all of Palawan. Table 4.1.11 shows the breakdown of these sites.

Table 4.1.11 Breakdown of Candidate Sites

From past desk studies	47 sites
From past feasibility studies	4 sites
New sites found by Study team	47 sites
Total	**98 sites**

2) Laying out of structures and determination of specifications

The Study team laid out the structures on the maps and defined their specifications.

Table 4.1.12 shows the main conditions for defining specification of structures. The details are explained in the Annex.

Table 4.1.12 Conditions for Definition of Structures in the Map Study from Site

Estimated river flow	To be derived from flow data of the nearest gauging station
Firm discharge water	River flow at 70 % of time during a year
Turbine efficiency	88 %
Generator efficiency	96 %
Operating hours per day	24 hours for Run-of-River type, 4 hours for Pondage type
Height of weir	Basically 3m (Run-of-River Type)

3) Screening of the sites by constraints

Constraints for screening the sites are as follows:

- ECAN	**Sites located in Core Zones and Restricted Use Zones are excluded**
- Catchment Area	**Sites with catchment areas of less than 10km^2 are excluded**

After the screening, the Study team finally listed 34 potential sites for mini and micro hydropower in all of Palawan. Total capacity is 29,875kW and total annual generation is 151.9 GWh. Table 4.1.14 shows the list of potential sites and Figure 4.1.9 shows the potential map of mini and micro hydropower in Palawan.

(b) Map Study from Demand

1) Calculation of electricity demands in un-electrified barangays

Based on the assumed unit demand per household, the Study team calculated electricity demand in 2015 for each un-electrified barangay. From the criterion that an un-electrified barangay for which electricity demand is more than 30kW is suitable for a mini-grid system, the Study team selected 27 barangays for mini-grid systems. The details are explained in Chapter 5.

2) Observation of topographic maps

In the same manner as explained in 4.1.1 (4) (iv) (a) 1), the Study team probed the topographic maps in which 27 un-electrified barangay exist.

Points of concern for finding potential sites on topographic maps in the Map Study from Demand are as follows:

- Topographic conditions
- Geological conditions
- Distance from a non-electrified barangay center
- Existing infrastructure

As a result, the Study team found two potential sites for a mini-grid system: Barangay Aramaywan, Quezon with a peak electricity demand of 31kW in 2015, and Barangay Culasian, Rizal with demand of 45kW.

3) Laying out of structures and determination of specifications

The Study team laid out the structures for the sites on a map and defined their specifications.

Table 4.1.13 shows the main conditions for defining the structure specifications. The conditions for estimating river flow, turbine efficiency, generator efficiency and weir height are the same as the Map Study from Site. However, the procedures for locating a good site are in many ways a kind of trial and error approach aimed at making the capacity meet the electricity demand in the barangay center. The details are explained in the Annex.

Table 4.1.13 Conditions for Definition of Structures in the Map Study from Demand

Firm discharge water	River flow at 100% of the time during the year
Operating hours per day	6 hours

4) Screening of the sites by constraints

In addition to the constraints for screening in the Map Study from Site, the distance from the power stations to the barangay center is also a criterion. In the Study, the Study team set the maximum distance at 5km. Based on this criterion, only the candidate site in Barangay Aramaywan was selected. The specifications of the Aramaywan candidate site are shown below in Table 4.1.14.

Table 4.1.14 List of Potential Sites for Mini and Micro Hydropower in Palawan

No.	Names of Site	Location	Names of River	NAMRIA Map Number	Catchment Area (km^2)	90% Discharge (m^3/s)	Maximum Plant Discharge (m^3/s) (70%FUF)	Backbone Line Data: Distance from Backbone Line (km)	Backbone Line Data: Capacity (kV)	Accessibility: Distance from Dam to Nearest Road (km)	ECAN Zoning	Generation Type	Civil Structure: Dam Height (m)	Civil Structure: Crest Length (m)	Civil Structure: Headrace Length (m)	Civil Structure: Pen-stock Length (m)	Electrical & Mechanical Equipment: Efective Head (m)	Electrical & Mechanical Equipment: Firm Capacity (kW)	Electrical & Mechanical Equipment: Designed Capacity (kW)	Electrical & Mechanical Equipment: Type of Turbine	Ope-ration hours (hr/day)	Annual Generation (kWh/yr)
1	Talakaigan	Cabigaan, Aborlan	Talakaigan river	2648-II	27.54	0.518	1.382	9.3	138 (planned)	3.8	Controlled Use Zone	Run-of-River	3	30	2,950	352	86.6	370	990	Cross Flow	24	6,083,534
2	Baraki	Baraki, Aborlan	Aborlan river	2648-II	34.54	0.650	1.733	8.8	138	6.8	Controlled Use Zone	Run-of-River	3	20	640 / Tunnel 2,880	209	58.8	320	840	Cross Flow	24	5,179,986
4	Malatgao (1)	Estrella Village, Narra	Malatgao river	2648-II	99.15	1.866	4.983	9.1	138	10.1	Controlled Use Zone	Run-of-River	5	200	1,250	405	52.7	820	2,200	Horizontal Francis	24	13,335,223
6	Iwahig (1)	Bagong Bayan, Puerto Princesa	Iwahig river	2749-III	27.06	0.145	0.557	13.2	138	12.7	Multiple Use Zone	Run-of-River	3	40	3,500	130	45.6	55	210	Cross Flow	24	1,285,235
7	Iwahig (2)	Montible, Puerto Princesa	Iwahig river	2749-III	95.75	0.511	1.949	5.7	138	5.6	Controlled Use Zone	Run-of-River	14	60	3,500	155	33.5	140	540	Cross Flow	24	3,312,354
8	Iwahig (3)	Montible, Puerto Princesa	Iwahig river	2649-III	97.15	0.519	1.982	5.3	138	5.6	Controlled Use Zone	Run-of-River	2	40	2,910	162	17.6	76	290	Cross Flow	24	1,768,597
15	Barong Barong	Aribungos, Brooke's Point	BarongBarong river	2546-I	18.65	0.266	1.106	7.0	69	1.1	Controlled Use Zone	Run-of-River	3	55	1,000	92	67.3	150	620	Cross Flow	24	3,772,253
20	Babuyan (1)	Puerto Princesa	Babuyan river	2750-II	24.88	0.133	0.513	1.3	138 (planned)	1.3	Multiple Use Zone	Run-of-River	3	40	950	61	3.5	4	15	Cross Flow	24	90,696
27	Aborlan	Cabigaan, Aborlan	Aborlan river	2648-II	39.42	0.742	1.985	8.5	138	2.6	Multiple Use Zone	Run-of-River	4	40	2,920	202	18.4	110	300	Cross Flow	24	1,851,954
28	Maoyon	Puerto Princesa	Unnamed river	2750-II	18.85	0.746	0.789	0.9	138 (planned)	0.8	Controlled Use Zone	Run-of-River	3	35	Tunnel 570	101	12.4	76	80	Cross Flow or Submerged Pomp	24	494,036
32	Imulnod	Imulnod, Brooke's Point	Imulnod river	2546-I	19.22	0.274	1.141	9.8	69	3.5	Controlled Use Zone	Run-of-River	14	60	Tunnel 800	168	48.0	110	450	Cross Flow	24	2,773,602
33	Filantropa	Maasin, Brooke's Point	Filantropa river	2546-I	30.93	0.115	0.554	8.2	69	5.6	Controlled Use Zone	Run-of-River	7	60	Tunnel 1,260	80	38.3	36	180	Cross Flow	24	1,073,187
39	Bakungan	Puerto Princesa	Bacungan river	2749-IV	26.04	0.248	1.042	0.2	138 (planned)	3.5	Controlled Use Zone	Run-of-River	3	40	Tunnel 3,400	21	14.2	29	120	Cross Flow	24	750,378
N11	Talakaigan (2)	Cabigaan, Aborlan	Talakaigan river	2648-II	25.35	0.477	1.272	9.3	138	4.1	Controlled Use Zone	Run-of-River	20	70	3,100	362	105.6	420	1,100	Cross Flow	24	6,822,767
N15	Ira-Iraan	Iraan, Rizal	Ira-Iraan river	2546-IV	28.83	0.410	1.711	25.0	69	14.2	Controlled Use Zone	Run-of-River	3	50	Tunnel 2,830	350	139.7	480	2,000	Cross Flow	24	12,102,545
N19	Tagbolante	Begon, Quezon	Tagbolante river	2648-II	22.86	0.394	1.751	45.0	69	17.2	Controlled Use Zone	Run-of-River	3	50	Tunnel 2,000	57	38.3	130	560	Cross Flow	24	3,400,602
N20	Saraza	Saraza, Brook's Point	Unnamed river	2546-III	18.76	0.267	1.114	20.5	69	2.4	Controlled Use Zone	Run-of-River	3	45	100 / Tunnel 1,640	109	58.4	130	540	Cross Flow	24	3,295,372
P1	Cabigaan	Cabigaan, Aborlan	Aborlan river	2619-I	35.28	0.664	3.985	11.5	138	5.0	Controlled Use Zone	Pondage	30	91	—	34	27.8	150	920	Horizontal Francis	4	2,963,199
P3	Dumanguena	Dumanguena, Narra	Branch river of Malatgao river	2648-II	24.51	0.461	2.768	10.4	138	0.5	Controlled Use Zone	Pondage	25	108	—	31	22.8	87	520	Cross Flow	4	1,688,323
P8	Quinlogan	Quinlogan, Quezon	Linlugan	2547-II	35.18	0.056	0.388	3.4	69	4.2	Multiple Use Zone	Pondage	25	70	—	31	22.8	11	63	Cross Flow	4	375,687
F1	Babuyan (FS)	Tagabinat, Puerto Princessa	Babuyan	2750-II	155.00	—	15.400	25.0	138 (planned)	5.0	Multiple Use Zone	Pondage	12	Aprox. 600	940 / Tunnel 1,280	210	43.7	—	5,600	Horizontal Francis	3	24,180,000
F3	Cabinbin (FS)	Mainit, Brooke's Point	Cabinbin	2646-II	26.66	—	1.860	5.0	13.2 Dist.Line	1.0	Controlled Use Zone	Run-of-River	4	21	1,800	250	56.9	—	800	Horizontal Francis	24	5,080,000
F4	BatangBatang (FS)	Princess Urduja, Narra	BatangBatang river	2647-IV	103.75	—	15.500	13.0	138	10.0	Controlled Use Zone	Run-of-River	6	55	4,770 / Tunnel 730	250	41.3	—	6,700	Horizontal Francis	24	27,400,000

No.	Names of Site	Location	Names of River	NAMRIA Map Number	Catchment Area (km^2)	90% Discharge (m^3/s)	Maximum Plant Discharge (m^3/s) (100%)	Barangay Data: Distance from Barangay Center (km)	Barangay Data: Needed Demand in 2015 (kW)	Accessibility: Distance from Dam to Nearest Road (km)	ECAN Zoning	Generation Type	Civil Structure: Dam Height (m)	Civil Structure: Crest Length (m)	Civil Structure: Headrace Length (m)	Civil Structure: Pen-stock Length (m)	Electrical & Mechanical Equipment: Efective Head (m)	Electrical & Mechanical Equipment: Designed Capacity (kW)	Electrical & Mechanical Equipment: Type of Turbine	Ope-ration hours (hr/day)	Sold Annual Generation in 2015 (kWh/yr)
D1	Aramaywan	Aramaywan, Quezon	Unnamed river	2648-III	20.74	0.670	0.384	1.1	30	2.0	Multiple Use Zone	Run-of-River	3	60	950	55	12.5	39	Cross Flow	6	51,373

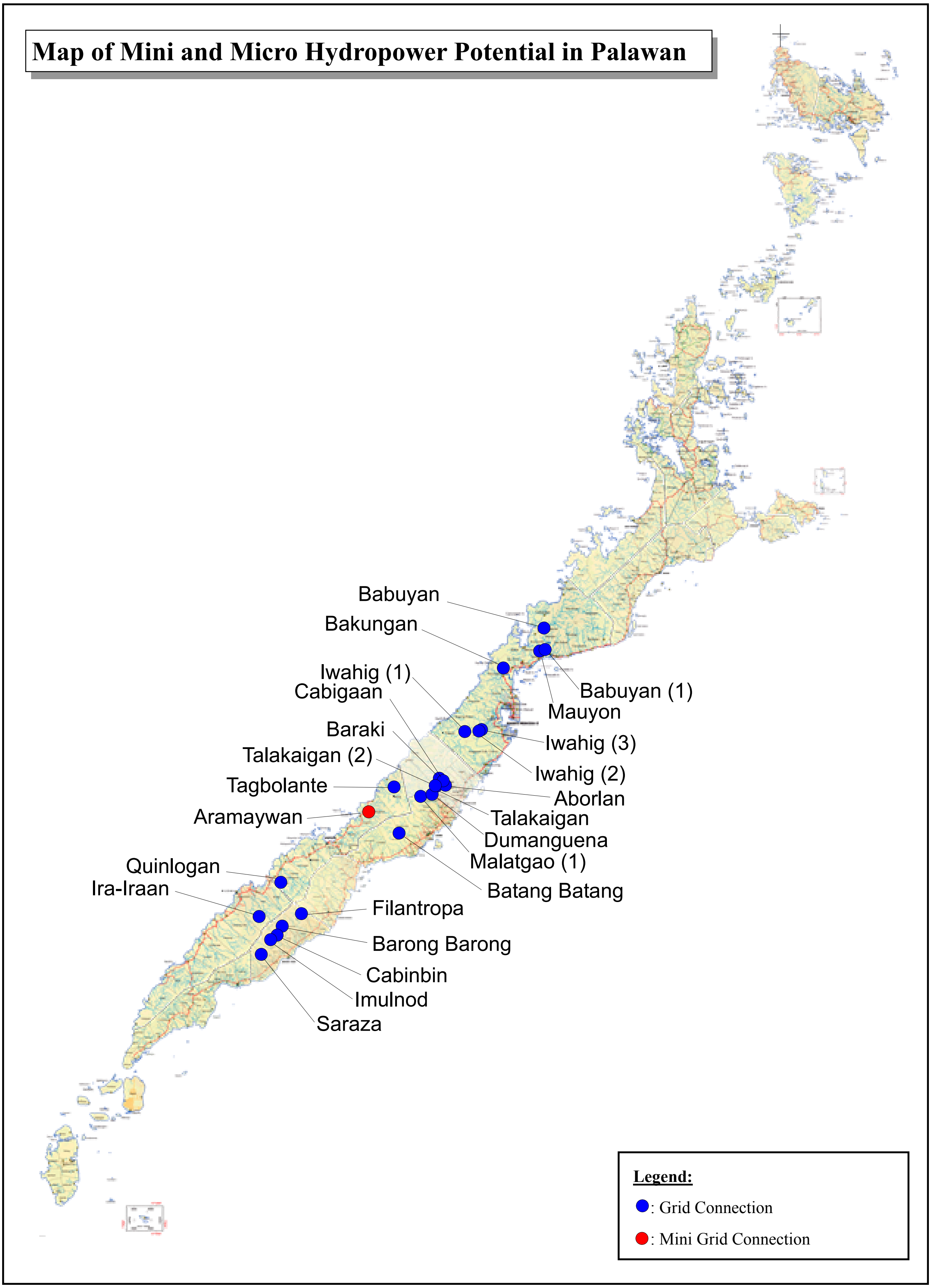


Figure 4.1.9 Map of Mini and Micro Hydropower Potential in Palawan

(5) Costs of the potential sites for mini and micro hydropower

(i) Costs of the sites for connection to the backbone grid

The potential sites listed above can be the candidates for connection to the backbone grid in Palawan.

The grid-connection project of Run-of-River type hydropower is basically considered as a 24-hour supply in order to maximize its plant discharge utilization, and in order "to increase its kWh". On the other hand, reservoir type hydropower is basically considered as 4 to 8-hour supply in order to maximize its daily or seasonal reserved river flow, and in order "to increase its kW". In the Study both types of hydropower were considered.

Each production cost for grid-connection projects was calculated based on its annual generation using the annual expense method. The reasons why the annual expense method was used for the calculation of the production cost are; (1) estimations using other methods would be very complicated since the net present value for existing facilities such as transmission lines and distribution lines can hardly be calculated, and (2) when using WASP-IV to make a generation plan, the most important value is the annual expense of each power station. The sites were ranked from cheaper production costs to more expensive costs. Meanwhile, the interest rate was set at 12% and the operation and maintenance cost rate was set as 2% of the development cost.

Additionally, at the time of development of hydropower it is essential to conduct a social-economic survey and an environmental impact assessment in the area in advance. Therefore, these costs are included in the development cost.

Table 4.1.15 Results of Estimations for the Selected Sites (Grid Connection, Run-of-River type)

Site Name	Capacity (kW)	Annual Generation (kWh)	Total Development Cost (1,000 Peso)	Development Cost (P/kW)	Production Cost (kWh)
Barong Barong	620	3,772,253	82,147	132,495	3.08
Malatgao (1)	2,200	13,335,223	290,496	132,044	3.08
Talakaigan	990	6,083,534	135,762	137,133	3.15
Ira-Iraan	2,000	12,102,545	300,969	150,484	3.51
Baraki	840	5,179,986	174,023	207,170	4.75
Talakaigan (2)	1,100	6,822,767	264,681	240,619	5.48
Saraza	540	3,295,372	133,140	246,555	5.71
Imulnod	450	2,773,602	143,550	319,000	7.31
Aborlan	300	1,851,954	96,194	320,647	7.34
Iwahig (2)	540	3,312,354	181,026	335,233	7.72
Iwahig (3)	290	1,768,597	97,911	337,624	7.82
Tagbolante	560	3,400,602	210,753	376,344	8.76
Bakungan	120	750,378	48,872	407,268	9.20
Iwahig (1)	210	1,285,235	90,408	430,516	9.94
Filantropa	180	1,073,187	83,016	461,200	10.93
Maoyon	81	494,036	38,227	471,940	10.93
Babuyan (1)	15	90,696	32,265	2,169,795	50.27
Cabinbin (past F/S)	800	5,080,000	115,124*	143,905	3.20**
BatangBatang (past F/S)	6,700	27,400,000	1,088,390	162,446	5.14***

Note: It is impossible to make comparisons with map study sites and F/S sites because of the differences of their accuracies and year for cost estimations.

* Interest During Construction, Contingency, Exchange Rate at 1999 (28Php/US$) and others are considered for the estimation of development cost of the Cabinbin project

** Since the financial analysis of the Cabinbin project has not been conducted yet, the Study team calculated the production cost using annual expense method.

*** Calculated by annual expense method based on the cost data from the report. In the report an electricity tariff of 2.88P/kWh was used in the financial analysis. The interest used in the analysis was 3.52%.

Table 4.1.16 Results of Estimations for the Selected Sites (Grid Connection, Pondage type)

Site Name	Capacity (kW)	Supply hours (h)	Annual Generation (kWh)	Total Development Cost (mil. Peso)	Development Cost (P/kW)	Production Cost (P/kWh)
Cabigaan	920	4	2,963,199	374,054	406,580	17.73
Dumanguena	520	4	1,688,323	300,328	577,553	24.98
Quinlogan	63	4	375,687	293,296	4,655,497	109.62
Babuyan (past F/S)	5,600	3	18,210,000	996,042	177,865	*5.45

* The newfound sites and F/S sites cannot be compared since the accuracies of the studies and the year for cost estimation are different.

Based on these results, the correlations between the capacity and the production costs are shown in Figure 4.1.10.

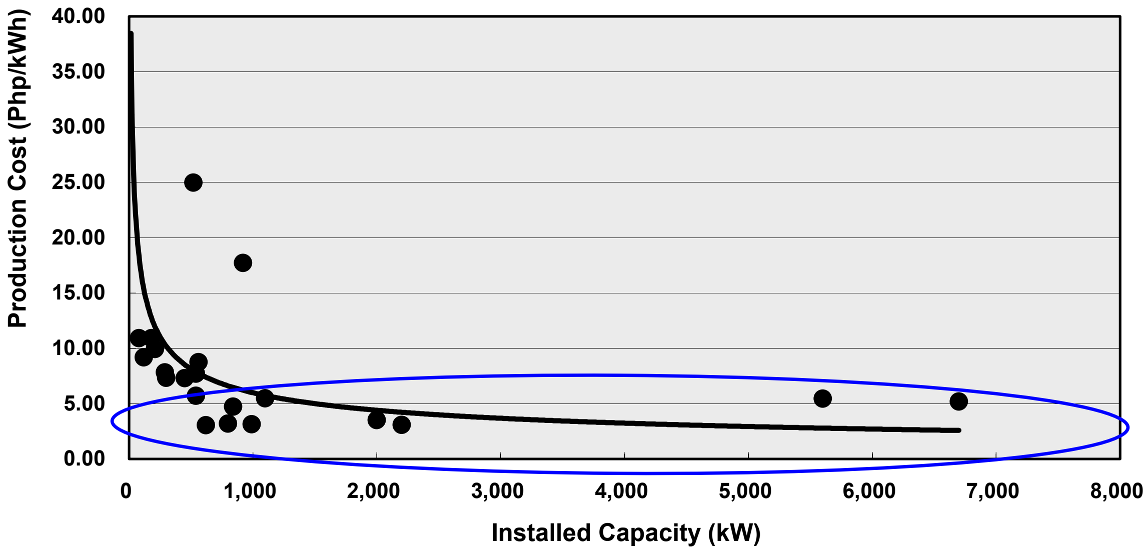


Figure 4.1.10 Correlations between Installed Capacity and Production Cost

The line in Figure 4.1.10 is an approximated line. Accurate correlation cannot be observed, since a hydropower site is very site-specific. Even with the same installed capacity, their production costs vary significantly due to different construction costs. Comparing with the wholesale power tariff of NPC-SPUG to PALECO, the sites within the circle can be considered as candidates for the grid-connection power supply. Of course these need to be studied more in the feasibility studies.

(ii) Costs of the sites for a mini-grid system

Except for the supply hour, the Study team estimated the cost of the Aramaywan candidate site based on the same conditions mentioned in 4.1.1 (5) (i). Since all generated electricity, especially in the day time, cannot be sold in a mini-grid system and the generation hour of most of the existing generators in BAPA is 5 to 6 hours, the generation hour by micro hydropower in a mini-grid system is also set at the same 6 hours. The interest rate and the operation and maintenance cost rate are the same as with the grid connection. The result of the calculation for the cost is shown in the Table 4.1.17. Meanwhile, the kWh cost was calculated using the Long Run Marginal Cost method since the profit and loss should be close to each other in the mini-grid system. Therefore, the number means that if the selling rate is more than the number, the system is profitable and that if it is not, the system is unprofitable.

Table 4.1.17 Results of Estimation for the Selected Sites (Mini-Grid Connection)

Site Name	Needed Capacity in Barangay Center in 2015 (kW)	Capacity (kW)	Supply hours (h)	Sold Annual Generation in 2015 (kWh)	Total Development Cost (mil. Peso)	Development Cost (P/kW)	Long Run Marginal Cost (P/kWh)
Aramaywan	31	39	6	51,373	20.1	514.592	61.22

4.1.2 Solar Energy Potential Survey

(1) Collection of existing reports and data

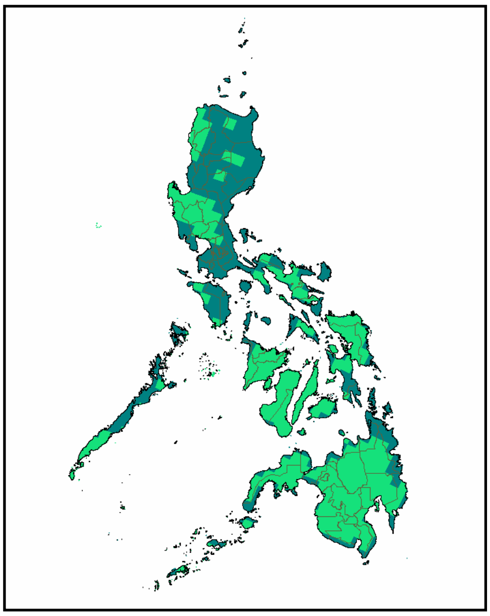
During the Study, the Study team collected the following reports and data regarding solar energy potential.

Table 4.1.18 Reports and Data Archives (Solar)

Category	Editor	Site (LAT, LON, H)	Contents	Data format	Duration
Report	USAID/NREL	Philippines	$kWh/m^2/day$		
	PAGASA	Philippines	Radiation		
			Duration		
Data	PAGASA	Puerto Princesa City (9+5N, 118+4E, 10m)	Radiation	Every 1 hour	1994-2002
			Duration		1984-2002

(a) Past desk studies on solar resources in the Philippines

A report was prepared by NREL (NREL: National Renewable Energy Laboratory) under contract with the USAID. In this report the latest meteorological observation data regarding solar power potential and its distribution was arranged in GIS format. Wind power potential was also included. Solar power potential is defined in terms of energy-density value ($kWh/m^2/day$) at a 40-km spatial resolution as shown in Figure 4.1.11.



Source: Assessment of Solar Resources in the Philippines

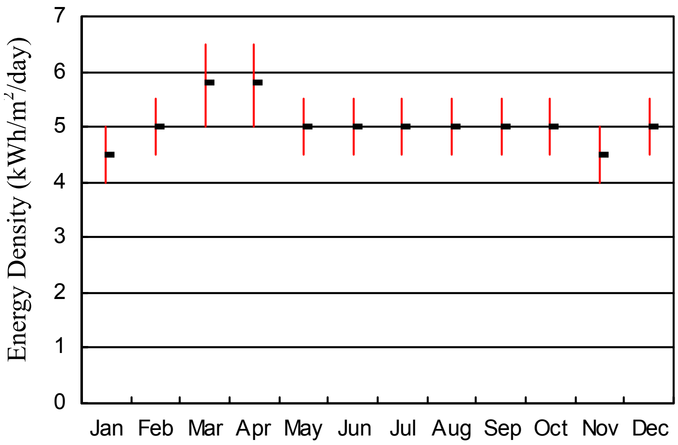
Figure 4.1.11 Estimation Result

Although the resolution is larger than that used in the wind energy potential survey, this GIS system can be useful for estimating the amount of potential energy and for finding project sites. As solar energy resources are evenly distributed as opposed to the wind energy potential, solar energy can be obtained as indicated in this system.

This assessment combines existing ground measurement data collected in the Philippines with the output of NREL's CSR (CSR: Climatological Solar

Radiation) model. This model converts information on satellite- and surface-derived cloud cover data to estimates of the monthly average daily total global horizontal solar resource.

As NREL reported in this report, the result of this analysis provides results that are comparable to values obtained from surface stations, even though the CSR model is capable of providing higher resolution data than the ground network.



Source: Assessment of Solar Resources in the Philippines

Figure 4.1.12 Average Global Horizontal Resource in Palawan

According to this report for the Palawan Province, annual average global horizontal solar resource is 4.5 - 5.0 kWh/m^2/day in the northern part of the province and 5.0 - 5.5 kWh/m^2/day in the southern part of the province. Average global horizontal solar resource of each month in Palawan is shown in Figure 4.1.12. The bars in Figure 4.1.12 show the range of solar resource in Palawan and the dots show the mean value.

Estimations for each municipality in Palawan are summarized by annual and twelve-month average daily total global horizontal solar resource data for a 40km grid.

(b) Solar radiation map of the Philippines prepared by PAGASA

This report was prepared by PAGASA (Philippine Atmospheric, Geophysical, and Astronomical Services Administration) of the Department of Science and Technology. In the report, datasets and figures related to solar radiation observed at 12 PAGASA stations were indicated as well as explanations on measurements, procedures and definitions used for data making. The report is suitable as an introduction on solar energy distribution in the Philippines.

In Palawan there is only 1 PAGASA station in Puerto Princesa City. This station observes hourly/daily totals of global radiation and bright sunshine duration. Global radiation measured with the use of a Pyranometer is indicated in terms of joules per square centimeter. Sunshine duration measured with the use of a Campbell-Stokes recorder is indicated in terms of hours.

Based on this data observed between 1984 and 1995, monthly average daily total radiation in Palawan is distributed from 1,423 (J/cm^2) in December to 1,957 (J/cm^2) in April. Maximum daily total radiation of 2,381 (J/cm^2) occurred in April 1995. And monthly average daily total sunshine duration is distributed from 4.6 (hours) to 8.0 (hours). Daily total duration between March and May is relatively high, and that between July and October is relatively low.

(c) Ground observation data prepared by PAGASA

As mentioned before, PAGASA is now observing solar radiation data and sunshine duration data in Puerto Princesa City. These data can be obtained in electronic format at PAGASA in the Science Garden in Quezon City. In the Study, radiation and duration data in Palawan were obtained from PAGASA.

In this section, solar data acquired from PAGASA is analyzed and the results of this analysis are compared with results of the USAID report. Based on this comparison, basic data used in the following work was determined.

- Monthly Average Daily Solar Radiation

Monthly average daily solar radiation in Puerto Princesa City is shown in Table 4.1.19. Annual average daily solar radiation is 4.691 (kWh/m^2/day). Solar radiation during the dry season tends to be higher than that during the rainy season because of the effects of cloud cover. The lowest radiation is 3.887 (kWh/m^2/day) in November and the highest radiation is 5.464 (kWh/m^2/day) in March.

Table 4.1.19 Monthly Average Daily Solar Radiation in Puerto Princesa City

(Unit: kWh/m^2/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AV
4.558	5.200	5.464	5.448	5.016	4.671	4.364	4.536	4.568	4.366	3.887	4.264	4.691

- Monthly Average Hourly Solar Radiation

Monthly average hourly solar radiation in Puerto Princesa City is shown in Figures 4.1.13 to 4.1.16. As mentioned in the above section, radiation during the dry season is higher than that during the rainy season. Peak radiation occurs between 12 PM and 1 PM. In this peak time, the highest hourly radiation is 0.740 (kWh/m^2/h) in March, and the lowest radiation is 0.539 (kWh/m^2/h) in November.

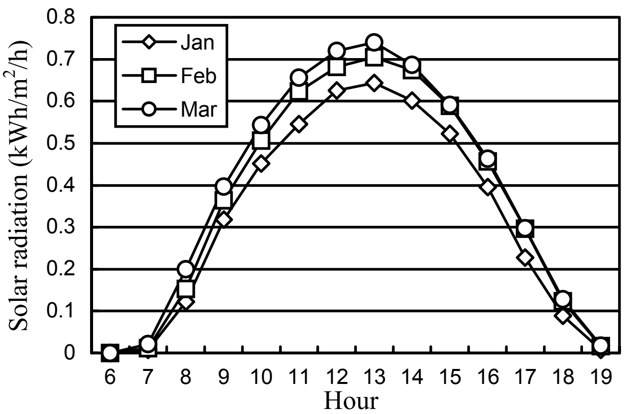


Figure 4.1.13 Monthly Average Hourly Radiation (January, February, March)

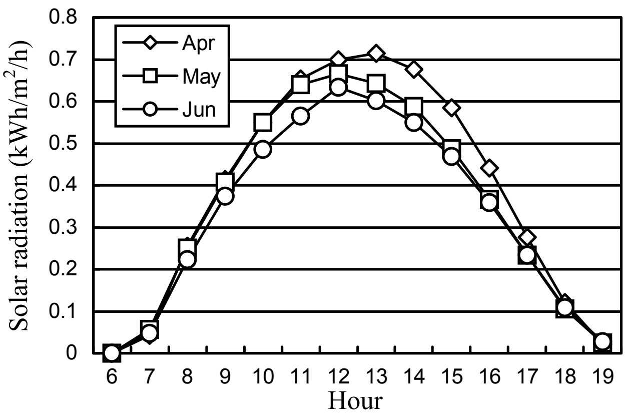


Figure 4.1.14 Monthly Average Hourly Radiation (April, May, June)

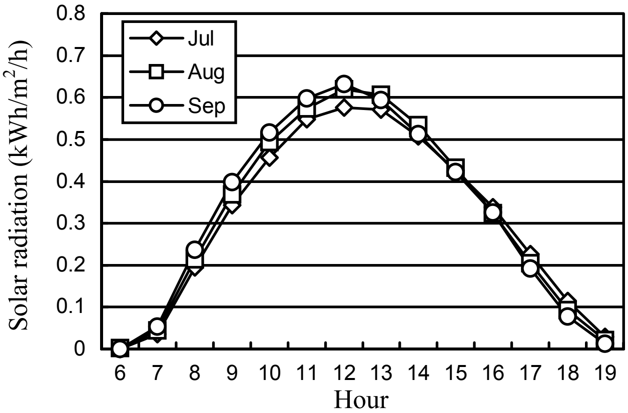


Figure 4.1.15 Monthly Average Hourly Radiation (July, August, September)

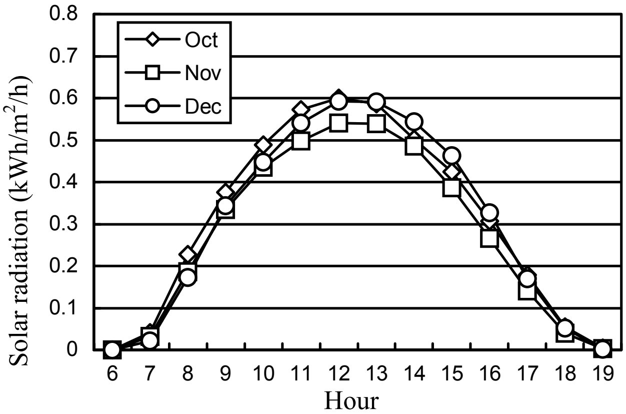


Figure 4.1.16 Monthly Average Hourly Radiation (October, November, December)

- Monthly Average Daily Sunshine Duration

Monthly average daily sunshine duration in Puerto Princesa City is shown in Table 4.1.20. Annual average daily sunshine duration is 5.9 (hours). Sunshine duration during the dry season tends to be higher than that during the rainy season, which is also the case for solar radiation. The lowest duration is 4.6 (hours) in July and the highest duration is 7.8 (hours) in April.

Table 4.1.20 Monthly Average Daily Sunshine Duration in Puerto Princesa City

(Unit: hours)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AV
6.7	7.3	7.6	7.8	6.8	4.9	4.6	4.8	4.7	4.7	5.4	5.6	5.9

- Monthly Average Hourly Sunshine Duration

Monthly average hourly sunshine duration in Puerto Princesa City is shown in Figures 4.1.17 to 4.1.20. As mentioned in the above section, duration during the dry season is higher than during the rainy season.

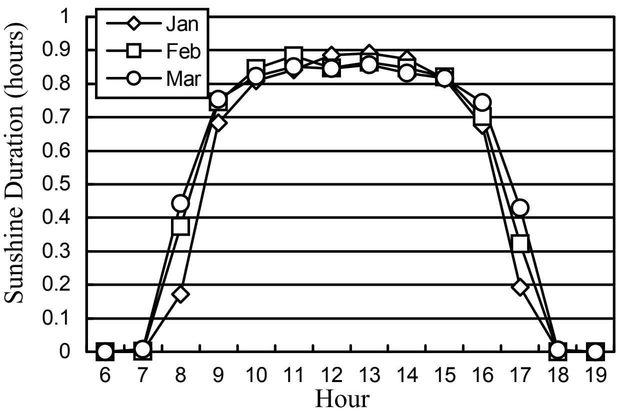


Figure 4.1.17 Monthly Average Hourly Duration (January, February, March)

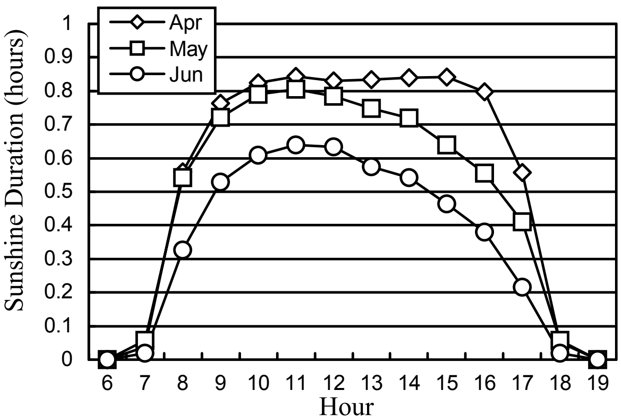


Figure 4.1.18 Monthly Average Hourly Duration (April, May, June)

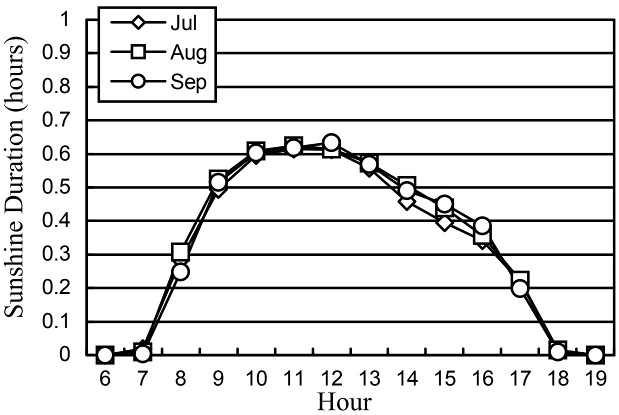


Figure 4.1.19 Monthly Average Hourly Duration (July, August, September)

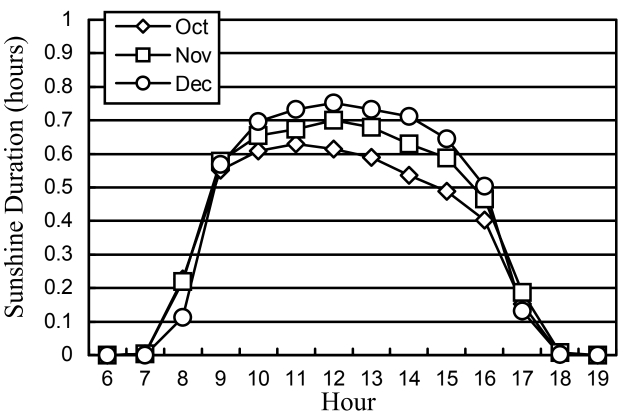


Figure 4.1.20 Monthly Average Hourly Duration (October, November, December)

(d) Comparison of radiation data

In this section, results based on the ground observation data are compared with output from the existing reports. According to comparisons with output from the USAID report as shown in Figure 4.1.21, USAID data is higher than the ground data as mentioned in this report. Both radiation data in November is the lowest among all the months.

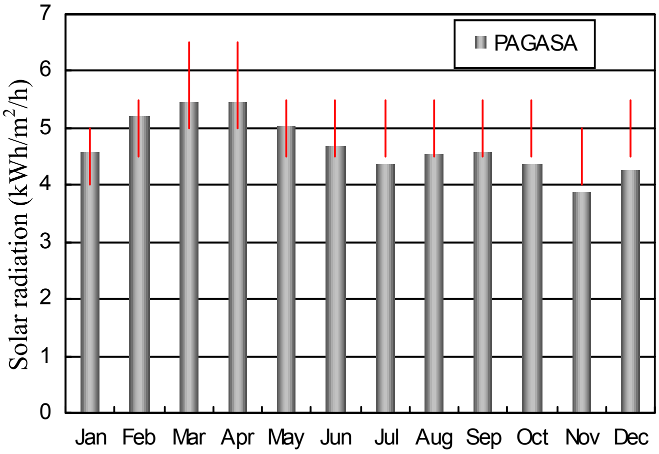


Figure 4.1.21 Comparison of Radiation Data

Even though the ground observation data reflects actual resource conditions, the ground observation data can represent only the average resource of the observation site. When considering solar resource distribution in all of Palawan, USAID data may prove to be more useful in the following work.

However, when estimating construction cost for solar power systems based on high radiation data, the concern is that the system cost may be underestimated. In addition, considering that it is usual to use the lowest monthly average daily radiation for solar power system designs, PAGASA radiation data may be better, because compensated PAGASA radiation data according to the tilt angle is lower than radiation of any parts of Palawan in the USAID report.

(4) Costs of solar energy

The costs of solar energy systems also depend on the conditions of the target households such as demand of each household. Therefore, the cost of solar energy will be covered in greater detail in section 5.3.2.(4).

4.1.3 Wind Energy Potential Survey

(1) Introduction

In this section the results of the wind energy survey will be explained. Considering the uneven distribution of wind energy, actual wind data observed in each candidate site is necessary to make a basic design for a wind power system in the Master Plan.

However, there is significant limitations on the existing wind energy data in terms of availability and quantity. Available existing reports regarding wind energy surveys are not sufficient enough to be utilized for the basic design of a wind power system for the Master Plan Study. In addition, the available ground observation wind data is also insufficient for the basic design of the wind power system. Thus, it is necessary to use the results of existing reports and available observation data to fill in the gaps between the available data and the required data.

(2) Data collection and analysis

The Study team collected the following reports and data regarding wind energy potential.

Table 4.1.21 Data Archives (Wind)

Category	Editor	Site (LAT, LON, H)	Contents	Data Format	Duration
Report	USAID/NREL	Philippines	Energy Density		
Data	PAGASA	Coron (12+0N, 120+2E, 10m)	Wind Speed Wind Direction	Every 3 hours	1996-2001
				Monthly	1961-2001
		Cuyo (10+1N, 121+2E, 10m)	Wind Speed Wind Direction	Every 3 hours	2001
				Monthly	1961-2001
		Puerto Princesa City (9+5N, 118+4E, 10m)	Wind Speed Wind Direction	Every 3 hours	2001
				Monthly	1961-2001
	PAGASA Puerto Princesa	Puerto Princesa City (9+5N, 118+4E, 10m)	Wind Speed Wind Direction	Hourly	2002
	NPC-SPUG	Cuyo (20m)	Wind Speed	Hourly	2000
	National Climate Data Center	Coron	Wind Speed	Daily	1994-1999
		Cuyo	Wind Speed	Daily	1994-1999
		Puerto Princesa City	Wind Speed	Daily	1994-1999

(a) Collection of existing reports and data

According to the renewable energy potential survey funded by USAID, the latest meteorological observation data regarding solar and wind power potential and its distribution is arranged in the Geographic Information System (GIS) format. And wind power potential is defined in terms of wind-energy-density value (W/m^2) for each $1km^2$ grid cell. This GIS system can be useful for finding potential areas (not sites) and roughly estimating the amounts of potential energy.

However, to formulate a barangay electrification plan for Palawan Province, it is necessary to analyze whether wind power energy in a specific barangay can be applied for realistic electric power resources or not. Thus, potential data in this system is not so reliable for the above-mentioned purpose in the case of identifying project sites, precise estimation of annual generation for a wind power system and verification of financial viability. This is because it is simulated data based on the Weibull Function and does not completely replicate actual wind energy conditions.

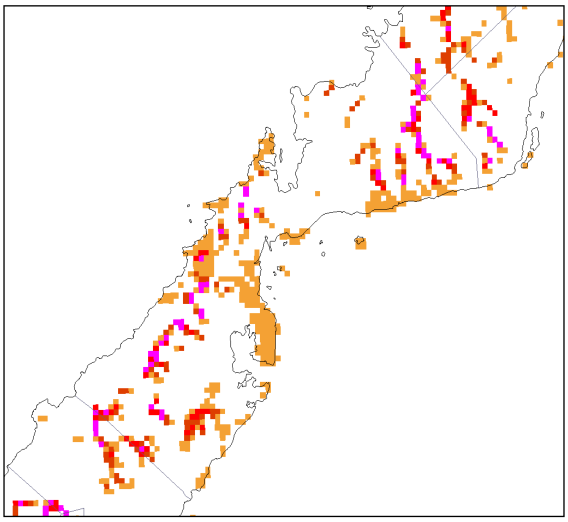


Figure 4.1.22 Wind Energy Potential Map

On the other hand, there are serious limitations on the actual wind data records. In Palawan, for example, there are only 3 observation stations operated by PAGASA, which are in Puerto Princesa City, Cuyo and Coron. Each station observes wind speed / direction every 3 hours, and available data is quite limited because the PAGASA head office is now processing hourly data. NPC-SPUG

(NPC-SPUG: National Power Corporation – Small Power Utility Group) also observed wind data every 1 hour for almost 1 year in Cuyo. But they suspended observations due to low wind energy potential.

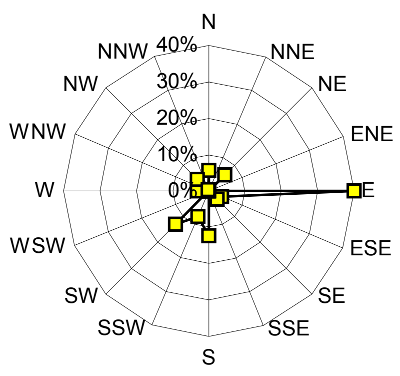
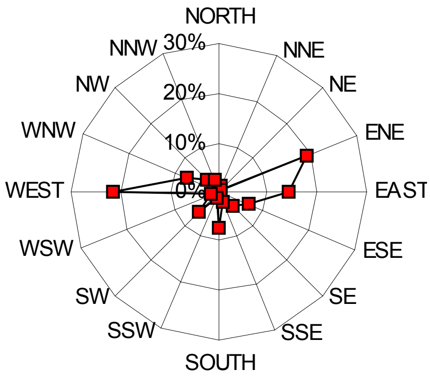
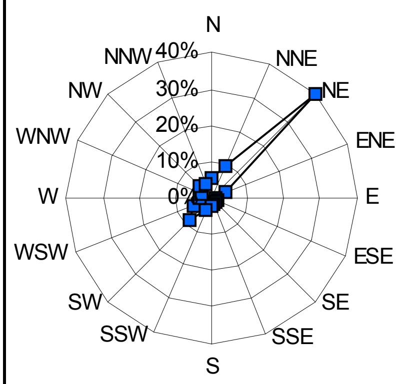
A wind energy survey by USAID reported that Palawan Province is identified as a relatively high wind potential area compared to other regions in the Philippines. Based on the actual data of 3 stations in Palawan, however, it is seems that there are not so many high potential areas in Palawan. This difference stems from not only the difference of base data, but also the features of wind energy potential, that is, unevenly distributed energy between individual sites.

(b) Ground observation data analysis

- Wind Direction

In this section, hourly wind data collected from PAGASA, PAGASA Puerto Princesa City and NPC-SPUG was analyzed to understand the features of wind energy potential at each site. The wind directions for each observation station in Palawan are summarized in Table 4.1.22.

Table 4.1.22 Summary of Wind Direction

<table>
<tr><th>Coron</th><th>Puerto Princesa City</th><th>Cuyo</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Primary Direction: EAST</td><td>Primary Direction: WEST</td><td>Primary Direction: NE</td></tr>
<tr><td>Source: PAGASA 2001</td><td>Source: PAGASA-Puerto 2002</td><td>Source: NPC-SPUG 2000</td></tr>
</table>

When designing the layout of a wind turbine at a specific site, special consideration must be given to the primary wind direction to prevent a reduction of generation efficiency by the wake influence.

- Wind Speed Distribution by Month

Figure 4.1.23 shows the transition of monthly wind speed in Coron. According to this figure, wind speed from December to April is 1.6 m/s above the average wind speed. In other words, wind speed is relatively low during the rainy season. As mentioned above, the annual average wind speed in Coron is too low to develop a wind power system.

Figure 4.1.24 shows the transition of monthly wind speed in Puerto Princesa City. According to this figure, wind speed from December to March 1.9 m/s above the average wind speed. Wind speed in Puerto Princesa City is also relatively low during the rainy season.

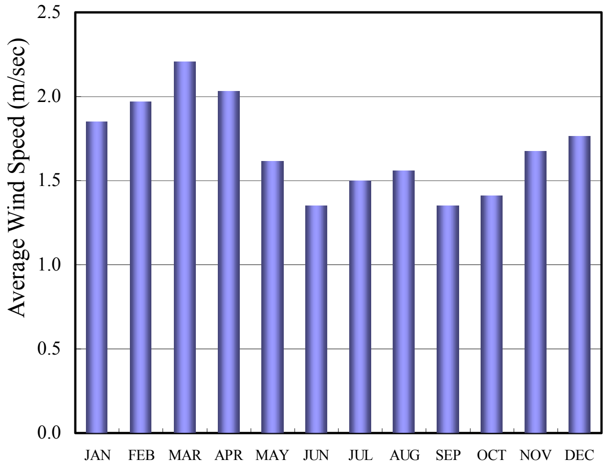


Figure 4.1.23 Monthly Wind Speed in Coron

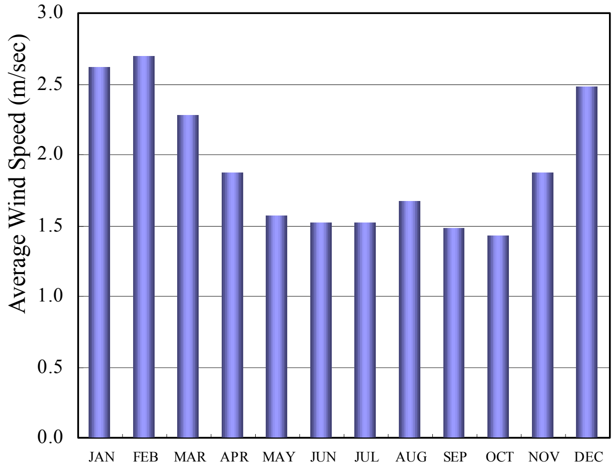


Figure 4.1.24 Monthly Wind Speed in PP

Figure 4.1.25 shows the transition of monthly wind speed in Cuyo. According to this figure, wind speed from November to March is 4.1 m/s above the average wind speed. The wind speed in Cuyo is also relatively low during the rainy season.

Compared with these data, it seems that the wind energy potential in Cuyo is relatively rich. In Cuyo, therefore, hourly wind distribution was also examined. Figure 4.1.26 shows hourly wind speed distribution in Cuyo. Considering that cut-in speed for almost all wind turbines is over 3m/s, a wind turbine cannot operate during one third of the year even in Cuyo.

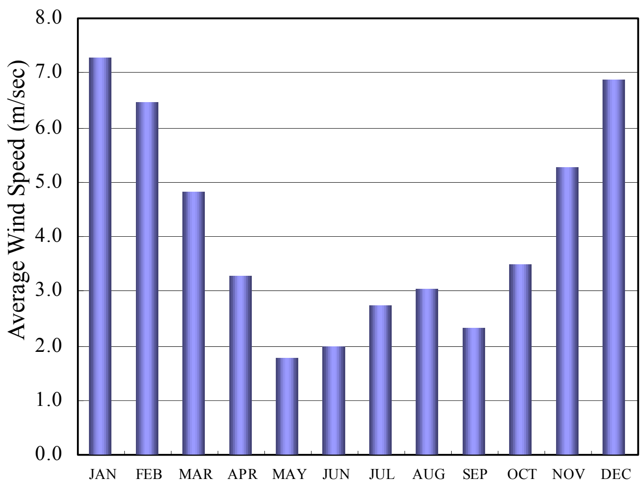


Figure 4.1.25 Monthly Wind Speed in Cuyo

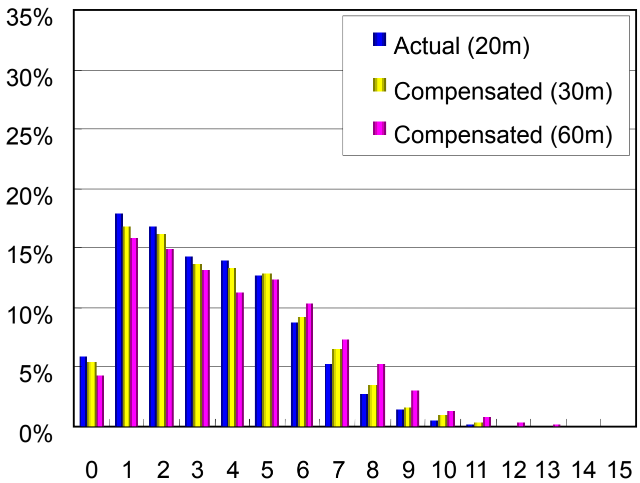


Figure 4.1.26 Wind Speed Distribution in Cuyo

- Estimated Data

It is commonly known that the distribution of wind speed can be approached by using the Weibull distribution function. By using this function, we estimated the distribution of wind speed at 20m-hub height in Cuyo where of the quantity of records was enough to evaluate.

In comparison with actual data, estimated data cannot completely replicate the actual wind distribution.

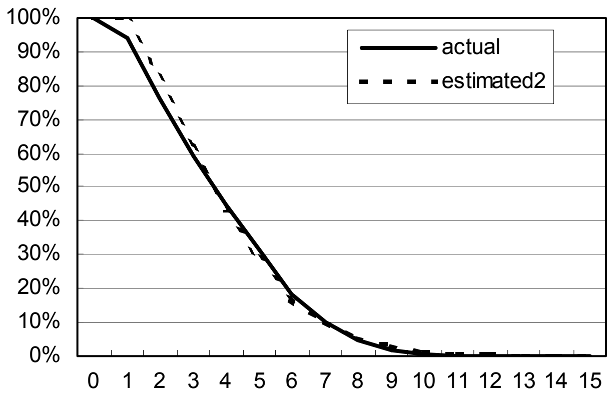


Figure 4.1.27 Cumulative Distribution of Estimated Wind Speed in Cuyo

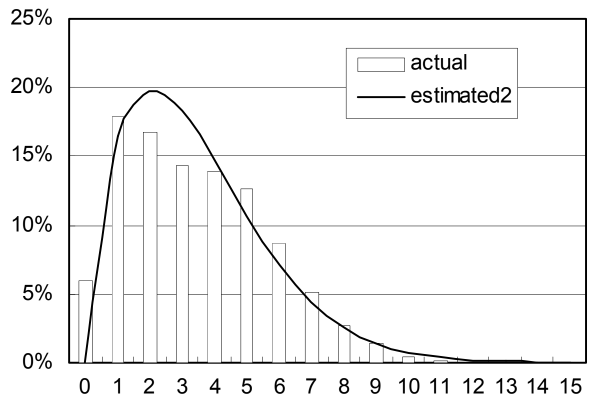


Figure 4.1.28 Distribution of Estimated Wind Speed in Cuyo

(c) Comparison between simulation data and actual data in Cuyo

Based on the USAID report, Cuyo is classified as a good potential area for rural utilization, even though observation data analysis shows the following opposite result. To solve this contradiction, observation data was adjusted to the same average wind speed of the USAID report in the following section.

Table 4.1.23 Comparison of Wind Speed in Cuyo

Data	Observation Period	Data Format	Annual AV. wind speed at anemometer height	Annual AV. wind speed at 30m height
PAGASA	1961-2001	Monthly	2 ~ 6 m/s	2 ~ 7 m/s
	2001	3 hours	1.6 m/s	1.9 m/s
NPC-SPUG	2000	Hourly	3.42 m/s	3.62 m/s
NCDC	1994-1999	Daily	1.36 ~ 2.18 m/s	1.60 ~ 2.55 m/s
USAID	-	-	-	5.6 ~ 6.4 m/s

According to Figure 4.1.29, which is based on the monthly PAGASA data, only the average wind speeds in 1962, 1963, 1964, 1972 and 1976 match the USAID classification. In other words, in spite of the long observation period of 40 years, the average wind speed does not match this classification during most years. Furthermore, NPC-SPUG data, which is observed to confirm whether the wind potential of Cuyo is worth developing or not, also does not match this classification.

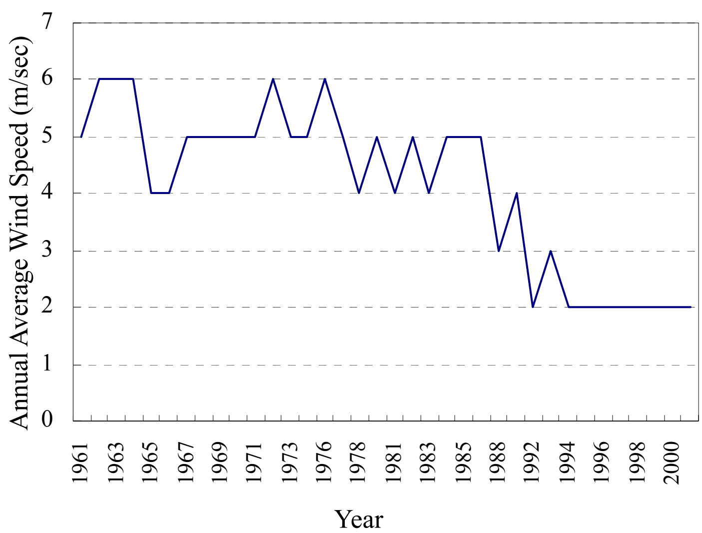


Figure 4.1.29 Annual Average Wind Speed Based on Monthly PAGASA Data in Cuyo

(3) Adjusting wind speed

(a) Adjustment procedure

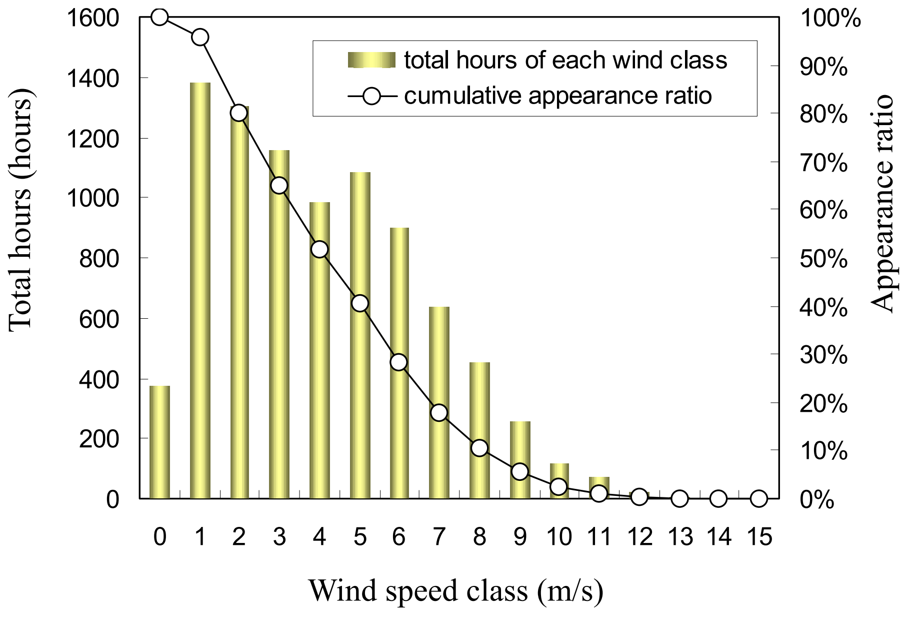
Based on the above examination, wind data observed at the NPC-SPUG station in Cuyo, which has sufficient records in amount and quality, is used to adjust the wind speed distribution.

The average wind speed compensated at the height of 120m is about 4.4m/s and this wind speed is matched with the wind speed in the moderate potential classification of the USAID report. Therefore, we assume that wind speed distribution in the excellent potential area at the height of 20m, which is same as height as the anemometer of the NPC-SPUG station, is that of the NPC-SPUG compensated for the height of 120m.

(b) Adjustment result

The adjusted wind speed distribution for the excellent potential area at the height of 20m is shown in Figure 4.1.30. As mentioned before, this distribution is estimated based on the distribution of the NPC-SPUG compensated for the height of 120m.

The adjusted wind speed distribution of each hub height for the excellent potential area is also shown in Figure 4.1.31. Based on this wind speed distribution, a wind power system will be designed in the following section.



Height	AV. Speed
20m	4.41 m/s
30m	4.68 m/s
40m	4.87 m/s
50m	5.03 m/s
60m	5.17 m/s

Figure 4.1.30 Wind Speed Distribution (at the height of 20m)

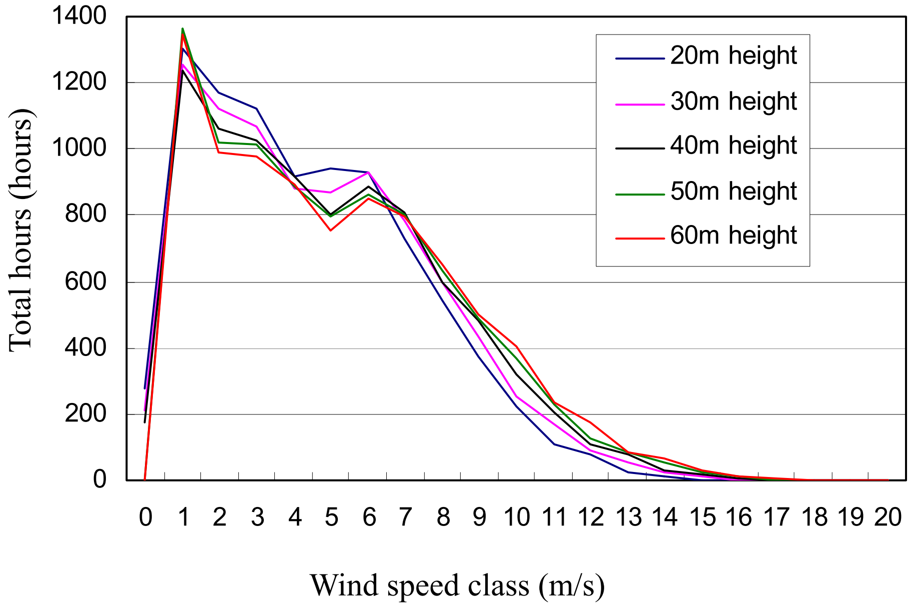


Figure 4.1.31 Wind Speed Distribution of each Hub Height

4.2 Peoples's Needs for Electrification

The electrification issue is related to not only the technical factors on the utilities and facilities side, but it is also related to the users. Therefore, it is important to formulate an energy master plan that considers socio-economic conditions of the electricity users and potential users. Data and information on social and economic trends in Palawan have great importance in providing the basis for predicting the level of demand, the reliability of supply needed, household's capacity to pay, as well as both positive and negative impacts that will give us a rationale for electrification and teach us lessons for future electrification. Hence, quantitative and qualitative sets of data related to socio-economic situations in Palawan were gathered and analyzed in the Study.

4.2.1 Framework of Socio-Economic Survey

(1) Study methodology

The survey aims at acquiring and analyzing comprehensive detailed data, information and documents of barangays in Palawan to properly reflect the diversity of social and economic conditions of the local areas in the electrification master plan. This socio-economic survey consists of two parts: one is to target all barangays in Palawan and the other is to target some sample barangays.

The specific objectives of these two survey styles are as follows:

(a) Survey of All Barangays: Collection and analysis of data, information and documents on socio-economic conditions of all barangays in Palawan for quantitative analysis that will lead to the Sample Barangay Survey;

(b) Sample Barangay Survey: Collection and analysis of more detailed data, information and documents on the sample barangays in Palawan for qualitative and quantitative analysis that will give useful indication for the study of the master plan for power development.

The former survey focuses on a provincial-wide gathering of secondary data and other related documents necessary for the conducting of the sample survey. The later survey is conducted for gathering pertinent data and information that will allow for quantitative and qualitative analysis. Specific data and information for both surveys include 1) demographic, 2) social, 3) economical, 4) organizational, 5) infrastructure, and 6) electrification / energization related data and information.

Especially, the sample barangay survey is comprised of four survey methods. Each characteristic is shown in Table 4.2.1.

Table 4.2.1 Sample Survey Methods

For getting detailed quantitative data **Quantitative Survey**

Questionnaire survey

- Purpose:
  To acquire quantitative and qualitative data widely from sample households chosen by systematic random sampling.
- Target:
  [At 24 barangays] *30 households in each barangay

  * The households are selected at regular intervals -sampling interval- from a random starting point. The sampling interval at the barangay level is defined in terms of the number of households, because the field operation specified for the enumerator is to approach the household and interact with a representative member respondent.

- Topics and questions [See Annex Attachment - C : Socio-economic Survey]
  Various topics from "Household Identification (Section1)" to "Household's Desire For Services (Section26)".

For getting detailed qualitative data **Qualitative Survey**

Key Informant Interview (KII)

- Purpose:
  To acquire more intimate qualitative data that is difficult to obtain by conventional survey methods, such as literature referencing or questionnaire surveys.
- Target:
  [At 12 barangays] Barangay captains, household heads (*representatives of rich, moderate and poor households), and heads of institutions providing electricity

  * For differentiating the socio-economic statuses in the community, the household heads were chosen by the following criteria:
  (i) Rich - own lands and livestock, with generator and other amenities, have business
  (ii) Middle - farmers who own lands, have small business but lower income
  (iii) Poor - landless, "nakikitanim" (farm in other's lands), work as farm labor, usually indigenous peoples (Batak), and bare subsistence level

- Topics and questions [See Annex Attachment - C : Socio-economic Survey]:
  Various topics from "Demographic Data" to "Energization & Electrification Profile and Concerns".

Focus Group Discussion (FGD)

- Purpose:
  To acquire qualitative data that is difficult to obtain by conventional survey methods, such as literature referencing or questionnaire surveys. Especially, 1) Draw insights on the community's perceptions, expectations, needs and demands pertaining to electrification; and 2) Gauge the community's absorptive capacity to maximize use of electricity for their socio-economic development.
- Target:
  [At 12 barangays] Around 20-25 community residents representing a cross section of the community.

- Topics and questions [See Annex Attachment - C : Socio-economic Survey]:

  (To electrified barangays) 1) Impacts of electrification at the household and barangay level, 2) Problems people encounter concerning present distribution and use of electricity, 3) Solution to the problems, 4) Management of electrification system in the barangay

  (To un-electrified barangays) 1) Reason for un-electrification, 2) Problems, needs and concerns in the barangay, 3) Perceived benefits from electrification, 4) Perceived problems from electrification, 5) Willingness to pay for electricity, 6) Management of electrification system in the barangay.

Direct Observation

- Purpose:
  To watch people's usage of electric appliances and electrified facilities including street lights, and roughly understand the settlement pattern of houses and other facilities.
- Target:
  Some households or facilities (depending on procedure off questionnaire survey, KII and FGD).
- Topics and questions:
  Actual usage of electrification and spot maps including settlement pattern.

(2) Whole barangay survey

The Study team visited several organizations and institutions to gather existing secondary data, such as the Provincial Planning and Development Office (PPDO) in Palawan, Department of Interior and Local Government (DILG) in Palawan, Department of Energy and others. Please refer to the Annex for a list of the references for collecting existing secondary data .

Although it was a time-consuming job to collect and analyze such data, there were not enough credible data due to inconsistence in measures, the dubiousness of such data, obsolete data and a lack of the data at the barangay level. Therefore, it is necessary for both central and local governments to gather more socio-economic data not only for this kind of master plan study, but for other purposes as well. In particular, the Community-based Monitoring System Database that PPDO in Palawan is updating gradually should be more enriched in the future.

(3) Sample barangay survey

The Study team selected 24 barangays as samples and considered the following factors for selecting sample barangays.

(a) Population size
(b) Electrification status
(c) Accessibility
(d) Proposal of Energy Unit of the PPDO in Palawan

The following characteristics or parameters derived from the Survey of All Barangays were considered for the selection of the 24 sample barangays at first;

1) Land area, 2) Population, 3) Density, 4) Energized level, 5) Number of households, 6) Number of households electrified, 7) Agriculture and fishing activities (computed), 8) Literacy rate (10 years old and over), 9) Number of students in primary and secondary level, 10) Number of households owning house and lot, 11) Number of households renting house and lot.

An attempt to simultaneously analyze data variations in the determination of groupings that may be possibly used in the selection of the barangays was made using cluster analysis. The next step was to generate correlations among such characteristics. This was done as it was suspected that the variables being considered are correlated and hence a meaningful subset with complete data can be used for the stratification of the barangays. From this viewpoint, population is correlated with almost all indicators except land area and density. This means that population can be taken to replace the other variables. Considering population data, the barangays were grouped into Low, Medium, and High categories using cluster analysis.

The next procedure for selecting sample barangays was based on the following factors;

1) Electrified EC-grid[1], 2) Electrified mini-grid and stand-alone, 3) Un-electrified EC-grid (barangays currently un-electrified, but will be electrified by the EC-grid system in the future), 4) Un-electrified mini-grid and stand-alone (barangays currently un-electrified, but will be electrified by only mini-grid and stand-alone systems in the future).

Moreover, some barangays, especially island-barangays were taken off the list of candidate barangays in consideration of accessibility.

Finally, after considering the sample barangays proposed by PGP, systematic random sampling was performed to decide the sample barangays.

Considering the above factors by using cluster analysis and cross-classification methods, 24 sample barangays were chosen as shown in Table 4.2.2

[1] The term "EC-grid" in this section means the electricity supply by ECs, and the term " Off-Grid"" means that by other systems such as a mini-grids, SHS and BCS.

Table 4.2.2 Sample Barangays

Barangay	Municipality	*1 Electrification Status	Land Area (Km^2)	No. of Sample Households/ Total No. of Households	*2 Qualitative Survey	Map Study
Electrified EC-Grid						
Jose Rizal	Aborlan	E-EC, L2	30.76	24/261 (9%)		
Burirao	Narra	E-EC, L1	77.40	25/504 (5%)		
Calategas	Narra	E-EC, L2	70.04	24/791 (3%)		
Narra (Poblacion)	Narra	E-EC, L3	84.60	24/3013 (0.8%)	X	
Inagawan Sub Colony	*3 PPC	E-EC, L1	No data	24/255 (9%)		
Manggahan (Poblacion)	PPC	E-EC, L3	0.10	30/270 (11%)	X	
Tagumpay (Poblacion)	PPC	E-EC, L3	0.013	28/237 (12%)	X	X
Tiniguiban	PPC	E-EC, L3	3.01	25/1419 (2%)		X
Panitian	Quezon	E-EC, L1	96.13	25/1332 (2%)		
New Agutaya	San Vicente	E-EC, L1	No data	24/406 (6%)	X	X
Electrified Mini-Grid and Stand-Alone						
Debangan	Taytay	E-NON-EC, L2	2.78	45/209 (22%)	X	X
Pularaquen*	Taytay	E-NON-EC, L1	5.48	30/275 (11%)	X	X
Un-Electrified EC-Grid						
Calatagbak	Quezon	UE-EC	28.86	24/297 (8%)	X	
Tagumpay	Roxas	UE-EC	44.75	26/491 (5%)	X	X
Un-Electrified Mini-Grid and Stand-Alone						
Igang-igang	Bataraza	UE-NON-EC	17.84	29/208 (14%)		
Santa Cruz	PPC	UE-NON-EC	19.40	30/162 (19%)	X	X
Tanabag	PPC	UE-NON-EC	60.68	28/91 (31%)		X
Aramaywan	Quezon	UE-NON-EC	99.41	25/596 (4%)	X	
Calumpang	Quezon	UE-NON-EC	76.72	25/335 (7%)	X	
Punta Baja	Rizal	UE-NON-EC	12.12	30/1907 (2%)		
Caramay	Roxas	UE-NON-EC	152.32	30/440 (7%)		X
Rizal	Roxas	UE-NON-EC	17.30	25/155 (16%)	X	X
Binga *	San Vicente	UE-NON-EC	1.38	30/243 (12%)		X
Alacalian	Taytay	UE-NON-EC	32.28	30/320 (9%)		X

*1: Energization status : E-EC : Electrified EC-grid
E-NON-EC : Electrified mini-grid and stand-alone
UE-EC : Un-electrified EC-grid
UE-NON-EC : Un-electrified Mini-grid and stand-alone
*2: Qualitative survey : X: KII and FGD were conducted
*3: PPC: Puerto Princesa City

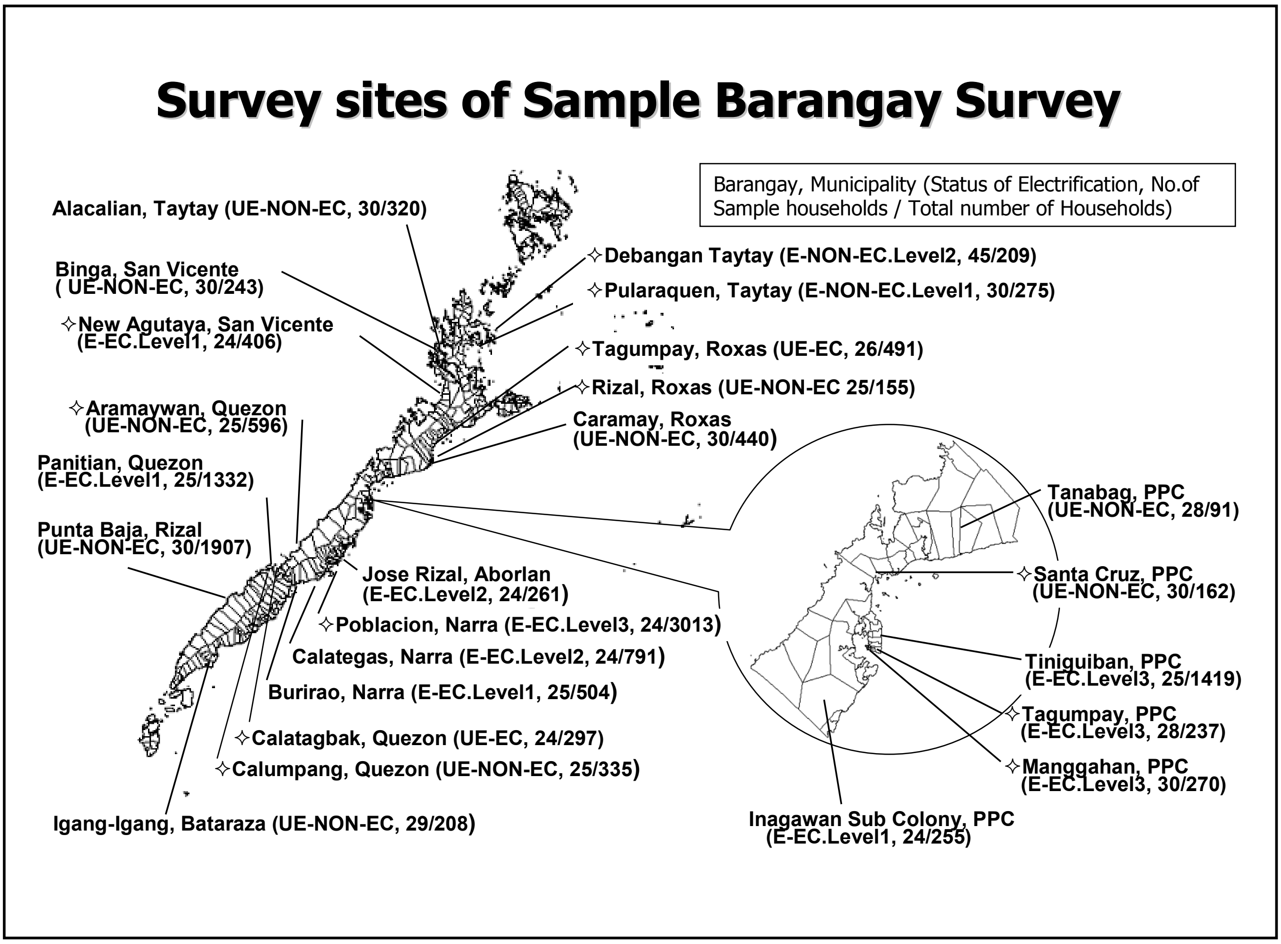


Figure 4.2.1 Survey Sites of Sample Barangay Survey

Although a sample of 30 households per barangay were targeted for the questionnaire survey, the target size was not attained for some barangays due to rough terrain, heavy rains, and thus unavailability of transportation at the time of data collection.

4.2.2 Findings from Socio-Economic Survey

Among various socio-economic data, we will describe several data in this report that are related to the level of demand, the reliability of supply needed, household's capacity to pay and both positive and negative impacts that will give us a rationale for electrification and teach us lessons for future electrification.

(1) Settlement patterns

Settlement patterns have an influence on the future expansion of the electric distribution lines. If un-electrified houses are located far from the existing distribution lines, stand-alone systems should be installed instead of trying to expand the distribution lines, considering installation and maintenance costs. Therefore, it is important to grasp the settlement patterns for each barangay. The Study team conducted a simple map study on 12 barangays by direct observation. The outcomes of the simple map study are shown in Table 4.2.3.

In the Philippines, each “Municipality” consists of several “Barangays”. A “Barangay” is made up by several “Sitios”, which are political units where clustering of house are situated. Also, the “Barangay Center” is the smallest political unit of government. As shown in Table 4.2.3, the average concentration ratio of households to the barangay center is 59%; 72% for the barangays electrified by on-gird, 42.5% for the barangays electrified by off-grid, 80% for the barangays that will be electrified by on-gird, and 54% for the barangays that will be electrified by off-grid, respectively. It is noted that fewer households are located near the barangay center in the barangays electrified or will be electrified by off-grid systems than in the barangays electrified or will be electrified by EC-grid systems. This tendency should be considered for future expansion of electrification.

The Study team could roughly grasp some tendencies regarding settlement patterns through socio-economic surveys. However, the tendencies were obtained from data that was limited in the number of samples and so it is necessary to conduct further surveys and more detailed map studies not only for improving the precision of the data, but for its effective use for other purposes.

Table 4.2.3 Settlement Patterns

Barangay	Tagumpay	Tiniguiban	New Agutaya	Pularaquen	Debangan	Tagumpay
Municipality/City	Puerto Princesa	Puerto Princesa	San Vicente	Taytay	Taytay	Roxas
Electrification Status	Electrified	Electrified	Electrified	Electrified	Electrified	Unelectrified
	EC-grid	EC-grid	EC-grid	Mini-grid and stand-alone	Mini-grid and stand-alone	EC-grid
Level	L3	L3	L1	L1	L2	
Settlement Pattern						
Concentration ratio to the barangay center	75%	80%	60%	55%	30%	80%
Description	The whole barangay is located within the city proper. The HH conentration is approximately 75% at 200 meters from the barangay center	HH concentration is approximately 80% near the barangay center/ Another 20% is located at 1km from the barangay center.	HH concentration near the barangay center is 60%. Other 40% of the total households are scatterd widely along the barangay road	Degree of HH concentration is 55% located within the barangay center. Other 18% are located approx. 3.2km, and other 10% are located approx. 6.4km from the center. Other HH are situated in island sitio.	Island Barangay. Settlement pattern is liner. The HH concentration is approximately 20% from the barangay center. Other households are located approx. 2.1km along the barangay road.	HH concentration is approximately % near the barangay center and other facilities loated near the center (a primary school or a health facility)
Barangay	Sta. Cruz	Tanabag	Caramay	Rizal	Binga	Alacalian
Municipality/City	Puerto Princesa	Puerto Princesa	Roxas	Roxas	San Vicente	Taytay
Electrification Status	Unelectrified	Unelectrified	Unelectrified	Unelectrified	Unelectrified	Unelectrified
	Mini-grid and stand-alone	Mini-grid and stand-alone	Mini-grid and stand-alone	Mini-grid and stand-alone	Mini-grid and stand-alone	Mini-grid and stand-alone
Level						
Settlement Pattern						
Concentration ratio to the barangay center	60%	50%	40%	75%	55%	45%
Description	HH concentration near the barangay center is 60%. Another 40% is near school.	HH concentration near the barangay center is 50%. Other 50% of the total households are scatterd widely and far from the center	HH concentration near the barangay center is around 30%. Other 60% of the total households are scatterd widely along the barangay road	About 75% of the total HH are concentrated at the barangay center	Approximately 55% of the HH are concentrated near the barangay proper. Other 15% are located approx. 3.7km from the center. Other 30% are located far area from the center.	About 45% of the total HH are concentrated within the barangay center/proper. Other 20% are located approx. 2.2km, other 10% are located approx.4km, other 25% are located approx. 5km from the barangay center/proper.

Source: Qualitative Survey (Direct Observation)

(2) Economic conditions

The data and information on economic condition is very important for demand forecasts and for understanding the capacity to pay for electricity, which is then applied in making the power development master plan. However, there were difficulties in collecting the relevant data and information for this survey. That is because 1) people have no records of their income and expenditure conditions, 2) manly people are engaged in jobs influenced by the weather such as agriculture and fishing, and 3) people don't want to reveal their economic situation to others. Therefore, although the Study team tried to obtain the real intention of the people by conducting qualitative survey such as KII and FGD, it will be necessary to conduct further investigations on this topic and make comparisons with other existing surveys on economic situations such as WB and USAID.

(i) Occupation of family members working/earning incomes

The common sources of regular income in the electrified barangays by EC-grid system are farming and fishing. Business and employment in government offices are dominant in the barangays located in the city. Typical of the entire group is their involvement in other irregular and additional sources of income such as driving, sewing/tailoring, carpentry, kaingin making, construction labor, renting and selling produce and wares.

Similarly, un-electrified barangays are basically farming and fishing communities. Rice and corn constitute the major crops with cashews serving as additional line crops. Supplementing these regular income sources are copra making, charcoal making, tending sari-sari stores and working as hired labor in construction and other's farms. Irregular income could hardly be recalled or estimated as they come so irregularly ("*paminsan -minsan*") during off planting season, which is during the summer months of April to June.

(ii) Monthly household income and expenditure

Table 4.2.4 shows economical data derived from qualitative surveys. Comparing their income and expenditure, households in the electrified and un-electrified barangays differ in absolute figures. Of interest is the fact that those in the electrified areas are spending almost 60% of their earnings indicating some substantive savings. For example, electrified barangays have an aggregated mean income of P12,708 and only an aggregated mean expenditure of P8,104. On the other hand, households in the un-electrified barangays have on average a P3,020 mean income and spend an average of P2,687, that is almost their entire income. These imply that those in the electrified areas have high disposable income and, thus, higher capacity to pay; while those in the un-electrified areas have very limited savings and, thus, very low or even nil capacity to pay for additional amenities such as electricity.

Table 4.2.4 Monthly Household Income and Expenditure

	Household Income		Household Expenditure		Electrification/ Energy Expenditure	
	Average	Range	Average	Range	Average	Range
Electrified	12,708	1,000-100,000	8,104	1,000-20,000	348	75 - 2,000
E-EC	21,916	1,000-100,000	9,375	1,000-20,000	226	
E-NON-EC	3,500	1,500- 5,000	6,833	1,500- 5,000	470	
Un-electrified	3,020	1,000- 7,000	2,687	1,000- 6,000	222	
UE-EC	2,250	1,000- 5,000	2,583	1,000- 5,000	166	
UE-NON-EC	3,791	1,000- 7,000	2,791	1,000- 6,000	279	

Source: Qualitative Survey

Tables 4.2.5(a) and 4.2.5(b) show the monthly household income patterns in electrified barangay and un-electrified barangays, respectively. From these data it should be noted that around 50-65% of households in barangays electrified by mini-grids, stand-alone systems and un-electrified are earning below P1,500 a month, while the percentage of households with the average monthly income below P1,500 are only 35% in barangays electrified by an EC-grid system.

Table 4.2.5(a) Monthly Household Income Patterns in Electrified Barangays

Name of Sampled Barangay	Jose Rizal	Burirao	Calategas	Poblacioin	Inagawan	Manggahan	Tagumpay	Tiniguiban	Panitian	New Agutaya	Debangan	Pularaquen
Municipality	Aborlan	Narra	Narra	Narra	PPC	PPC	PPC	PPC	Quezon	San Vicente	Taytay	Taytay
Electrification status	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-OFF	Electrified-OFF
Electrification level	Level 2	Level 1	Level 2	Level 3	Level 1	Level 3	Level 3	Level 3	Level 1	Level 1	Level 2	Level 1
No. of surveyed households/ Total household	24/261	25/504	24/791	24/3013	24/255	30/270	28/237	25/1419	25/1332	24/406	45/209	30/275
	%	%	%	%	%	%	%	%	%	%	%	%
Below P500	16.67	12.00					25.00	34.78	8.00	20.83	10.34	73.33
P 500-1000	4.17	4.00	16.67	4.17			3.57	8.70	72.00	4.17	3.45	13.33
P 1001-1500	4.17	8.00	12.50	4.17	8.33				4.00	12.50	10.34	6.67
P 1501-2000	12.50	8.00	12.50				3.57			4.17	10.34	
P 2001-2500		4.00			8.33				4.00	4.17	17.24	
P 2501-3000	8.33			12.50		3.45		8.70		8.33	10.34	
P 3001-3500	4.17		8.33				7.14		4.00	4.17		
P 3501-4000	12.50	4.00	4.17			3.45	3.57	8.70		12.50	3.45	
P 4001-4500		4.00				3.45		4.35		8.33		
P 4501-5000		4.00	12.50					4.35			6.90	
P 5001-5500	4.17		4.17	8.33			3.57			4.17	3.45	
P 5501-6000				4.17	4.17		14.29			8.33	3.45	
P 6001-6500	12.50		4.17	4.17	4.17		7.14					
P 6501-7000				4.17		3.45						
P 7001-7500							3.57					
P 7501-8000			4.17	8.33		6.90				4.17		
P 8001-8500							10.71	4.35			3.45	
P 8501-9000		4.00				3.45	3.57			4.17		
P 9001-9500								4.35				
P 9501-10000	4.17			4.17				4.35				
Above P 10001	12.50	12.00	16.67	37.50		13.79	7.14	8.70			10.34	
No response	4.17	36.00	4.17	8.33	75.00	55.17	7.14	8.70	8.00		6.90	6.67
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Below P1500	25.00	24.00	29.17	8.33	8.33	0.00	28.57	43.48	84.00	37.50	24.14	93.33
Average Below P1500 (exept the place where over 20% "no	36.58										58.74	

Source: Questionnaire Survey

Table 4.2.5(b) Monthly Household Income Patterns in Un-Electrified Barangays

Name of Sampled Barangay	Kalatagbak	Tagumpay	Igang Igang	Sta Cruz	Tanabag	Aramayan	Calumpang	Punta Baja	Caramay	Rizal	Binga	Alacalian
Municipality	Quezon	Roxas	Bataraza	PPC	PPC	Quezon	Quezon	Rizal	Roxas	Roxas	San Vicente	Taytay
Electrification status	Unelectrified-ON	Unelectrified-ON	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF
Electrification level												
No. of surveyed households/ Total household	24/297	26/491	29/208	30/162	28/91	25/596	25/335	30/1907	30/440	25/155	30/243	30/320
	%	%	%	%	%	%	%	%	%	%	%	%
Below P500	8.33	15.38	65.52	24.14	33.33	4.00	16.00	10.00	16.67	24.00	3.33	16.67
P 500-1000	79.17	19.23	10.34	17.24	20.00	44.00	24.00	10.00	6.67	8.00	6.67	13.33
P 1001-1500		11.54	10.34	6.90	6.67	28.00	12.00	20.00	6.67	8.00	6.67	13.33
P 1501-2000	8.33	3.85	3.45	3.45	10.00	4.00	4.00	6.67		8.00	10.00	3.33
P 2001-2500	4.17	3.85		10.34	6.67	8.00	20.00	16.67		4.00	16.67	3.33
P 2501-3000		3.85	3.45			4.00	8.00	6.67	3.33		6.67	16.67
P 3001-3500				3.45	3.33	4.00	8.00			8.00	3.33	3.33
P 3501-4000				3.45		4.00		3.33			6.67	6.67
P 4001-4500										4.00	6.67	6.67
P 4501-5000				3.45						12.00	3.33	6.67
P 5001-5500										4.00	6.67	
P 5501-6000				3.45				3.33		4.00	6.67	
P 6001-6500										4.00	3.33	
P 6501-7000							4.00					
P 7001-7500												
P 7501-8000												
P 8001-8500												3.33
P 8501-9000											3.33	
P 9001-9500												
P 9501-10000												
Above P 10001			3.45	6.90				6.67	3.33	12.00	6.67	6.67
No response		42.31	3.45	17.24	20.00		4.00	16.67	63.33		3.33	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Below P1500	87.50	46.15	86.21	48.28	60.00	76.00	52.00	40.00	30.00	40.00	16.67	43.33
Average Below P1500 (exept the place where over 20% "no	66.83		51.39									

Source: Questionnaire Survey

Considering the above data from qualitative and questionnaire survey, if people can spend around 10% of their income for electricity usage, estimated peoples' capacity to pay for electricity usage in un-electrified barangays may be below P150 as a reasonable payment and P300 as a maximum payment.

(3) Electrification and Energization Concerns

(i) Electric appliances

Appliances purchased and owned by households are shown in the Table 4.2.6 (although such electric alliances are usually used in electrified barangays, some households in un-electrified barangays are using them by generator sets and dry cell batteries). A percentage over 100 means that some households own multiple appliances. For example, it is reported that the better off households use more than 5 bulbs for lighting, while the poorer ones use only two. Aside from bulbs for lighting, the top three appliances usually purchased by the households, whether rich, middle income or poor are television, electric fan and radio.

Television is a popular priority item because it is a medium for information, news, current events and entertainment. It is also a status symbol especially for those in the rural areas. The number of hours of use for television ranges from 2-6 hours daily, with an average of 4 hours for electrified households. Television viewing is usually from 6pm to 10pm. The number of hours is limited despite the presence of continued electric supply because most of the children are studying by then and are being kept away from the television sets.

Electric fans have a high rank as they provide "a little comfort/convenience in their home."

Radios, of course, are their companion medium, being very portable, which lets people attend to household chores while they listen to news, dramas or music. However, the radio is often operated by dry-cell batteries, especially in rural barangays.

As can be noted, refrigerators are popular, too. For electrified households, refrigerators are used continuously for 24 hours to preserve their food stock. For un-electrified households, refrigerators are used only during the first few days of the week (2-3 days) when they have their full food stock for storage. When the stocks get low, they just turn the refrigerators off to save electricity.

Moreover, in some cases in the un-electrified areas, people don't buy these appliances even if they can afford because of the limited electric supply they get from generator sets or the total absence of electric power in other areas. But whenever electricity is continuously available, there must be a strong motivation for people to invest in various household appliances for reasons of convenience, recreation, and prestige.

Table 4.2.6 Electric Appliances Owned by Households by Different Electrification Status

(Unit:%)

Appliances	E-EC, L3	E-EC, L2	E-EC, L1	E-NON-EC, L2	E-NON-EC, L1	UE-EC	UE-NON-EC
Incandescent	117	56	81	0	7	15	14
Fluorescent	264	118	119	103	137	58	74
Energy saving Lamp	89	33	80	7	3	12	9
BW TV	4	1	0	0	0	0	0
Color TV	94	32	41	17	40	4	17
Radio /tape	59	21	35	33	37	42	36
VHS	12	3	19	10	0	4	2
VCD-DVD	27	20	6	3	17	0	8
Washing machine	52	20	29	0	10	4	3
Vacuum	2	0	0	0	0	0	0
Flat iron	62	26	29	0	7	0	2
Refrigerator	67	33	27	7	13	4	6
Rice cooker	16	6	2	0	0	0	0
Microwave oven	7	3	2	0	0	0	0
Electric fan	132	29	48	13	7	0	8
Video game set	6	0	0	0	0	0	0
Karaoke set	12	17	13	0	17	31	8
Cell phone charge	94	11	6	0	7	0	6
Electric tools	2	0	0	0	0	0	1

Source: Questionnaire Survey

Appliances purchased and owned by households of different socio-economic status are shown in the Table 4.2.7. It can be seen that as the households become economically better off, the type and number of appliances bought increases. The rich households are expected to purchase additional amenities that include flat irons, washing machines, karaoke machines, cellular phones, VCD/CD players, ovens, computers and air conditioners. Aside from the availability of electricity, the number of appliances depends on the socio-economic status of the households.

Table 4.2.7 Electric Appliances Owned by Households by Different Socio-Economic Status

Appliances	Rich		Moderate		Poor		Price Range (Peso)
	EC Grid	Non-EC Grid	EC Grid	Non-EC Grid	EC Grid	Non-EC Grid	
Television	X	X	X	X	X		6,000 - 45,000
Radio /tape player	X	X		X		X	250 - 750
VCD/ CD	X	X		X	X		2,000 - 4,000
Washing machine	X	X	X	X			5,000 - 15,000
Flat iron	X	X	X				300 - 1,500
Sewing machine				X			Don't know
Refrigerator	X	X	X	X	X		7,000 - 15,000
Oven	X						1,000 - 3,000
Electric fan	X	X	X	X	X		200 - 1,500
Air conditioner	X						10,000 - 25,000
Karaoke set		X		X	X		3,000 - 7,500
Cellular phone	X						2,000 - 6,000
Computer	X						15,000 - 45,000

Source: Qualitative Survey

(ii) Plan to buy appliances in the future

Survey results (see Table 4.2.8) on electrical appliances that households plan to buy in the future show the popularity of recreational and communicative appliances, such as color TVs, VCD/DVDs, karaoke sets and radio/cassette players. Also, the popularity of washing machines, electric fans and refrigerators is outstanding. The difference of the order of preference on the electric appliances that households plan to buy in the different electrification status also provides some interesting indications. From the un-electrified EC-grid barangays, the top electrical appliance identified by households as the one they intend to buy is color TV (83%). The next is an enumeration of appliances identified with percentages that are proximate to each other - radio/cassette (42%), washing machine (42%), refrigerator (42%), and VCD/DVD (41%). Among households in the un-electrified mini-grid and stand-alone barangays, color TV was the most frequently mentioned item that they plan to buy in the future (75%). The next item was refrigerator (47%), then VCD/DVD (46%). Close behind was washing machine (44%). As seen above, the electric appliance that people are willing to buy with a high priority after electrification is color TV (except lightings).

Table 4.2.8 Electric Appliances that Households Plan to Buy in the Future

Rank	E-EC, L3	E-EC, L2	E-EC, L1	E-NON-EC, L2	E-NON-EC, L1	UE-EC	UE-NON-EC
1	VCD/DVD (46.2%)	Color TV (63.1%)	Radio/Cassette (63.1%)	Color TV (66.7%)	Electric Fan (56.7%)	Color TV (82.5%)	Color TV (74.5%)
2	Washing Machine (40%)	Washing Machine (52.2%)	Color TV (52.2%)	VCD/DVD (63.3%)	Color TV (50.0%)	Radio/Cassette Washing Machine (42.2%)	Refrigerator (46.7%)
3	Microwave Oven (39.1%)	VCD/DVD (51.3%)	Washing Machine (51.2%)	Electric Fan (60.0%)	Refrigerator (46.7%)		VCD/DVD (45.5%)
4	Color TV (37.4%)	Refrigerator (48.5%)	Electric Fan (38.1%)	Refrigerator (50.0%)	Washing Machine Flat Iron Karaoke (36.7%)	Refrigerator (41.9%)	Washing Machine (44.4%)
5	Electric Fan (35.1%)	Electric Fan (47.3%)	VCD/DVD (34.8%)	Karaoke (36.7%)		VCD/DVD (41.1%)	Radio/ Cassette (42.1%)

Source: Questionnaire Survey

(iii) Energy usage

As shown in Table 4.2.9, it is clear that many people own and use kerosene for lighting, even if their household is electrified. One of the reasons for this tendency may be that people are using kerosene for saving the time for using electricity to when an unannounced brownout happens. Also, the Table shows the spread of the usage of dry cell battery. They are mainly used for lights. Another noteworthy point is the usage of electric small-scale gen-sets in un-electrified barangays. Some people are enjoying the benefits brought by electricity, although there is an opinion that electric voltage from gen-sets is low and inadequate to run various appliances.

Table 4.2.9 Source of Electricity and Lighting used by Households

(Unit:%)

	E-EC, L3	E-EC, L2	E-EC, L1	E-NON-EC, L2	E-NON-EC, L1	UE-EC	UE-NON-EC
Kerosene	51.0	98.6	90.5	80.0	93.3	100.0	97.6
Dry cell battery	28.4	38.9	45.9	73.3	83.3	53.1	62.1
Candles	52.0	4.2	1.4	3.3	10.0	2.0	2.4
Charcoal (for ironing only)	2.0	9.7	1.4	26.7	10.0	4.1	7.5
LPG	4.9	0.0	0.0	3.3	0.0	0.0	2.4
Car battery	0.0	0.0	1.4	6.7	23.3	2.0	3.2
Electric Gen-set	2.0	1.4	0.0	53.3	40.0	12.2	26.5
Solar PV system	0.0	0.0	0.0	13.3	0.0	0.0	1.6
Micro-hydro	1.0	1.4	0.0	0.0	0.0	0.0	0.0
Electricity from grid	82.4	59.7	51.4	0.0	0.0	0.0	7.5

Source: Questionnaire Survey

From the results of the questionnaire survey, the average monthly lighting expenditure of households from un-electrified EC-grid and mini-grid and stand-alone barangays were P166 and P279, respectively. Current lighting expenditure patterns of un-electrified barangay are shown in Table 4.2.10. It is clear that the majority of people are spending below 200 pesos or between 200 and 400 pesos for lighting. This expenditure includes the price of kerosene or dry cell batteries for electric lights.

Table 4.2.10 Current Lighting Expenditure Pattern in Un-electrified Barangays

Name of Sampled Barangay	Kalatagbak	Tagumpay	Igang Igang	Sta Cruz	Tanabag	Aramayan	Calumpang	Punta Baja	Caramay	Rizal	Binga	Alacalian
Municipality	Quezon	Roxas	Bataraza	PPC	PPC	Quezon	Quezon	Rizal	Roxas	Roxas	San Vicente	Taytay
Electrification status	Unelectrified-ON	Unelectrified-ON	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF
Electrification level												
No. of surveyed households/ Total household	24/297	26/491	29/208	30/162	28/91	25/596	25/335	30/1907	30/440	25/155	30/243	30/320
	%	%	%	%	%	%	%	%	%	%	%	%
Below P200	83.33	38.46	82.76	48.00	67.86	76.00	48.00	50.00	26.67	48.00	36.67	56.67
P 200-400	16.67	3.85	10.34	20.00	14.29	16.00	44.00	33.33	13.33	8.00	30.00	20.00
P 401-600	-	3.85	-	4.00	3.57	4.00	8.00	13.33	6.67	-	10.00	6.67
P 601-800	-	3.85	-	4.00	-	–	–	3.33	3.33	-	10.00	3.33
P 801-1000	-	-	-	-	-	–	–	-	–	-	–	3.33
P 1001-1200	-	-	-	-	-	–	–	-	–	-	–	–
P 1201-1400	-	-	-	4.00	-	–	–	-	–	-	3.33	–
P 1401-1600	-	-	-	-	-	–	–	-	-	4.00	3.33	3.33
P 1601-1800	-	-	-	-	-	–	-	-	-	-	–	-
P 1801-2000	-	-	-	-	-	–	-	-	-	-	–	-
P 2001-2200	-	-	-	-	-	–	-	-	-	-	–	-
P 2201-2400	-	-	-	-	3.57	–	-	-	-	-	–	-
P 2401-2600	-	-	-	-	-	–	-	-	-	-	–	-
P 2601-2800	-	-	-	-	-	–	-	-	-	-	–	-
P 2801-3000	-	-	-	-	-	–	-	-	-	-	–	-
P 3001-3200	-	-	-	-	-	–	-	-	-	-	–	-
P 3201-3400	-	-	-	-	-	–	-	-	-	-	–	-
P 3401-3600	-	-	-	-	-	–	-	-	-	-	–	-
P 3601-3800	-	-	-	-	-	–	-	-	-	-	–	-
P 3801-4000	-	-	-	-	-	–	-	-	-	-	3.33	-
Above P 4001	-	-	-	-	3.57	–	-	-	-	-	3.33	-
No response		50.00	6.90	20.00	7.14	4.00			50.00	40.00	-	6.67
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Below P400	100.00	42.31	93.10	68.00	82.14	92.00	92.00	83.33	40.00	56.00	66.67	76.67
Average Below P400 (exept the place where over 20% "no	100.00		80.12									

Source: Questionnaire Survey

(iv) Electricity usage

For major activities like lighting, studying, cooking and other household chores, electricity is being supplied primarily by PALECO's grid system. This is being supplemented, however, by the use of generator sets and use of dry cell batteries. These are used to augment their supply especially when brownouts occur. Dry cell batteries are used mainly for flashlight and transistor radios. A number of households had already their generators before the grid electricity came to the area and they opted to keep these generators for some of their business operations. Despite the monthly bills, the household respondents in general prefer a more efficient energy source such as the grid electricity.

Monthly bill for electricity varied widely, from P75, P80, P100, P800, P1,000 to P2,000 per month. The higher bill goes to barangays within Puerto Princesa under PALECO which enjoy a 24-hour electric supply. The bill radically goes down for barangays outside the city which depend on other energy sources such as solar power and generator set for electricity.

(v) Problems encountered for electrification

When asked about problems encountered for electrification, respondents from EC-grid-powered households have articulated the following three problems; 1) Charging of Power Purchase Adjustment (PPA), 2) Recurring voltage fluctuations, 3) Unannounced brownouts. The PPA is a popular acronym among the respondents. But when asked what they know about it, no one was able to fully explain it. All they knew is that this is being charged unfairly to the electric consumers, which is partly correct. They also took note of the voltage fluctuations that can damage household appliances especially, saying that these fluctuations are difficult to monitor and control from their end.

Though there are no reports on the damage caused by such fluctuations, respondents are wary that their appliances may be affected next. Being mostly in the business sector, respondents feel bad about the unannounced brownouts basically because of its adverse effect on their business. Also, they consider this as a sign that maintenance is not being performed well by the power distributor and that they are being shortchanged in terms of their payments.

Respondents from mini-grid and stand-alone powered households, on the other hand, enumerated a longer list of problems, as they are dependent on other energy sources for electricity. The problems associated with using mainly generators are as follows; 1) Only accessible houses can be served, 2) Low voltage is generated, 3) Poor maintenance/poor management, 4) Capacity is lessened during rainy days, 5) People's inability to pay.

The above factors regarding problems encountered with electrification are related to the impact of electrification that will be mentioned later.

(vi) Perceptions on impact of electrification

People's perception on the impact of electrification will provide useful indications that will give us a rationale for electrification and teach us lessons for future electrification. According to the results of this socio-economic survey, the positive impacts of electrification were highly recognized by most respondents. (Approval ratio of positive impacts was almost 100% in various aspects). Electricity is regarded as a very positive technology/service in general. Almost nobody complains electricity itself, which absolutely makes peoples' lives more comfortable. If properly distributed and managed, electricity is beneficial to the people.

On the other hand, there was a smaller perception on the negative impacts than the positive impacts, as seen in the results of questionnaire survey (Approval ratio of negative impacts ranged from 0% to around 80% in various aspects). Therefore, electrification has enormous significance in developing more comfortable lives for people. An aggregate picture of the impacts of grid electrification based on the qualitative survey, such as the responses of the barangay officials, the household informants and the participants in the FGDs, is summarized below (see Table 4.2.11).

Table 4.2.11 List of Impact of Electricity based on Qualitative Survey

Positive Impacts	
Livelihood	- Commodities (fish, food) can be stored longer as ice can now be manufactured - More varied livelihood opportunities - Faster movement of goods and services
Business	- Faster transactions - Repairs can be done - Will attract more investors
Education and Communication	- Computers can be used - Better lighting and more time for studying - Faster communication
Household chores	- Acquisition of appliances and gadgets that will shorten time for household chores - Comfort and convenience (electric fan, TV, refrigerator)
Peace and order	- Fewer stand-bys - Fewer accidents thanks to streetlights - Fewer fire hazards
Health	- Operation of microscope - Vaccines can be stored at the barangay - Better and more efficient health services
Recreation	- Additional and more varied recreational activities
Community activities	- Community feasts and celebrations are more joyous - Meetings can be done at night
Others	- Faster house construction - Population control
Negative Impacts	
- Electric consumption is an additional expense leading to higher household maintenance. - Additional activities and recreation will make the barangay a little noisy especially at night. - Careless use of electricity could cause a fire. - Benefits of electrification can be a pulling factor for in-migration of outside populace who may later on compete for control of production and the economy in the area.	

Source: Questionnaire Survey and Qualitative Survey

(4) Willingness to pay for electricity

Questionnaire survey results are shown in tables 4.2.12(a) and 4.2.12(b). The tables reveal that almost all are willing to pay though lower than what they are currently spending on electricity.

Only in the un-electrified mini-grid and stand-alone areas are people willing to pay the same amount as they are presently spending for electricity. When asked how much they are willing to pay with their current monthly lighting expenditure as a reference, 61% of the respondents in the electrified EC-grid households responded they are willing to pay an amount less than their current monthly lighting fixtures if a new source of electricity were to be provided to them. 60% of the households in the electrified mini-grid and stand-alone barangays likewise expressed that they are willing to pay an amount lower than their current monthly lighting expenditures.

The highest percentage of households (43%) in the un-electrified EC-grid barangays expressed that they are willing to pay the same amount as their current monthly lighting expenditures. Sixty-seven percent of the households in the un-electrified mini-grid and stand-alone barangays expressed they are willing to pay less than their current lighting expenditures.

Table 4.2.12(a) Willingness to Pay in Electrified Barangays

Name of Sampled Barangay	Jose Rizal	Burirao	Calategas	Poblacioin	Inagawan	Manggahan	Tagumpay	Tiniguiban	Panitian	New Agutaya	Debangan	Pularaquen
Municipality	Aborlan	Narra	Narra	Narra	PPC	PPC	PPC	PPC	Quezon	San Vicente	Taytay	Taytay
Electrification status	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-ON	Electrified-OFF	Electrified-OFF
Electrification level	Level 2	Level 1	Level 2	Level 3	Level 1	Level 3	Level 3	Level 3	Level 1	Level 1	Level 2	Level 1
No. of surveyed households/ Total household	24/261	25/504	24/791	24/3013	24/255	30/270	28/237	25/1419	25/1332	24/406	45/209	30/275
	%	%	%	%	%	%	%	%	%	%	%	%
same	29.17	40.00	25.00	25.00	29.17	13.33	23.08	8.00	60.00	4.17	23.33	40.00
more than	–	8.00	–	4.17	–	6.67	30.77	–	–	4.17	6.67	3.33
lower than	66.67	48.00	70.83	70.83	70.83	33.33	42.31	–	32.00	12.50	70.00	53.33
no response	4.17	4.00	4.17	–	–	46.67	3.85	92.00	8.00	79.17	–	3.33
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Questionnaire Survey

Table 4.2.12(b) Willingness to Pay in Un-Electrified Barangays

Name of Sampled Barangay	Kalatagbak	Tagumpay	Igang Igang	Sta Cruz	Tanabag	Aramayan	Calumpang	Punta Baja	Caramay	Rizal	Binga	Alacalian
Municipality	Quezon	Roxas	Bataraza	PPC	PPC	Quezon	Quezon	Rizal	Roxas	Roxas	San Vicente	Taytay
Electrification status	Unelectrified-ON	Unelectrified-ON	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF	Unelectrified-OFF
Electrification level												
No. of surveyed households/ Total household	24/297	26/491	29/208	30/162	28/91	25/596	25/335	30/1907	30/440	25/155	30/243	30/320
	%	%	%	%	%	%	%	%	%	%	%	%
same	70.83	23.08	34.48	28.00	46.43	36.00	24.00	20.00	23.33	24.00	23.33	33.33
more than	8.33	30.77	6.90	12.00	7.14	16.00	–	–	23.33	20.00	10.00	13.33
lower than	20.83	42.31	58.62	56.00	32.14	48.00	72.00	80.00	50.00	56.00	66.67	46.67
no response	–	3.85	–	4.00	14.29	–	4.00	–	3.33	–	–	6.67
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Questionnaire Survey

From the perspective of a qualitative survey, respondents said the people would be willing to pay between P100 and P150 per month for a regular supply of electricity, with emphasis on the adjective “regular”.

In addition, the great majority of respondents recommended the collection of dues by an authorized fee collector who would do house-to-house collection. They also explained that people are not likely to pay regularly if they themselves have to go to the collection office to pay because this is viewed as an additional burden on their time and resources.

(5) Household desire for services and barangay needs

(i) Household desire for services

Electricity is only one of the needs people consider as indispensable for their life and aspire in the future. That is, there are various prioritized aspirations in each household. Therefore, if the aspiration of electrification is weaker than other aspirations, the expansion of the electrification system to un-electrified barangays will be difficult or electric consumption will not increase too much in electrified households. It is very important to consider the households’ intentions and their desires for services in the power development master plan.

Table 4.2.13 Prioritized Rank*[1] of Services People Desire

	Average Rank	E-EC, L3	E-EC, L2	E-EC, L1	E-NON-EC, L2	E-NON-EC, L1	UE-EC	UE-NON-EC
House ownership	2.1	1	1	1	4	4	2	2
Water system	2.6	2	2	4	2	3	1	4
Electricity	2.7	4	4	3	3	1	3	1
Educational facilities	7.4	6	8	9	8	6	8	7
Irrigation	6.4	6	7	6	6	8	5	7
Road, bridge, and other infrastructure	5.4	6	6	5	5	8	3	5
Public transportation	7.7	6	10	7	8	8	6	9
Health facilities	6.1	5	5	7	6	6	8	6
Toilet	7.9	6	9	9	8	5	8	10
Job opportunities	2.7	3	3	1	1	2	6	3

*1: 1=highly desired, 10 = least desired

Source: Questionnaire Survey

The top three recurring needs, from the perspective of the barangay officials interviewed and based on aggregated rankings are water system, electricity, and roads. Water system tops the list and according to informants, they can bear having no electricity, but cannot do without water, especially potable water.

They further explained that people would not be able to appreciate the value of electricity if they don't have water. With a water supply, they would have better health, use good health as a capital for their livelihood, gain more adequate income, and that’s the time perhaps when they would consider having electricity.

Then, although there was not strong aspiration from the opinion of households, barangay captains see roads as an important infrastructure next to electricity. The other items such as schools, health facilities and agricultural support services come as lower priorities but which they would also like to address.

(ii) Barangay needs

The top two services needed by the community, which surfaced during the qualitative survey, were electrification and the provision of potable water.

Electricity was desired mainly to light up and speed up development of their respective barangays, as well as to speed up communication. Electrification would allow the community members to acquire cellular phones and regularly charge their batteries. Also, a continuous and regular supply of electrification is highly required.

Potable water, on the other hand, was a frequently expressed need because residents had to spend for "delivery" of their drinking water taken from springs/sources that are quite a distance from their houses.

All told, the community's main concerns were electrification, a need for potable water and a need for additional income and livelihood opportunities. Also, these un-electrified barangays were far from the main road network, hence the communities likewise wanted to be connected to the national highway for easy transport of their produce.

The need for public transport thus cropped up a number of times in relation to this. They also emphasized that a good road network would allow for immediate response to emergency situations, especially health-related emergencies.

In the fishing communities, people also voiced their desire to have the following structures built in their communities: 1) an ice plant to prolong the shelf-life of fish they catch; 2) a pier for faster and easier transport of produce; 3) a breakwater to avert the loss of land mass and flooding in the community during the rainy season; and 4) a light house to guide fishermen at night and during bad weather. The "lighthouse" in Rizal at the time of the Study was the tallest tree in the school yard.

Other opinions of prioritized services that each electrified barangay needs derived from qualitative surveys such as KII or FGD are as follows: 1) Irrigation, 2) Livelihood opportunities, 3) Schools, 4) Health center/hospital, 5) Market, 6) Ice plant, 7) Port, 8) Gasoline station and 9) Dump site.