

Smart Energy in the Philippines

Ma, Zheng; Jørgensen, Bo Nørregaard; Billanes, Joy Dalmacio

Publication date:
2016

Document version:
Final published version

Citation for pulished version (APA):
Ma, Z., Jørgensen, B. N., & Billanes, J. D. (2016). *Smart Energy in the Philippines*.

Go to publication entry in University of Southern Denmark's Research Portal

Terms of use

This work is brought to you by the University of Southern Denmark.
Unless otherwise specified it has been shared according to the terms for self-archiving.
If no other license is stated, these terms apply:

- You may download this work for personal use only.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying this open access version

If you believe that this document breaches copyright please contact us providing details and we will investigate your claim.
Please direct all enquiries to puresupport@bib.sdu.dk

Smart Energy in the Philippines

Zheng Ma
Center for Energy Informatics
University of Southern Denmark,
Odense, Denmark
zma@mmmi.sdu.dk

Joy Dalmacio Billanes
Center for Energy Informatics
University of Southern Denmark,
Odense, Denmark
joyb@mmmi.sdu.dk

Bo Nørregaard Jørgensen
Center for Energy Informatics
University of Southern Denmark,
Odense, Denmark
bnj@mmmi.sdu.dk

September, 2016

Contents

Acronyms and Abbreviations	5
Definitions.....	6
1. Introduction.....	7
2. Historical development of Smart energy system in Philippines	9
2.1 Pre-reform Period (1972-1986).....	9
2.2 Reform Period (1987-2000).....	10
2.3 EPIRA Period (2001-Present).....	10
3. Sectors of the energy system.....	12
3.1 Electricity Production	12
3.2 Energy transmission.....	13
3.3 Energy distribution and supply	14
3.4 Energy consumption	15
4. Electricity market.....	17
4.1 Electricity wholesale market.....	17
4.2 Electricity retail market.....	20
5. Stakeholders in the smart energy system	22
5.1 Power Producers	22
5.2 Grid Companies	24
5.3 Distribution Companies	24
5.4 Consumers.....	27
5.5 Prosumers.....	27
5.6 Government.....	28
6. Discussions	29
6.1 Political situation	29
6.2 Economic aspect	30
6.3 Geographical aspect	30
6.4 Social aspect.....	31
6.5 Electricity Infrastructure aspect	31
6.6 Comparison to Other ASEAN	32
7. Conclusion and recommendation.....	32
References.....	33

List of Figures

Figure 1 Transmission lines capacity.....	13
Figure 2 Luzon-Visayas HDVC link	14
Figure 3 Energy consumption by sector	16
Figure 4 Energy Consumption	16
Figure 5 WESM Trading Timetable (TRANSCO, 2003).....	18
Figure 6 WESM Operation (D. Rivera, 2014).....	19
Figure 7 Energy generation and consumption from 2001-2014	30

List of Tables

Table 1 The development of power energy in the Philippines from 1972 to present..	11
Table 2 Electricity production from 2001 to 2014.....	12
Table 3 Electricity Generation by resources from 2001 to 2014.....	13
Table 4 Energy Power Consumption by sector from 2010 to 2014.....	15
Table 5 Power Consumption by area from 2003 to 2014	16
Table 6 WESM trading participants in 2012	17
Table 7 Feed-in-Tariff Rate and installation Target in 2012 and 2015	20
Table 8 PDUs average electricity price in Dec 2005	20
Table 9 PDUs average electricity price in Sept 2012	21
Table 10 Generation companies and Independent Power Producers in Philippines....	24
Table 11 Private distribution utilities by area (PSALM, 2012b)	25
Table 12 Electric Cooperatives in Philippines by region (PSALM, 2012b).....	27
Table 13 Value chain in Philippines	28
Table 14 Top power companies in Philippines.....	29

Acronyms and Abbreviations

BOT	Build-Operate-and-Transfer
DOE	Department of Energy
DU's	Distribution Utilities
EPIRA	Energy Power Industry Reform Act
ERC	Energy Regulatory Commission
GENCO	Generation Company
HVDC	High Voltage Direct Current
IPP	Independent Power Producers
MEDP	Missionary Electrification Development Plan
NPC	National Power Corporation
NPC SPRUG	National Power Corporation- Small Power Utilities Group
PSALM	Power Sector Assets and Liabilities Management
PV	Photovoltaic
RCOA	Retail Competition and Open Access
R.A	Republic Act
RE	Renewable Energy
TRANSCO	National Transmission Corporation
WESM	Wholesale Energy Spot Market

Definitions

Aggregators	a person or entity, engaged in consolidating electric power demand of end-users in the contestable market, for the purpose of purchasing and reselling electricity on a group basis
Captive market consumers	end-users who do not have the choice of a supplier of Electricity, as may be determined by the Energy Regulatory Commission (ERC)
Contestable market consumer	the electricity end-users who have a choice of a supplier of electricity, as may be determined by the ERC
Missionary Electrification Development Plan (MEDP)	a detailed master plan or development program for the electrification of existing missionary areas
Independent Power Producer (IPP)	an existing power generating entity, which is not own by NPC
Non-stock government owned corporation	government-controlled corporation where no part of the income for the corporation given as dividends to its members, trustees and officers
Privatization	the sale, disposition, change and transfer of ownership and control of assets and IPP contracts from the Government or a government corporation to a private person or entity.
Restructuring	the process of reorganizing the electric power industry in order to introduce higher efficiency, greater innovation and end-user choice
Stock Corporation	a government profit corporation, which has shareholders, each of whom receives a portion of the ownership of the corporation through shares of stock

1. Introduction

Philippines is an archipelago situated in Southeast Asia and known as the Pearl of the Orient seas for being abundant in natural resources. As time passed by, Philippines improved its economy and people learned to adapt new technologies. The standard of living in the country has changed that increased the demand for electricity.

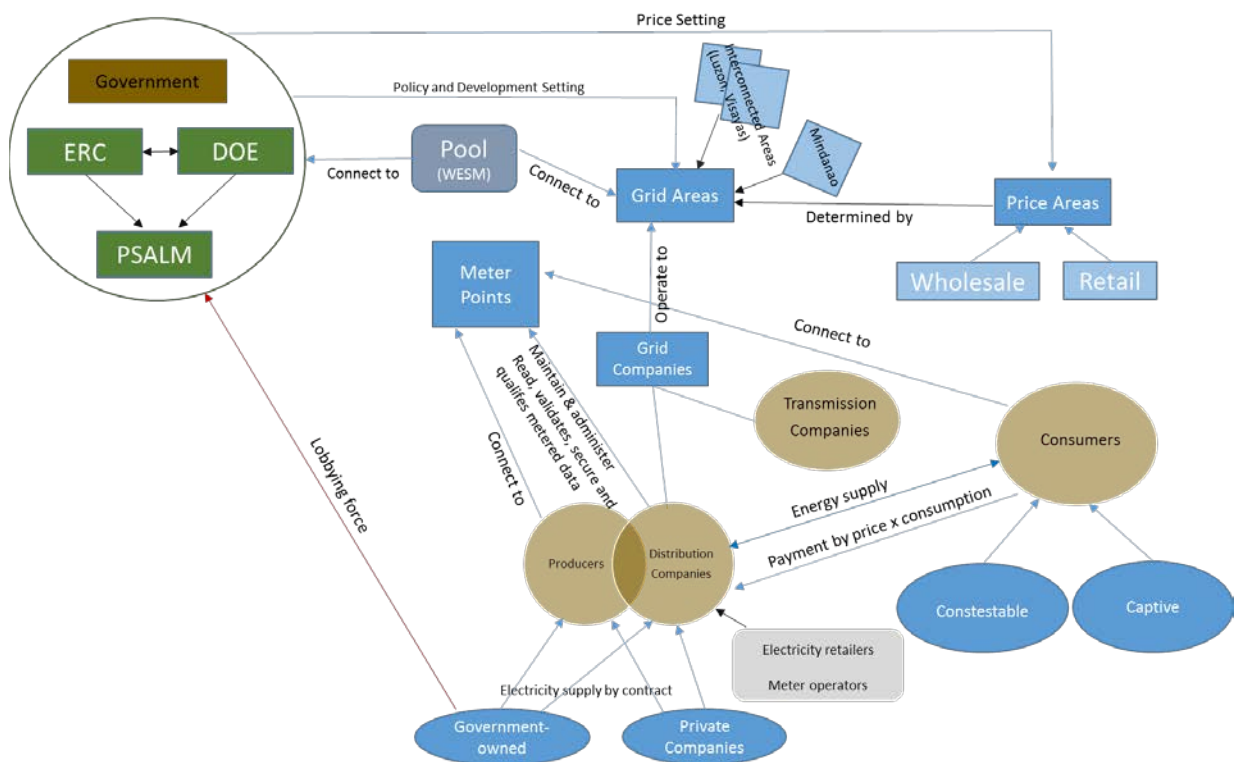
Establishing an electricity system in the Philippines is a big challenge. Geographical location of the country is one thing to consider. Philippines is prone to natural disasters such as typhoons, earthquakes and volcanic eruptions damaging the country's economy and infrastructures. Philippines consisting 7,100 islands, 2800 of which are populated, also create huge challenge in developing the power infrastructure of the country.

The electricity stability is an important aspect that investors take into consideration before investing projects in a certain country. Various researches shows that that Philippines is one of the countries in Asia without electricity subsidy from the government, and therefore electricity price is much higher compared to other ASEAN countries. Another thing is that, private companies like Meralco and Veco dominate power industry in the Philippines. Meralco is the biggest electricity distributor in the country dominating mainly the Luzon area and therefore has the capacity to decide power price. The high demand of energy is an advantage to distribution utilities power like Meralco to increase the power rate further. The high cost of electricity will pushed away foreign investors from the Philippines.

The rapid growth of population in the country is another factor affecting the power industry. Philippines has reached the population of more than 100 million in 2016 definitely affecting the electricity supply. The frequent power outage in early 1990's calls government attention for energy reform. The energy consumption of the country has an average increase of 7% each year. In 2013 to 2014, power consumption reached 152,527 GWh reaching up to the maximum level of the country's energy supply (shown in figure 5).

In addition, Philippines has been depending on fuel to generate electricity. Fuel energy caused pollution and it is costly for the country to import fuel from other countries. The world calls for an action to reduce pollution and produce more energy from renewable resources. Philippines responded to the global challenge by opening its door for clean, sustainable and smarter energy. Under R.A 9316 and R.A 9513, Philippine government took an initiative to increase the energy supply mainly the exploration and utilization of renewable energy.

This report firstly introduces the historical grid development, and then, based on the smart grid business ecosystem in Philippines (shown in Figure below), the main sectors, the stakeholders and electricity markets (wholesale and retail markets) are introduced.



Smart grid business ecosystem in Philippines

2. Historical development of energy system in Philippines

The Department of Energy in the Philippines aims to improve life by providing a sustainable, responsive and environmental-friendly energy (NEDA, 2001). The energy system of the Philippines is divided into 4 sectors: generation, transmission, distribution and consumption (NEDA, 2001). Historically, National Power Corporation (NPC) controls the generation and transmission sectors. National Power Corporation is a government-owned corporation in the Philippines. While Meralco¹ is a private-owned company that acquired the biggest distribution channel of electricity in the country serving 22 cities and 89 municipalities.

There are two remarkable events contributed to the development of Philippine electric power system: Republic Act 9136 (NEDA, 2001) and Republic Act 9513 (ERC, 2009). The R. A 9136 or commonly known as the Electric Power Industry Reform Act of 2001 (EPIRA) and the R.A 9513 is known the Renewable Energy Act of 2008.

Philippines experienced the first taste of electricity during Spanish occupation on 1892 when the first generating plant La Electricista started its operation in Manila using steam power generators serving residential and municipal offices in Manila. Meralco acquired La Electricista in 1904, and then Meralco became the generation and distribution utilities in Manila. Meralco expanded its business by acquiring small electricity company plants to supply electricity to the neighbor provinces. Philippine government established the National Power Corporation (NPC)² under the Commonwealth Act No. 120 as a non-stock government owned corporation on November 3, 1936 and under Republic Act 2641 in 1960, NPC changed into a stock corporation (NPC, 2016). Since then, NPC solely monopolized the electricity generation and transmission until late 1980s.

This chapter describes the three significant periods (pre-reform, reform and EPIRA period) that shaped the smart energy system in Philippines. It also discusses the relevant events and laws implemented as the country developed its smart energy system.

2.1 Pre-reform Period (1972-1986)

President Marcos declared Martial Law on September 21, 1972 and controlled the country including the electricity system. It was on November 7, 1972, under Presidential Decree No. 40 (P.D, 1972) declaring NPC as the only Generation and transmission utility operating the country. Then in 1973, the issuance of Executive Order 269 allowing electric cooperatives to supply electricity mainly in the rural areas under National Electrification Administration (NEA) (P.D., 1973). Thus, under P.D No. 40, Meralco and electric cooperatives buy electricity from NPC. During the NPC monopoly over the power system of the country, the power sector was financially stable and there was enough power to supply the consumers (ADB, 2005).

On February 1986, the Martial Law has ended and Philippines taken over by the new administration. The new government had ordered to close the 260MW Nuclear Power plant in Bataan due to high-cost and safety issues. The report show that there were total of 6 power plants in Luzon that have been stopped to operate and that started the shortage of power supply in the country (ADB, 2005).

¹ <http://www.meralco.com.ph/about-us/history>

² <http://www.napocor.gov.ph/>

2.2 Reform Period (1987-2000)

In order to cope with the power crisis, President Aquino signed E.O 215 on July 10, 1987 to amend P.D No. 40 and allowing the private sectors to generate electricity (LawPhil). On July 9, 1990, Republic Act No. 6957 or commonly known as Build-Operate-and-Transfer scheme (BOT Law) was approved encourage private operators or the Independent Private Producer (IPP's) to finance, construct and operate power plants with an assurance of reasonable return of investment (ADB, 2005). In 1992 and 1993, there were 4 to 8 hours per day of power outage in Luzon area while in Mindanao consumers experienced up to 12 hours power cut per day (ADB, 2005). In order to solve the power crisis in 1993, under R.A 7468 or Power Crisis Act the Philippine government added 1000MW more of installed energy capacity from the IPPs (ADB, 2005).

2.3 EPIRA Period (2001-Present)

The Philippine power crisis from the early 1990s and the piled up debts of NPC owed from domestic and international creditors reaching the total amount of P830.7 billion (USD16.6 billion) in 2001 (PSALM, 2012a) pushed the government to call for power industry reform.

On June 8, 2001, the President of the Philippines approved R.A 9136 or EPIRA LAW under the responsibility of the Department of Energy. The main goals of R.A 9136 are to privatize NPC assets and restructure the entire power industry (NEDA, 2001). R.A 9136 or EPIRA law of 2001 ensures to provide clean and cost- efficient energy (NEDA, 2001).

The Energy Regulatory Commission (ERC) was established under R.A 9136 (NEDA, 2001) to govern, implement energy laws and responsible to issue licenses to private electricity producers (NEDA, 2001). EPIRA also created Private Sector Assets and Liabilities (PSALM), as a government-owned corporation to manage the privatization of NPC assets and the National Transmission Corporation (Transco) that is responsible for NPC transmission assets (NEDA, 2001). While the Congress is responsible for issuing franchise to electricity transmission and distribution entities (NEDA, 2001).

Under Energy Power Industry Reform Act and EPIRA Law, NPC assets, IPP's contract and disposable assets owned by NPC were sold to the private companies excluding selected assets like Agus and Pulangi power plants in Mindanao, which instead transferred under PSALM and still operated by NPC (ERC, 2009). Aside from operating of the two power plants

Under EPIRA, the energy market is open for all IPP's and other private sectors to ensure the reliability and affordability of power in the country (NEDA, 2001). Few years after the establishment of EPIRA, the Department of Energy established the Wholesale Electricity Spot Market (WESM) pursuant to R.A 9136 or EPIRA Law to ensure an open access for energy retailers and wholesalers (NEDA, 2001).

Renewable Energy Act of 2008 under R.A 9513 focuses on exploration, utilization and development of renewable energy like biomass, solar, geothermal, hydropower and ocean energy. In addition, this Act not only encourages the big companies but also the end-users to participate in the movement by generating renewable energy. Renewable energy Act of 2008 offered fiscal and non-fiscal incentives on RE investors. The non-fiscal incentives include FIT, green energy option program and net metering for renewable energy (ERC, 2009)

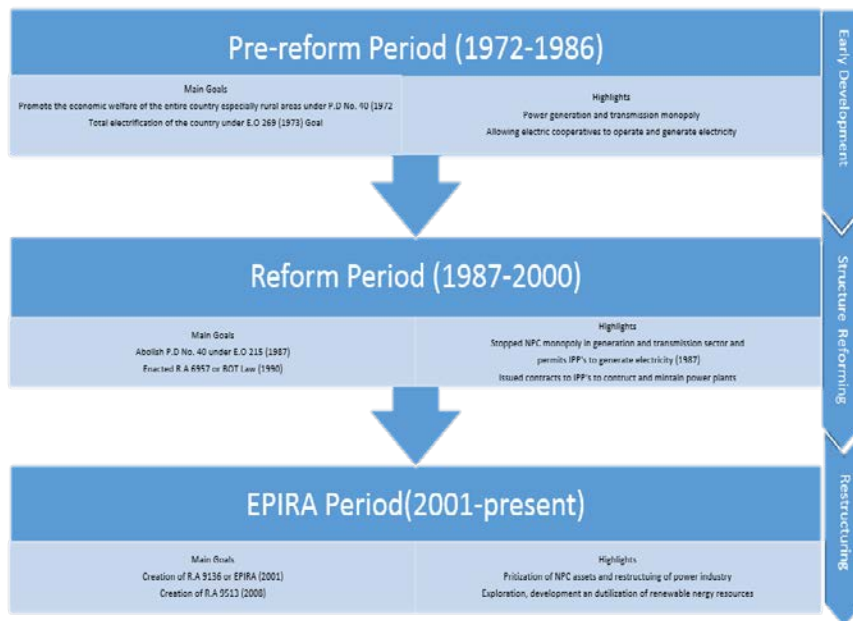


Table 1 The development of power energy in the Philippines from 1972 to present

3. Sectors of the energy system

3.1 Electricity Production

The electricity producers consist of the Generation companies (GENCOs), Independent power producers (IPPs) and NPC- SPRUG.

Under the EPIRA, electricity production sector is an open and competitive market. Luzon, Visayas and Mindanao are the three main islands in the Philippines. There is local electricity producers in each area to cover the local electricity supply. Electricity production in Luzon covers 75.5% of the total electricity production in the Philippines, electricity production in Visayas covers 12.5% and electricity production in Mindanao covers 12% of the total electricity production in Philippines (2001-2002).

Electricity production (GWh)	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
Luzon	72,571	77,389	81,868	87,820	95,222	102,250	111,586
Visayas	11,262	17,858	16,827	16,752	17,799	21,939	22,114
Mindanao	11,685	13,651	14,657	15,862	16,638	17,830	18,828
Total	95,518	108,898	113,352	120,434	129,659	142,019	152,528

Table 2 Electricity production from 2001 to 2014 (GwH)

The renewable energy of the Philippines is generated from hydropower, geothermal, wind, solar and biomass. The table below indicates that the ‘energy smart program of the Philippines’ government’ increases the renewable energy supply each year. The renewable energy resources from wind, solar and biomass generated 74GwH electricity in 2005 to 2006. The electricity generation from these renewable energy resources (wind, solar, biomass) varies each year. For instance, the total renewable generation increased 39% in 2007 to 2008, increased 27% in 2009 to 2010, 73% in 2011 to 2012, and 27% in 2013 to 2014 (shown on table 3).

On the other hand, non-renewable energy in Philippines comes from oil, coal and natural gas. Unfortunately, Philippines is limited in the oil resource, and mainly dependent on the fuel purchase from other countries. Table 3 shows that the non-renewable energy supply increase to 10% (112, 815 GwH) of the total electricity generation in 2013-2014 from 101, 492GwH in 2001-2012. In general, the total electricity production increase in an average of 3 to 8% each year.

Electricity generation by energy source (GwH)		2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
Non-RE								
Oil-based energy	Thermal	4,475	2,611	583	982	2,273	1,207	901
	Diesel	9,034	11,762	9,869	7,822	8,303	6,094	8,535
	Gas Turbines	2,650	1,302	355	1,212	1,905	351	762
	Total	16,159	15,675	10,452	10,016	12,482	7,652	10,199
Natural gas		9,619	25,523	33,227	38,365	39,405	40,233	37,481
Coal		34,917	31,133	30,551	32,586	39,777	53,607	65,135
Non-RE total		60,695	72,331	74,230	80,967	91,664	101,492	112,815
RE								
	Hydro	14,137	16,463	18,326	18,406	17,591	19,950	19,156
	Geothermal	20,684	20,104	20,367	20,938	20,253	20,192	19,913
	Other RE (wind, solar,			74	122	169	464	643

	Biomass)							
Re Total		34,821	36,567	38,767	39,466	38,013	43,606	39,712
Total		95,516	108,897	113,352	120,433	129,677	142,098	152,527

Table 3 Electricity Generation by resources from 2001 to 2014 (units: GWh) (DOE, 2014a)

3.2 Energy transmission

The high-voltage transmission lines of the National Grid Corporation of the Philippines (NGCP) interconnect between islands. The transmission companies are responsible for developing the transmission lines in Philippines (NEDA, 2001). Under the EPIRA Law, Energy Regulatory Commission (ERC) sets up standards to distinguish the overhead voltage transmission lines from the sub-transmission assets: 230 KV and above in the Luzon grid, 138-230 KV in the Mindanao grid. There are only 69KV transmission lines in the Visayas region and other isolated grid areas that are below the transmission voltage standard and are part of the sub-transmission system (NEDA, 2001). Other islands that do not connect to the national grid are defined as the missionary areas. The government owned Small Power Utilities Group (NPC-SPUG)³ supplies electricity to the missionary areas (NEDA, 2001).

In 2009, National Transmission Corporation (TRANSCO) granted 25 years contract to the National Grid Corporation of the Philippines (NGCP) to operate and maintain the transmission system in Philippines. NGCP is a private-owned company that manages a transmission lines of over 19,490 circuit- kilometers and sub-station capacity of 27,726 MV from Luzon to Mindanao (PSALM, 2012c).

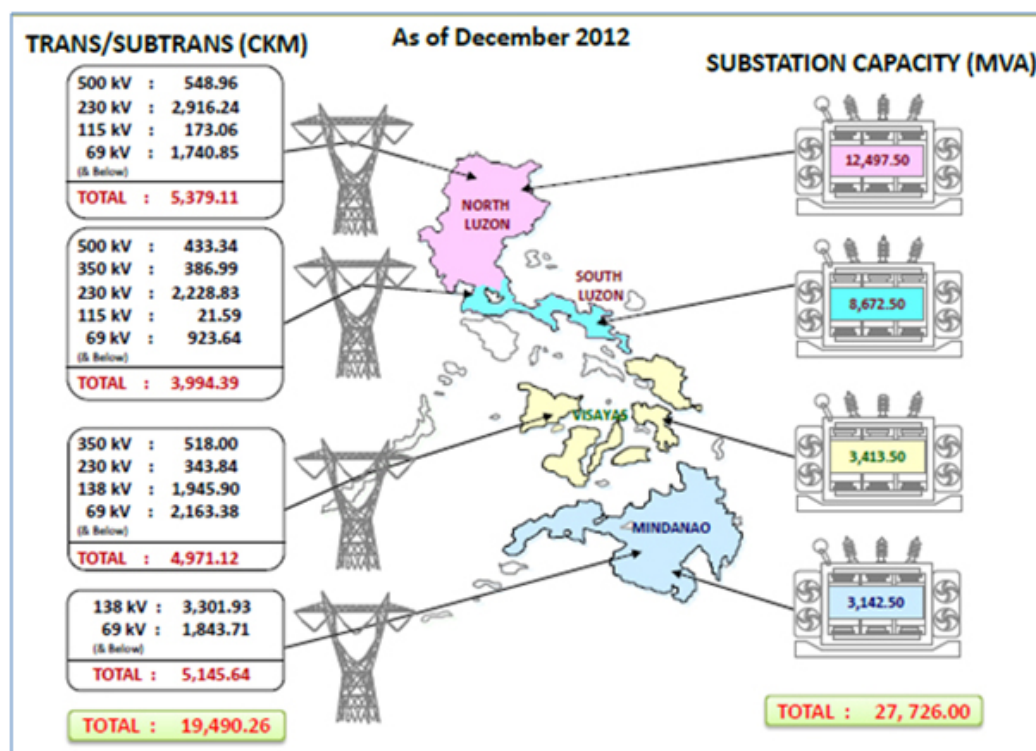


Figure 1 Transmission lines capacity

(PSALM, 2012c)

Currently, only single transmission line connecting Luzon and Visayas that started its operation in 1998. It is a Luzon-Leyte HVDC link transmitting bulk of geothermal power

³ <http://www.spug.ph/>

from Leyte to Luzon, feeding the AC grid in the Manila region (ALLAIRE et al.). The HVDC link is consist of three sections: 256Km from Leyte to Samar overhead lines, 23Km submarine cable crossing the San Bernardino Strait in Samar (Visayas) to Sorsogon in Camarines Sur (Luzon) and 176Km overhead lines in Luzon. The HVDC link has a power rating of 440MW with DC voltage of 350kVDC from 230kVAC end (ALLAIRE et al.).



Figure 2 Luzon-Visayas HDVC link

(ALLAIRE et al.)

Moreover, NGCP is seeking an approval from ERC to establish submarine cables between Visayas and Mindanao to share the excess electricity from Luzon and Visayas. The project is supposed to resume from 2016 to 2018, and adds 2,400MW electricity capacity in Mindanao (D. Rivera, 2015).

3.3 Energy distribution and supply

Distribution utilities in Philippines is consist of privately owned distribution utilities (PUs) and Electric Cooperatives (ECs). The privately owned distribution utilities (PUs) are required to apply and receive the franchise from the National Congress for the electricity production and distribution. While the renewals and cancellation of the government-owned ECs are under the responsibility of National Electrification Administration (NEA).

The electricity retail tariffs are regulated by ERC in accordance to the principles of EPIRA (EPIRA Law started in 2001 and Renewable Energy Act enacted in 2008 to increase energy supply and offer cost-efficient power in Philippines(NEDA, 2001).

However, tariffs for the electricity suppliers to contestable markets are not subject to the ERC regulation. Meralco, Veco and Electric Cooperatives are the main players in the distribution sector. Veco, the second biggest distribution company in the Philippines covers the Visayas areas. Visayas belongs to the sub-transmission line with 69kV transmitting power, and there are 13 distribution substations from the VECO⁴ electricity company with a total capacity of 410MV in this area. From the substations, distribution lines are operating at medium-voltage levels of 23kV, 13.8kV and 4.16kV disperse the power throughout Cebu City and nearby

⁴ <http://www.vecocom.ph/page.html?main=efficiency&sub1=about%20energy>

municipalities. The end-users receive a low-voltage electricity between 220 to 440V. There are additional branch circuits for the industrial and commercial establishments for heating, ventilation and air-conditioning.

3.4 Energy consumption

R.A 9136/ EPIRA defines two types of electricity consumers: contestable consumers and captive consumers. In general, the monthly average consumption of the contestable consumers is at least 1MW in the first 12 months and then can be reduced to 750kW after 2 years. Contestable consumers are also allowed to choose electricity suppliers from the registered companies from the WESM list (NEDA, 2001). On the other hand, aggregators are allowed to sell electricity to end-users whose aggregated demand in a contiguous area is at least 750kW. The captive consumers are the end-users that consume less electricity compared to the contestable consumers, cannot choose electricity suppliers, and their default electricity suppliers are as determined by ERC (NEDA, 2001). The captive consumers are usually the households.

The electricity end-users consist of residential, commercial, and industrial end-users. The electricity consumption and losses of the utility companies are included in the total electricity consumption in Philippines per year that reached 4,124,000 MWh (equals to 4.3% of the total energy consumption), and the electricity losses during generation and transmission processes reached 17,752,000 MWh (equals to 14.26% of the total electricity consumption).

The industrial sector has the highest electricity consumption among other sectors, which consumed 28,080,000 MWh electricity in 2001-2002, is 30% of the total energy consumption in Philippines. Moreover, the industrial sector consumed roughly 27% of the total electricity each year from 2005 to 2014 (shown on table 4).

The residential consumers have the second highest electricity consumption in Philippines from 2001 to 2014 (as shown in table 3). The residential electricity consumption reached 27,262,000 MWh equals to 28.5% of the total energy consumption between 2001 and 2014. Utilities own used of energy. Meanwhile, the Commercial sector shares 21% to 24% of the total energy consumption (shown in figure 1 and 2).

The electricity losses during the electricity transmission and distribution increase each year in Philippines. For instance, in 2003 to 2004, the electricity losses took 14% of the total electricity consumption (shown on table 4). There is an average of 11.5% electricity losses in Philippines from 2010 to 2014. The electricity losses in Philippines are higher compared to US and Denmark where only 6% in 2011 (WorldBank, 2016). Reducing the power losses will enhance electrical efficiency and reduce power waste.

Consumption (MWh)	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
Residential	27,262,000	31,276,819	31,861,559	33,019,819	36,336,751	38,388,442	41,582,589
Commercial	20,207,000	22,891,227	24,924,495	27,606,418	31,016,766	34,410,056	37,064,534
Industrial	28,080,000	30,200,285	31,593,301	33,552,620	35,660,734	39,404,926	42,105,466
Others	2,214,000	2,427,621	24,522,220	3,036,294	3,119,358	3,113,784	4,157,808
Electricity Sales	77,763,000	86,795,953	90,831,575	97,215,151	106,133,609	115,317,208	124,910,397
Utilities own use	4,124,000	8,064,377	8,818,610	7,929,016	8,201,186	10,749,632	12,605,236
Power Losses	13,628,000	14,037,637	13,701,686	15,288,605	15,342,394	16,039,820	15,011,206
Total	95,515,000	108,897,967	113,351,877	120,432,772	129,677,189	142,106,660	152,526,839

Table 4 Energy Power Consumption by sector from 2010 to 2014

(DOE, 2014a)

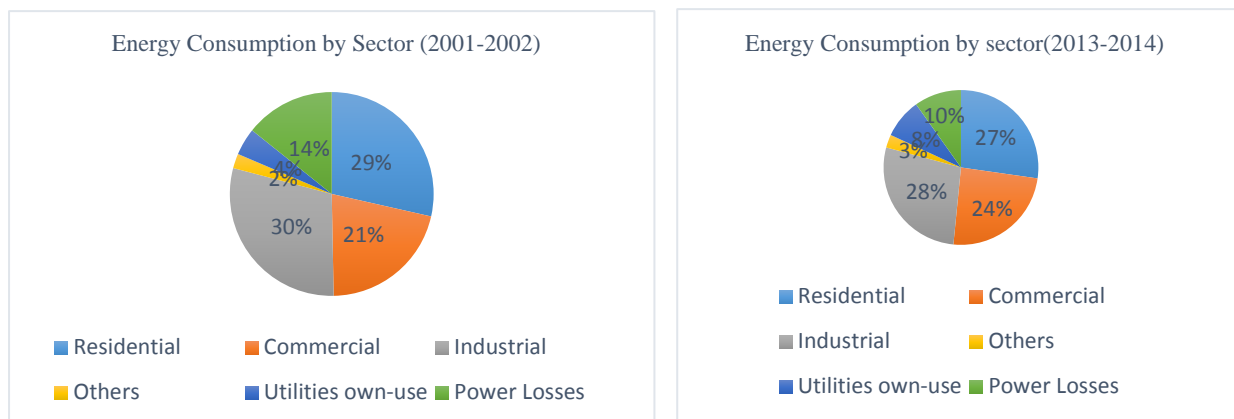


Figure 3 Energy consumption by sector

The Philippines electricity consumption is mainly in Luzon that consumed 76% or 82,874,657MWh of electricity in 2003 to 2004 (shown in figure 3). Luzon has the biggest electricity consumption area, and consumed 113,224,524MWh or 74% of the total electricity consumption in 2013 to 2014 (shown in figure 4). Moreover, Visayas and Mindanao consumed 14% and 12% of the total energy consumption in Philippines (shown in table 5).

Consumption by Area (Mwh)	2003- 2004	2005-2006	2007-2008	2009-2010	2011-2012	2013-2014
Luzon	82,874,657	84,987,151	89,656,533	95,957,302	104,687,824	113,224,524
Visayas	12,425,290	13,708,111	14,914,200	17,081,842	19,580,317	20,474,993
Mindanao	13,598,020	14,656,608	15,862,039	16,638,047	17,829,519	18,827,323
Total	108,897,967	113,351,870	120,482,772	129,677,191	142,097,660	152,526,840

Table 5 Power Consumption by area from 2003 to 2014

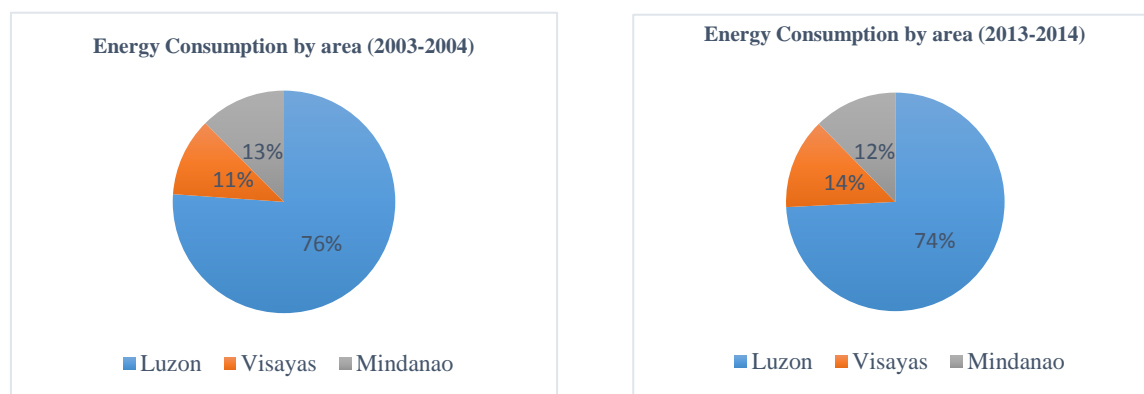


Figure 4 Energy Consumption

4. Electricity market

The electricity market in Philippines can be divided into the wholesale market and retail market:

4.1 Electricity wholesale market

Concerning to the wholesale market, Philippines established a Wholesale Spot Market (WESM) that serves as a centralized dispatch market based on offers from suppliers and bids from customers. The Wholesale Spot Market (WESM) is a platform of electricity trading that involves the trading between generators, network service producers, suppliers and buyers (DOE, 2012). WESM started its operation on 2006 in Luzon and 2010 in Visayas (DOE, 2012). Mindanao will be able to participate on WESM after the construction of submarine cables connecting Visayas and Mindanao.

Department of Energy is mandated not only establish WESM but also in planning and implementing rules (DOE, 2014c). The Philippine Energy Market Corporation (PEMC) administers the retail competition in WESM and facilitates the customers switching between suppliers (DOE, 2014c). In June 2013, the Retail Competition and Open Access (RCOA) was established (DOE, 2013) to take protect the rights of the retail customers. For instance, under RCOA, retail customers can establish contracts with authorized energy suppliers (DOE, 2014c). Only the registered pool members under ERC can participate in the energy trading (DOE, 2014c). Table 6 shows that in 2012, out of 251 expected trading participants only 124 trading participants are registered (shown on table 8). The 124 WESM registered participants consist of 47 generating companies and 77 customer-trading utilities. The customer trading participants are comprised of 6 Private Distribution Utilities (PDUs), 26 Electric Cooperatives (ECs), 13 bulk end-users and 7 wholesale aggregators (DOE, 2012).

Participants		Expected Participants	Registered Participants
Generation Companies		54	47
Customer Trading Participants	PDUs and LGUs	16	6
	ECs	72	51
	Bulk users	102	13
	Wholesale aggregators	7	7
Total participants		251	124

Table 6 WESM trading participants in 2012

(DOE, 2012)

WESM players include the Market Operator (MO), System Operator (SO), transmission provider, Distribution Utilities (DU's), directly connected customers, and suppliers. Trading participants, mainly GENCOs submit bid to sell energy on an hourly basis. The prices are ranked from the highest to lowest bid. PEMC serves as the Market Operator that administers the operation of the WESM. Market Operator determines the dispatch schedule for each hour and then submits it to the System Operator. System Operator is responsible for central dispatch and ensures the security and reliability of the trading system at all times. The TRANSCO serves Network Service Provider that provides and maintains the trading infrastructure (e.g. transmission network and associated facilities) necessary to transmit the electricity. Distribution Utilities are directly connected to the consumers and suppliers through WESM (TRANSCO, 2003).

WESM is a real-time energy market, wherein the generation schedules to meet customers' demand for each hour of the day. WESM timetable is divided into 2 periods: Dispatch period and settlement period (TRANSCO, 2003):

Dispatch period consists of three different stages: one week ahead, pre-dispatch and real time. One week ahead, the market operator provides 7 days forecast to provide views on the market prices and demands for electricity. The forecast is based on the 7 days hourly bids and offers submitted by the trading participants started at 1200H prior to start the week ahead market. The purpose of the forecast is to give the trading participants' time to plan their activities and in particular for Generators to plan their unit commitment schedules. If ever the trading participants failed to submit the appropriate bids then the market operator will substitute a set of default data. Pre-Dispatch activity occurs a day before the real time. The forecast market prices is presented every 4 hours within 24 hours before the dispatch to allow the participants to prepare for the next day schedule. The pre-dispatch always starts with the most recent bids submitted by participants, and uses the most up to date demand forecast network status and generator loading information available from the MO. The cut off of the trading participants to submit hourly bids and offers for the trading interval is 4 hours before the real-time dispatch to allow time for SO to conduct security screening. If there is no revision then it will proceed to the real time dispatch. The real time dispatch runs 5 minutes before the start of the next hour. Real time dispatch provides the prices, which will be used in the settlement. The schedules produced during the real time dispatch is presented to the MO trading site. All trading participants are required to operate in accordance with schedules. In general, the trading is an hourly basis producing 24 prices daily.

Settlement period: The settlement period is divided into two stages: initial settlement and final settlement. The system operator (SO) will read all the meters and send it to the MO to settle the market prices. Once the data is available, the MO will perform initial settlement informing the payments of individual participants. The purpose of initial settlement is to give participants an advance time to agree with the sums before the final settlements took place. After the initial settlement, the participants are given some time to review the results and raise any concerns to the MO. Within 18 days, the MO published the final settlement statements. The settlement amounts acquired by the trading participants is paid within 30 days after the billing period or 12 days after the issuance of the final statement.

A week ahead there is a daily Market forecast for next 7 days in hourly intervals	Pre-dispatch occurs every 4 hours within 24 hours (Starts at 1200H)	Real Time Dispatch every hour (5 minutes prior to start the next hour)	Initial Settlement Statement Published by the MO within 7 working days after the end of each billing	Within 18 working days, MO shall prepare the Final settlement The Market clears and all moneys are paid into the market within 12 working days after the issuance of final settlement
Dispatch Period (D-1)			Settlement Period	

Figure 5 WESM Trading Timetable (TRANSCO, 2003)

How WESM works



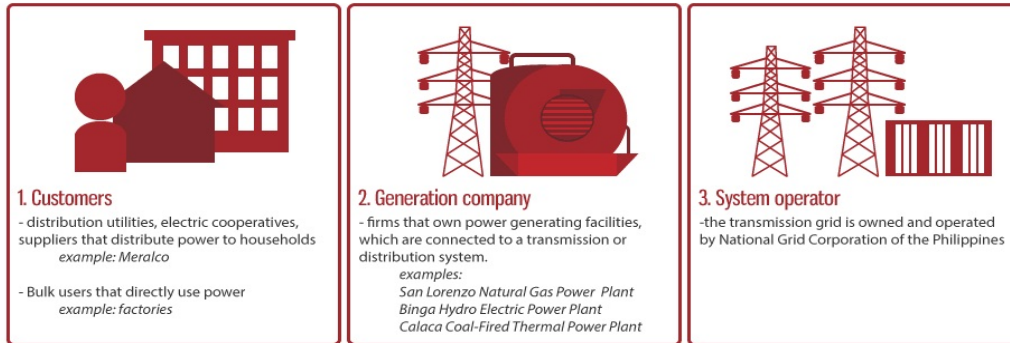
What is WESM?

The wholesale electricity spot market (WESM), created under Republic Act No. 9136 or the Electric Power Industry Reform Act (EPIRA) of 2001, is where trading of electricity is done.

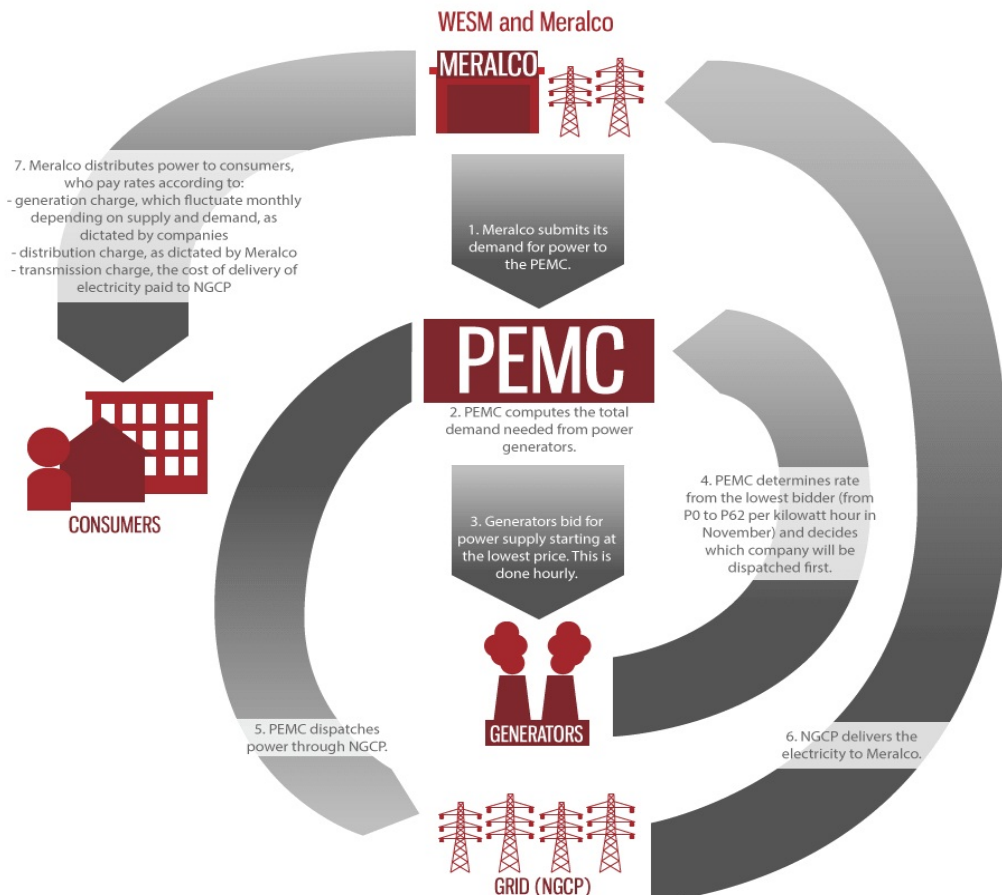
Who is responsible for WESM operation?

The Philippine Electricity Market Corporation (PEMC) is a non-stock, non-profit organization made up of representatives from the various sectors of the electric power industry that acts as the market operator of WESM.

Who can participate in WESM?



A WESM Member should be registered with PEMC to be able to participate in trading and injecting power into the grid.



Sources: Wholesale Electricity Spot Market, Energy Regulatory Commission, Department of Energy
 Text by Danessa Rivera
 Design by Analyn Perez

Figure 6 WESM Operation (D. Rivera, 2014)

4.2 Electricity retail market

The electricity retail market in Philippines is an open access market. The retail market law is established under EPIRA by offering Feed-in-Tariff (FIT) in 2008 (ERC, 2009), and implemented since 2012. The FIT scheme is a non-fiscal incentive encouraging investors to produce renewable energy while reducing the electricity burden of the end users. The FIT scheme allows renewable energy investors to recover the investment cost during the given 12 years FIT period (ERC, 2009).

Electricity price differs across areas in Philippines. The distribution utilities decide the electricity retail price, and the price differs based on the end users' types, such as industrial, commercial and residential end users. There are various electricity price among customers. (shown on table 8 and 9). In Visayas, the residential consumers got the highest electricity price compared to commercial and industrial consumers. In Mindanao, the residential consumers pay the lowest electricity rate compared to industrial and commercial consumers. Meralco is the biggest distribution utility in the country serving more than 5 million power consumers. VECO⁵ is the second largest distribution utility in the country and mainly operate in Visayas region. The electricity price in Visayas is cheaper compare to Luzon. Mindanao gets the cheapest electricity price especially the residential consumers operated by mostly electricity cooperatives.

The electricity rate is increasing each year. In 2005, few years after the enactment of EPIRA, the average residential electricity price was P7.10/kWh, commercial price was P7.26/kWh and the industrial price was P6.29/kWh (shown in table 8). According to the statistics for September 2012, the average residential electricity price was P8.72/ kWh, the commercial electricity price was P 9.14/kWh and industrial price was P 6.87/kWh (shown in table 8). Residential area in Luzon charged the highest rate compare to the residential areas in Visayas and Mindanao, and the average rate in 2005 is P6.88/kWh and P8.23/kWh in 2012.

Through the net metering system, the end-users can produce electricity form home or offices using photovoltaic system connected to the Distribution Utilities' grid (ERC, 2009). In 2012, the ERC approved FIT initial rates of P8.53/kWh for 200MW on Wind, P6.63 /kWh for 250MW on Biomass, P9.68 kWh for 50MW on solar and P5.90 kWh for 200MW on hydro. And in 2015, ERC announced the new solar FIT rate is P8.69 71MW expanded from 50MW in 2012 to 500MW and validated until March 15, 2016 (R. Olchondra, 2015). Other renewable installations tariffs remain the same (IEA, 2015).

	2012 Rate in Pesos	Installation Target (MW)	2015 Rate in Pesos	Installation Target (MW)
Solar	9.68	50	8.69	500
Wind	8.53	200	8.53	200
Biomass	6.63	250	6.63	250
Run-of-river Hydro	5.90	250	5.90	250

Table 7 Feed-in-Tariff Rate and installation Target in 2012 and 2015

	Residential	Commercial	Industrial	Average
Luzon	7.70	7.57	6.70	7.32
Visayas	5.87	6.04	5.82	5.91
Mindanao	4.58	4.81	4.59	4.66
Philippines	7.10	7.26	6.29	6.88

Table 8 PDUs average electricity price in Dec 2005

(unit: Pesos /kWh) (DOE, 2005)

⁵ <http://www.veco.com.ph/page.html?main=company&sub1=profile&sub2=History>

	Residential	Commercial	Industrial	Average
Luzon	10.64	9.33	7.50	9.15
Visayas	8.95	8.87	7.43	8.41
Mindanao	6.56	9.23	5.68	7.15
Philippines	8.72	9.14	6.87	8.23

Table 9 PDUs average electricity price in Sept 2012

(unit: Pesos /kWh) (DOE, 2012)

5. Stakeholders in the smart energy system

5.1 Power Producers

Producers are the power generators that produce renewable and non-renewable energy in the country including the private power plants or IPP's, NPC-SPUG and GENCOs. Only registered WESM members are connected to the meter points. The meter points can validate and secure information regarding the activities of the consumer and monitor the condition of the grid within the covered areas. IPP's supply power to NPC and other distribution utilities. NPC-SPUG supplies electric power to cooperatives on remote areas not covered by the national grid. For instance, Palawan Island is not covered by the national grid and considered as missionary area. Therefore, NPC-SPUG and three other IPP's are the power suppliers to Palawan Electric Cooperative (PALECO) ⁶. In 2009, 120 generation companies and Independent Power Producers in Philippines (empowerconsumers, 2009). The 31 NPC-owned generation plants are contracted to private IPPs.

Independent Power Producers (IPPs)	Type
1. Cebu Private Power Corporation	
2. East Asia Utilities Corporation	
3. Duracom Mobile Power Corporation	
4. East Asia Diesel Power Corporation	
5. Angeles Power Inc.	
6. ORMAT Leyte Co., Ltd.	
7. Quezon Power (Philippines), Limited Co.	
8. Panay Power Corporation	
9. Bauang Private Power Corporation	
10. Magellan Cogeneration, Inc.	
11. Edison (Bataan) Cogeneration Corporation, Inc.	
12. Trans-Asia Power Generation Corporation	
13. Mindanao Energy Systems, Inc. (MINERGY)	
14. Luzon Hydro Corporation	
15. CIP II Power Corporation	
16. Northern Mindanao Power Corporation	
17. Western Mindanao Power Corporation	
18. Southern Philippines Power Corporation	
19. EEI – Power Corporation	
20. Mindanao II Geothermal Partnership	
21. Mindanao I Geothermal Partnership	
22. PNOC Exploration Corp.	
23. First Gas Power Corporation (Sta. Rita)	
24. Northern Mini Hydro Corporation	
25. Hydroelectric Development Corporation	
26. Island Power Corporation	
27. Tarlac Power Corporation	
28. Mirant Sual Corporation	
29. Mirant Pagbilao Corporation	
30. Mirant Island Generation Corporation	
31. Mirant Navotas II Corporation	
32. KEPCO Philippines Corporation (KEPHILCO) Thermal Power Plant	
33. First Cabanatuan Ventures Corporation	
34. CBK Power Company Ltd (Kalayaan I Pumped Storage Power Plant)	
35. CBK Power Company Ltd (Caliraya Hysroelectric Power Plant)	
36. CBK Power Company Ltd (Botocan Hysroelectric Power Plant)	
37. San Roque Power Corporation	

⁶ <http://www.paleco.net/>

38. Toledo Power Company	
39. Delta P., Inc.	
40. Lazard Power Corporation	
41. Cagayan Electric Power and Light Company, Inc. (Solar Photovoltaic Plant)	
42. Coral Bay Nickel Corporation	
43. Bubunawan Power Company, Inc.	
44. Subic Power Corporation (ENRON Power Corporation)	
45. Sorsogon II Electric Cooperative, Inc (Cawayan HEPP)	
46. Hydro Electric Development Corp (change of ownership Talomo HEPP)	
47. FG Bukidnon Power Corp. (change of ownership – Agusan HEPP)	
48. Trans-Asia Oil and Energy Development Corporation	
49. Sta. Clara Power Corp. (Loboc Hydroelectric Power Plant)	
50. National Power Corporation-Masinloc Coal Fired Thermal Power Plant	NPC-owned
51. NorthWind Power Development Corporation	
52. National Power Corporation-Leyte Geothermal Power Plant	NPC-owned
53. National Power Corporation-Masinloc Coal Fired Thermal Power Plant	
54. Ilocos Norte Electric Cooperative , Incorporated (Agua Grande Mini Hydro Power Plant)	
55. CE Casecan Water and Energy Co., Inc.	
56. National Power Corporation – Angat Hydroelectric Power Plant	NPC-owned
57. First Gas Power Corporation’s San Lorenzo Combined Cycle Power Plant	
58. CE Cebu Geothermal Power Company, Inc. (Upper Mahiao Geothermal Power Plant)	
59. Visayas Geothermal Power Company	
60. CE Luzon Geothermal Power Company, Inc.	
61. Avon River Holdings, Corporation	
62. Avon River Holdings, Corporation	
63. Avon River Holdings, Corporation	
64. CBK Power Company Ltd (Kalayaan II Pumped Storage Power Plant)	
65. Batangas Coal-Fired Thermal Power Plant	NPC-owned
66. Bacon-Manito Geothermal Power Plant Complex	NPC-owned
67. KEPCO Ilijan Corporation (KEILCO)	
68. People’s Energy Services (Barit Hydroelectric Power Plant	
69. Palinpinon Geothermal Power Plant I and II	NPC-owned
70. Angeles Electric Corporation (Petersville Power Plant)	
71. Binga Hydroelectric Power Plant	
72. Mid-Islands Power Generation Corporation	
73. Bohol Diesel Power Plant	NPC-owned
74. Magat River Hydroelectric Power Plant	NPC-owned
75. Pantabangan Hydroelectric Power Plant	NPC-owned
76. Davao Light and Power Company-Bajada Diesel Power Plant	
77. Masiway Hydroelectric Power Plant	NPC-owned
78. Tiwi Geothermal Power Plant	NPC-owned
79. Agus 6 Hydroelectric Power Plant	NPC-owned
80. Agus 7 Hydroelectric Power Plant	NPC-owned
81. Power Barge 102	NPC-owned
82. Pulangi IV Hydroelectric Power Plant	NPC-owned
83. Agus 4 Hydroelectric Power Plant	NPC-owned
84. Agus 5 Hydroelectric Power Plant	NPC-owned
85. Agus 1 Hydroelectric Power Plant	NPC-owned
86. Agus 2 Hydroelectric Power Plant	NPC-owned
87. Ormat-Makban Geothermal Power Plant	NPC-owned
88. Power Barge 117 – Diesel Power Plant	NPC-owned
89. Diesel Power Barge 101	NPC-owned
90. Amlan Hydroelectric Power Plant	NPC-owned
91. Iligan Diesel Power Plant	NPC-owned
92. Limay Combined Cycle Power Plant	NPC-owned
93. Lubang Electric Cooperative, Inc.-Cabra Diesel Power Plant	
94. Panay Electric Company, Inc.	
95. Power Barge 118	NPC-owned
96. Bohol I Electric Cooperative, Inc.-Janopol Mini-Hydroelectric Power Plant	
97. Panay Diesel Power Plant 1	
98. Samar I Electric Cooperative, Inc. -Ton-ok Mini Hydroelectric Power Plant	
99. National Power Corporation – Naga Power Plant Complex	NPC-owned
100. National Power Corporation-Power Barge 104	NPC-owned

101. Oriental Mindoro Electric Cooperative, Inc.-Dulangan Mini-hydroelectric Power Plant	
102. Linberg Philippines, Inc. – Philips Semiconductors, Inc., Light Industry and Science Park I	
103. Linberg Philippines, Inc. – Philips Semiconductors, Inc., Light Industry and Science Park II	
104. Navotas I Gas Turbine Power Plant	NPC-owned
105. Asia Pacific Energy Corporation (APEC)	
106. BOHECO I – Bagong Banwa Diesel Power Plant	
107. BOHECO I – Balicasag Diesel Power Plant	
108. BOHECO I – Batasan Diesel Power Plant	
109. BOHECO I – Bilangbilangan Diesel Power Plant	
110. BOHECO I – Cabilao Diesel Power Plant	
111. BOHECO I – Cuaming Diesel Power Plant	
112. BOHECO I – Hambongan Diesel Power Plant	
113. BOHECO I – Mantatao Diesel Power Plant	
114. BOHECO I – Mocaboc Diesel Power Plant	
115. BOHECO I -Pamilacan Diesel Power Plant	
116. BOHECO I – Pangapasan Diesel Power Plant	
117. BOHECO I – Ubay Diesel Power Plant	
118. Bicol Hydropower Corporation	
119. CEBECO I – Mantayupan Mini-hydroelectric power plant	
120. STEAG State Power, Inc. IPP L001	

Table 10 Generation companies and Independent Power Producers in Philippines

(empowerconsumers, 2009)

5.2 Grid Companies

Luzon, Visayas and Mindanao are the three national grid areas in the country. Luzon and Visayas grids are interconnected through HDVC link. The development of submarine cable in Mindanao is ongoing and expected to finish on 2018. Electricity prices in each grid areas are classified between wholesale and retail price, which is set in the market spot area mainly in WESM. The transmission of power to the missionary areas or SPUG are under the responsibility of NPC. The Grid Companies are the transmission companies that build and manage the transmission lines and deliver high power voltage electricity from the power generators to the distribution lines. National Grid Corporation of the Philippines (NGCP)⁷ is the official transmission company in the country providing overhead transmission lines and the approved as WESM official spot metering service provider.

5.3 Distribution Companies

The distribution companies are the DU's and EC's that supply electricity to the end-consumers using low voltage wires. The power rates imposed by the distribution companies varies on grid areas and are subject to ERC regulation. There are 156 distribution utilities in the country supplying power to the end consumers (PSALM, 2012b). There are 21 private distribution utilities in the country and 135 electric cooperatives (shown in table 11 and 12).

Meralco is the most dominant power distributor in the country serving more than 5 million power consumers mainly in Luzon area. VECO is the second biggest electricity distribution company operating in Visayas region and more than 100 electric cooperatives that supply power to the end consumers in the area of responsibility.

⁷ <http://www.ngcp.ph/corporate.asp>

Private utilities by Area (21)		
Luzon (13)	Visayas (4)	Mindanao(4)
Angeles Electric Corporation	Bohol Light Co., Inc.	Cagayan Electric Power and Light Co., Inc.
Cabanatuan Electric Corporation	Mactan Electric Company	Cotabato Light and Power Co., Inc.
Dagupan Electric Corporation	Panay Electric Co., Inc.	Davao Light and Power Co., Inc
Ibaan Electric and Engineering Corporation	Visayan Electric Co., Inc	Iligan Light and Power Co., Inc.
Manila Electric Company		
La Union Electric Co.		
Public Utilities Department - Olongapo		
San Fernando Electric Light and Power Co., Inc		
Tarlac Electric, Inc		
Clark Electric Distribution Corporation		
San Fernando Electric Light and Power Co., Inc.-Florida		
Lima Utilities Corporation		
First Bay Power Corporation		

Table 11 Private distribution utilities by area (PSALM, 2012b)

Luzon Area (52)	
Region 1 (6)	
	Central Pangasinan Electric Cooperative, Inc
	Ilocos Norte Electric Cooperative, Inc.
	Ilocos Sur Electric Cooperative, Inc.
	La Union Electric Cooperative, Inc.
	Pangasinan I Electric Cooperative, Inc.
	Pangasinan III Electric Cooperative, Inc.
Region 2 (7)	Batanes Electric Cooperative, Inc.
	Cagayan I Electric Cooperative, Inc
	Cagayan II Electric Cooperative, Inc
	Isabela I Electric Cooperative, Inc
	Isabela II Electric Cooperative, Inc.
	Nueva Vizcaya Electric Cooperative, Inc.
	Quirino Electric Cooperative, Inc
Region 3 (14)	Aurora Electric Cooperative, Inc.
	Nueva Ecija I Electric Cooperative, Inc.
	Pampanga I Electric Cooperative, Inc.
	Pampanga II Electric Cooperative, Inc.
	Pampanga III Electric Cooperative, Inc.
	Peninsula Electric Cooperative, Inc.
	Pampanga Rural Electric Service Cooperative, Inc.
	San Jose City Electric Cooperative, Inc.
	Tarlac I Electric Cooperative, Inc.
	Tarlac II Electric Cooperative, Inc.
	Zambales I Electric Cooperative, Inc.
	Zambales II Electric Cooperative, Inc.
	Nueva Ecija II Electric Coop., Inc.- Area 1
	Nueva Ecija II Electric Coop., Inc.- Area 2
Region 4-A (5)	Batangas I Electric Cooperative, Inc.
	Batangas II Electric Cooperative, Inc.
	First Laguna Electric Cooperative, Inc.
	Quezon I Electric Cooperative, Inc.
	Quezon II Electric Cooperative, Inc.
Region 4-B (8)	Busuanga Island Electric Cooperative, Inc.
	Lubang Electric Cooperative, Inc.
	Marinduque Electric Cooperative, Inc.
	Occidental Mindoro Electric Cooperative, Inc.
	Oriental Mindoro Electric Cooperative, Inc.
	Palawan Electric Cooperative, Inc.

	Romblon Electric Cooperative, Inc.
	Tablas Island Electric Cooperative, Inc.
Region 5 (12)	Albay Electric Cooperative, Inc.
	Camarines Norte Electric Cooperative, Inc.
	Camarines Sur I Electric Cooperative, Inc.
	Camarines Sur II Electric Cooperative, Inc.
	Camarines Sur III Electric Cooperative, Inc.
	Camarines Sur IV Electric Cooperative, Inc.
	First Catanduanes Electric Cooperative, Inc.
	Sorsogon II Electric Cooperative, Inc.
	Ticao Island Electric Cooperative, Inc.
	Masbate Electric Cooperative, Inc.
	Sorsogon I Electric Cooperative, Inc.
	Albay Power & Energy Corporation
Visayas (32)	
Region 6 (10)	Aklan Electric Cooperative, Inc.
	Antique Electric Cooperative, Inc.
	Capiz Electric Cooperative, Inc.
	Central Negros Electric Cooperative, Inc.
	Guimaras Electric Cooperative, Inc.
	Iloilo I Electric Cooperative, Inc.
	Iloilo II Electric Cooperative, Inc.
	Iloilo III Electric Cooperative, Inc.
	Negros Occidental Electric Cooperative, Inc.
	Northern Negros Electric Cooperative
Region 7(10)	Bantayan Electric Cooperative, Inc.
	Bohol I Electric Cooperative, Inc.
	Bohol II Electric Cooperative, Inc.
	Cebu I Electric Cooperative, Inc.
	Cebu II Electric Cooperative, Inc.
	Cebu III Electric Cooperative, Inc.
	Camotes Electric Cooperative, Inc.
	Negros Oriental I Electric Cooperative, Inc.
	Negros Oriental II Electric Cooperative, Inc.
	Province of Siquijor Electric Cooperative, Inc.
Region 8 (12)	Biliran Electric Cooperative, Inc.
	Don Orestes Electric Cooperative, Inc.
	Eastern Samar Electric Cooperative, Inc.
	Leyte II Electric Cooperative, Inc.
	Leyte III Electric Cooperative, Inc.
	Leyte IV Electric Cooperative, Inc.
	Leyte V Electric Cooperative, Inc.
	Northern Samar Electric Cooperative, Inc.
	Samar I Electric Cooperative, Inc.
	Samar II Electric Cooperative, Inc.
	Southern Leyte Electric Cooperative, Inc.
	Maripipi Multipurpose Cooperative
Mindanao (27)	
Region 9 (4)	Zamboanga City Electric Cooperative, Inc.
	Zamboanga del Sur I Electric Cooperative, Inc.
	Zamboanga del Sur II Electric Cooperative, Inc.
	Zamboanga del Norte Electric Cooperative, Inc.
Region 10 (8)	Bukidnon II Electric Cooperative, Inc.
	Camiguin Electric Cooperative, Inc.
	First Bukidnon Electric Cooperative, Inc.
	Lanao del Norte Electric Cooperative, Inc.
	Misamis Occidental I Electric Cooperative, Inc.
	Misamis Occidental II Electric Cooperative, Inc.
	Misamis Oriental I Electric Cooperative, Inc.
	Misamis Oriental II Electric Cooperative, Inc.
Region 11 (3)	Davao del Norte Electric Cooperative, Inc.
	Davao del Sur Electric Cooperative, Inc.
	Davao Oriental Electric Cooperative, Inc.
Region 12 (5)	South Cotabato I Electric Cooperative, Inc.

	South Cotabato II Electric Cooperative, Inc.
	Sultan Kudarat Electric Cooperative, Inc
	Cotabato Electric Cooperative Inc.
	Cotabato Electric Cooperative, Inc. - PPALMA Area
CARAGA (7)	Agusan del Norte Electric Cooperative, Inc.
	Agusan del Sur Electric Cooperative, Inc.
	Dinagat Island Electric Cooperative, Inc.
	Siargao Electric Cooperative, Inc.
	Surigao del Norte Electric Cooperative, Inc.
	Surigao del Sur I Electric Cooperative, Inc.
	Surigao del Sur II Electric Cooperative, Inc.
Others (24)	
CAR (5)	Abra Electric Cooperative, Inc.
	Benguet Electric Cooperative, Inc.
	Ifugao Electric Cooperative, Inc.
	Kalinga-Apayao Electric Cooperative, Inc
	Mt. Province Electric Cooperative, Inc.
ARMM (7)	Basilan Electric Cooperative, Inc.
	Cagayan de Sulu Electric Cooperative, Inc.
	Lanao del Sur Electric Cooperative, Inc.
	Maguindano Electric Cooperative, Inc.
	Siasi Electric Cooperative, Inc.
	Sulu Electric Cooperative, Inc.
	Tawi-tawi Electric Cooperative, Inc.
ECOZONE (10)	TRANSCO - Bataan
	Mactan Enerzone Corporation
	TRANSCO - Baguio
	Subic Enerzone Corporation
	TRANSCO - Cavite
	TRANSCO - Mactan
	Balamban Enerzone Corporation
	MECO for the account of MEZ
	Lima Enerzone Corporation (Formerly Lima Utilities Corporation)
	First Industrial Township Utilities, Inc.
NGCP (2)	National Grid Corporation of the Philippines
	NATIONAL TRANSMISSION CORPORATION

Table 12 Electric Cooperatives in Philippines by region (PSALM, 2012b)

5.4 Consumers

Consumers are the known are the end-users. Consumers buy electricity from power producers or through WESM. R.A 9136 or EPIRA defined the two types of market consumer-contestable market consumer and captive market consumer. Under section 31 of R.A 9136, contestable market consumers are those who consumes of at least 1MW per month for the preceding 12 months, and allowed to choose power supplier from the registered members of WESM (NEDA, 2001). The captive consumers are end-users that consume less than 1MW of electricity and does not have a choice to choose power supplier as determined by ERC (NEDA, 2001).

5.5 Prosumers

Prosumers are both consumer and supplier of energy. They are consist of either household, industrial or commercial consumers that produce their own power through solar photovoltaic panels and at the same time selling back excess electricity to the distribution companies and use them as credits to lower their electricity bill .

Moreover, the prosumers are connected to the meter system provided by the distribution utilities. In compliance to the Renewable Energy Act of 2008, Meralco started the net metering system. This is part of the net metering program under Renewable energy Act of

2008 where end-consumers are encouraged to produce their own electricity. Households having 20 photovoltaic panels can produce 675 KWh energy in a month (Ranada, 2014).

5.6 Government

Describing the smart energy system in the Philippines, the government is responsible in implementing energy laws and policies. It includes the approval for power rates of all grid areas, granting franchise and impose penalties for any non-compliance to the EPIRA Law. Different organizations involved in the energy system of the Philippines are JCPC, ERC, DOE and PSALM.

The Joint Congressional Power Commission (JCPC) mainly the congress approves the laws passed by the Department of Energy (NEDA, 2001). Under EPIRA, the DOE is mandated to supervise the restructuring of the country's power industry, including the establishment of WESM (NEDA, 2001). DOE is responsible for preparing, controlling, supervising and implementing all plans and programs of the government related to energy exploration, development, utilization, distribution and conservation. National Electrification Administration (NEA) is under the Department of energy and serves guarantor for purchases of electricity in the wholesale electricity spot market (WESM) by any electric cooperative or small distribution utility to support their credit standing (NEDA, 2001). EPIRA Law did not include the Small Power Utilities Group (SPUG) for privatization. Thus, the NPC remains a power producer to unviable, unserved, and marginalized areas like SPRUG. The Department of energy (DOE) is responsible for preparing the Missionary Electrification Development Plan (MEDP). On the other hand, Energy Regulatory Commission (ERC), an independent quasi-judicial regulatory body responsible in overseeing the power sectors' (GENCOS, Suppliers and Aggregators) activities and promulgate necessary rules and regulations, including competition rules, and impose fines or penalties for any non-compliance with or breach of the EPIRA (NEDA, 2001). The Private Sector Assets and Liabilities Management (PSALM) manages the privatization of NPC and National Transmission Commission (TRANSCO), which is under the responsibility of PSALM, managed the transmission assets of NPC (NEDA, 2001).

Value chain	Generation	Transmission	Distribution	Consumption
Stakeholders	Producers prosumers	Transmission companies	Distribution companies	Consumer (Contestable and captive)
Stakeholder Types	Renewable and non- renewable energy producers	Private Transmission Company	State owned and private distribution companies	Residential, Industrial, Commercial
Stakeholder's name list	IPPs GENCOs (San Miguel Corporation Aboitiz Lopez Group) Prosumers	NGCP	PDU's (Meralco, VECO, Davao Electric & Co) ECs	Buildings Households
Technology Provided		Smart Grid (SCADA, ODCC, EMS)	Smart grid Net meters Smart Phone apps	Photovoltaic Solar panels

Table 13 Value chain in Philippines

6. Discussions

6.1 Political situation

Philippines has one of the highest electricity price in Asia. One of the main reasons is that there is no power subsidy, which is favorable to the electricity producers to influence the price. The government instead imposes multiple taxes and fees added on the retail price. The final price including the VAT rates and royalties are passed to the consumers. For example, one of the royalties is the fee for using Malampaya (a private oil and gas company in Philippines, the first offshore natural gas company in Philippines) natural gas that equal to P1.45/kWh (Oplas, 2015)

Establishing conventional power plants in the Philippines is costly and time-consuming. For example, it takes almost 3 years to receive the government permits (DOE, 2014b). Therefore, the fastest solution for the government to generate more electricity is issuing contracts to the established IPPs, especially during the power shortages.

On the other hand, the power shortage and financial issue in Philippines started since the closedown of the 620MW Bataan Nuclear Plant (established during Martial law period) in 1988 that President Aquino ordered to close the nuclear plant due to safety measures, and Philippines is still paying the remaining debts of NPC until now. Although the Bataan Nuclear Plant hasn't been ever operated until now, the government spent 2.3 Billion USD for the establishment of Bataan Nuclear Plant from 1976-1984, and have been spending P50 million pesos each year for the maintenance of the said nuclear plant (Lopez, 2015).

The Philippines' government has no control over electricity price that is mainly dominated by the private companies. The main goal of EPIRA is to reduce the electricity cost and provide a stable electricity supply. There is still heavy power shortage and high electricity price since since the implementation of EPIRA. It shows that the government needs to review the EPIRA law and restructure those rules that do not work out.

The electricity generation sector in Philippines is fully controlled by the private sectors that is open and competitive. Three biggest players in this sector control 60% of total national energy generation. They are San Miguel Corporation sharing 22% (2,545MW); Aboitiz at 20% (2,350MW) and Lopez group share 18% (2,150 MW) (Rappler, 2014). Other private generation companies and IPPs contribute the rest 40% of the total electricity generation. Meralco is the biggest distribution company in Philippines, and Veco is the second. The San Miguel Corporation and Lopez group own Meralco, while Aboitiz owns two distribution companies that are Veco and Davao Light and Power Co.

Generation company	Area of Operation	Distribution Company	Capacity
San Miguel Corp	Luzon	Meralco	2,545 MW
Aboitiz (renewable and non-renewable)	Visayas and Mindanao	VECO, Davao Light and Power Co Cotabato Light	2,350MW
Lopez Group	Luzon	Meralco	2,150 MW

Table 14 Top power companies in Philippines

6.2 Economic aspect

There is demand for the further development of the electricity industry in Philippines. However, the reliance on oil imports, low per-capita income, cost-reflective electricity and poor energy infrastructure strongly affect the development of the electricity industry in the Philippines. The research found that the electricity prices are various according to different areas and seasons. For instance, the electricity price is high especially in the urban areas during the summer time when energy supply is low. There is increasing electricity supply and consumption in Philippines (shown in Figure 6). Although the electricity supply is increasing each year, due to the high frequency of the electricity blackouts in Philippines, it can be argued that the electricity demand is still higher than the supply in Philippines. Therefore, there is a huge potential for the smart energy business in the country.

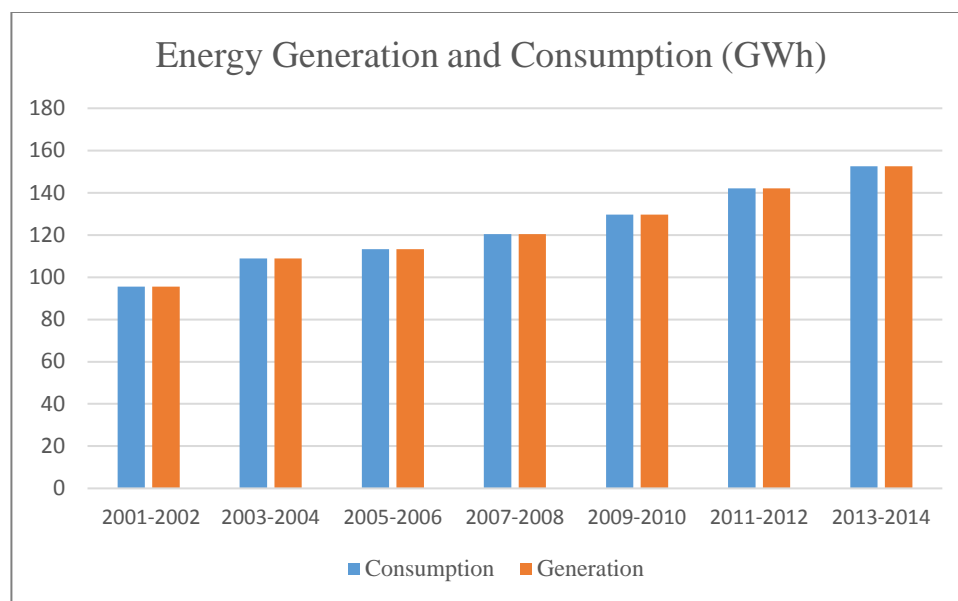


Figure 7 Energy generation and consumption from 2001-2014

Tourism industry is one of the biggest financial resources in Philippines. In 2014, the tourism industry contributes 7.8% of the total Philippines' GDP (Adel, 2015). The main tourism areas, e.g. Palawan and Mindoro, are categorized as off-grid or missionary areas. However, there is no efficient electrical infrastructure in the missionary areas because it is expensive to build electricity infrastructure in the rural areas. Instead, the government allows the private local companies to produce and supply electricity in these areas.

On the other hand, The NGCP's transmission link project between Visayas and Mindanao that has been approved in 2016 and is expected to finish in 2018, will supply 2,400MW additional capacity to Mindanao (Rappler, 2016). At a certain level, the new Mindanao-Visayas interconnecting lines may moderate the imbalance between electricity production and consumption across the three main islands in Philippines (Visayas, Luzon and Mindanao).

6.3 Geographical aspect

There is high impact of the geographical location on the development of national energy infrastructure. Philippines are prone to natural disasters such as typhoons, earthquakes and volcanic eruptions. There are at least 20 typhoons (Ortega, 2014) each year that destroy the lands and infrastructures.

There are 7,100 islands in Philippines, and 2,800 inhabited islands have the major issue of establishing electricity infrastructure. Big cities and provinces in Luzon, Visayas and Mindanao are connected to the main transmission lines. However, the identified off grid areas (that disconnect to the national grids, or only have local grids) like the islands of Zamboanga, Sulo, Palawan and Mindoro that only have the local electricity supply through NPC-SPUG and distribution by the local electric cooperatives (that are also owned by the NPC-SPUG). Most of the off grid areas are prone to human and natural disasters, so the government issues contracts to the local private electricity producers to supply electricity on these islands. The NPC-SPUG distribute the electricity across these off grid islands to Electric cooperatives.

Summer month in the Philippine is from February to May and it is the power peak season. The country experience long power blackout especially in Mindanao as the island is mostly dependent on hydroelectric power. During summer, the temperature in the Philippines reaches up to 35 degrees affecting the generation of energy in hydroelectric plants.

Government took an action to help the off-grid areas in their electricity. In 2015, NPC-SPUG supplied fuel tanks to 15 off-grid plants. The tanks will serve as storage of fuel while waiting for next fuel supply to come. Among the 15 NPC-SPUG plants received the fuel tanks are San Pascual, Peña, Chico, Gilotongan, Gin-Awayan and Nabuctot in Masbate, and Lahuy and Quina-salang in Camarines Sur for Luzon; Caluya in Antique, Pilar in Cebu and Gigantes in Iloilo for the Visayas; and Siasi and Luuk in Sulu, Sitangkay and Tandubas in Tawi-Tawi for Mindanao (Miraflor, 2014).

6.4 Social aspect

The Philippines' population reaches more than 100 million in 2016 wherein 16 million population are not connected to electricity. The rapid growth of population indicates the increasing electricity demand. In 2015, there were 3 months' power blackout between March and June in Luzon area (R. T. Olchondra, 2015). The government claims that the climate affects the power supply in Philippines, particularly the hydroelectric resources.

The population with less than 16,841 pesos annual income is defined as the poverty in Philippines and the low-income family cannot afford to send their children to schools. The poverty rate in the Philippines decreased to 16.6% in 2015 from 26.6% in 2009 (Daang Matuwid, 2016). The government believes that it is not a good solution to subsidize the electricity price, because everyone including the high-income population can receive the benefit. Instead of providing an electricity subsidy, the government established the Conditional Cash Transfer (CCT) - "Pantawid Pamilyang Pilipino" program in 2008 to improve health, nutrition, and education of children aged between 0-18 (Daang Matuwid, 2016). However, the governmental financial support is not even enough for the children to live healthy due to the high price of the prime commodities in Philippines. The 7.7 million poverty population has received the benefit from the program until 2016, wherein the government has spent P62 Billion until 2015 on this program (Aquino, 2016). In this program, each child can receive P500 for social and health support, and P300 for education support each month. The CCT program covers a maximum of three children for a maximum monthly stipend of P1400 per family (Aquino, 2016).

6.5 Electricity Infrastructure aspect

The smart metering system has been introduced in Philippines via private companies like Meralco. Consumers can monitor and customize their electricity consumption with the smart metering system. In addition, through the smart metering system, consumers also can produce electricity at home or offices by using the photovoltaic system for the self-electricity

consumption. This pilot project of Meralco started in the Luzon installing 40,000 smart meters to the consumers.

Moreover, Philippines adapts modern technology for its transmission lines. The NGCP pilot project on Smart grid include using Energy Management System, Supervisory Control and Data Acquisition (SCADA) and Overall Disaster Control Center (ODCC), which would maintain and monitor power grid more effectively and reduce damages caused by typhoons, earthquakes and other calamities (Cuevas-Miel, 2014).

6.6 Comparison to Other ASEAN

The open access and retail competition should lower the prices in electricity. Unfortunately, until 2010, Philippines has high electricity price with an average price of P8/KWh. In addition, comparing to other countries, the electricity prices in Philippines is the highest in Southeast Asia (Arangkada Pilipinas, 2016).

7. Conclusion and recommendation

The EPIRA was established and implemented for 15 years, and the main goal is to produce efficient and affordable electricity in Philippines. However, the effort is not significant so far. The introduction of the open access and retail competition aims to increase the electricity production, lower the production cost and electricity price. However, few big companies, such as the Lopez group, Aboitiz and San Miguel Corporation, dominate the electricity industry in Philippines. These companies own the main electricity production and distribution in Philippines, and mainly control the electricity prices.

In general, the issues in energy system in the Philippines is not about the high demand or low supply of electricity. This issue rooted from the government. The never-ending issues in electricity will reduced if the government manage the electricity system and resources wisely.

The development of the smart energy system in Philippines is complicated due to the social, environmental, political, and financial influences. The government can review and update the EIPRA law and seek more sustainable and affordable energy. For instance, the side effort of the “open for competition” in the EPIRA is not to control electricity prices. Therefore, the government can perform other task, for instance, the government may limit the business ownership to increase the competition among the electricity production, and as a result, there will be an increase in the electricity supply and lower electricity price.

In addition, it is necessary to improve the electricity infrastructure and utilize renewable energy resources instead of fuel and oil import, due to the abundant renewable energy resources, such as solar, ocean, wind and other hydro energy in Philippines. Lastly, there is a huge potential for power industry in Philippines.

References

- ADB. (2005). *Sector Assistance Program Evaluation of Asian Development Bank Assistance to Philippines Power Sector*. Retrieved from Philippines: <http://www.oecd.org/countries/philippines/36052225.pdf>
- Adel, R. (2015). Tourism contributes 7.8% GDP in 2014 Retrieved from <http://www.philstar.com/business/2015/07/21/1479399/tourism-contributes-7.8-gdp-2014>
- Allaire, J. F., Désilets, G. L., Clarke, C. D., Moreau, G., R. Wilhelmsson, L., Ekehov, B. S. S., & Garcia, M. P. Leyte-Luzon Hvdc Power Transmission: Commissioning Highlights, Performance Measurements And Operating Experience. Retrieved 2016 <https://library.e.abb.com/public/0f6ede6460a69c09c1256fda004aeac2/cigre2000leyte-luzon.pdf>
- Aquino, T. (2016). PNoy: 7.7 million Filipinos lifted from poverty through Conditional Cash Transfer program. Retrieved from <http://interaksyon.com/article/122749/pnoy-7-7-million-filipinos-lifted-from-poverty-through-conditional-cash-transfer-program>
- Arangkada Pilipinas. (2016). Power Background. Retrieved from http://www.investphilippines.info/arangkada/seven-winners/infrastructure/power/background/#fnote_83
- Cuevas-Miel, L. (2014). NGCP to pilot 'smart' technology in power grid by 2016. Retrieved from <http://interaksyon.com/business/83421/ngcp-to-pilot-smart-technology-in-power-grid-by-2016>
- DOE. (2005). *Average Electricity Price per Customer Class in P/kWhr*. Retrieved from <http://www.doe.gov.ph/consumer-e-desk/electricity-and-fuel-rates/average-electricity-price>.
- DOE. (2012). *21st EPIRA Status Report*. Philippines Retrieved from http://www.doe.gov.ph/doe_files/pdf/01_Energy_Situationer/21st%20EPIRA%20Status%20Report_FINAL.pdf.
- DOE. (2013). *Providing Supplemental Policies to Empower Constable Customers Under tge Regime of Retail Competition and Open Acess And Ensure Greater Competiton in the Generation and Supply Sectors of the Philippine Power Industry*. Philippines Retrieved from http://www.doe.gov.ph/doe_files/pdf/Issuances/DC/DC2013-07-0013.pdf.
- DOE. (2014a). *2014 Philippines Power Statistics*. Retrieved from Philippines: http://www.doe.gov.ph/doe_files/pdf/02_Energy_Statistics/power_statistics_2014.pdf
- DOE. (2014b). *Energy Investment Briefing*. Philippines Retrieved from <http://www.doe.gov.ph/microsites/ipo%20web/EIF2014/P2-Energy%20Projects%20and%20Registration%20Procedures.pdf>.
- DOE. (2014c). *Promulgating the Retail Market Manuals For The Implementation of Retail Competition and Open Access And Providing For Transitory Arrangements*. Philippines.
- Daang Matuwid. (2016). Poverty rate cut to 16.6% by 2015. Retrieved from http://president.gov.ph/daang_matuwid/poverty-rate-cut-to-16-6-by-2015/
- empowerconsumers. (2009). List of IPPs and NPC generation companies. Retrieved from <https://empowerdconsumers.wordpress.com/2009/09/07/tools-%E2%80%B9empowerdconsumers%E2%80%99s-weblog-%E2%80%94-wordpress/>

- ERC. (2009). *RA 9513, Renewable Energy Act of 2008, IRR*. Philippines Retrieved from <http://lia.erc.gov.ph/documents/290#>.
- IEA. (2015). *Feed-In Tariff for Electricity Generated from Biomass, Ocean, Run-of-River Hydropower, Solar and Wind Energy Resources*. Retrieved from <http://www.iea.org/policiesandmeasures/pams/philippines/name-43253-en.php>
- LawPhil. (2016). Executive Order NO. 215 July 10, 1987.
- Lopez, M. T. (2015). Bataan nuclear plant will take years to rehab, House committee told. Retrieved from <http://www.bworldonline.com/content.php?section=Economy&title=bataan-nuclear-plant-will-take-years-to-rehab-house-committee-told&id=115276>
- Miraflor, M. B. (2014). NPC starts fuel storage upgrade for SPUG. Retrieved from <http://www.manilatimes.net/npc-starts-fuel-storage-upgrade-for-spug/75404/>
- NEDA. (2001). *Republic Act 9136*. Philippines Retrieved from <http://www.neda.gov.ph/wp-content/uploads/2013/12/R.A.-9136.pdf>.
- NPC. (2016). National Power Corporation Historical Background. Retrieved from <http://www.napocor.gov.ph/index.php/menu-transparency/submenu-about-us/subsubmenu-historical-background>
- Olchondra, R. (2015). FIT rates for new solar projects trimmed. Retrieved from Business Inquirer website: <http://business.inquirer.net/191242/fit-rates-for-new-solar-projects-trimmed>
- Olchondra, R. T. (2015). Worst case: 3 months of outages in 2015. Retrieved from <http://business.inquirer.net/180299/worst-case-3-months-of-outages-in-2015>
- Oplas, B. S. (2015). The Philippine electricity market: Monopoly and competition. Retrieved from <http://www.bworldonline.com/content.php?section=Weekender&title=the-philippine-electricity-market-monopoly-and-competition&id=113411>
- Ortega, A. P. (2014). Philippines' Country Report. Retrieved from http://www.adrc.asia/countryreport/PHL/2014/PHL_CR2014B.pdf
- P.D. (1972). *PRESIDENTIAL DECREE NO. 40*. Philippines Retrieved from http://www.doe.gov.ph/doe_files/pdf/OCSP/PD_40.pdf.
- P.D. (1973). *Presidential Decree No. 269, s. 1973*. Manila Retrieved from <http://www.gov.ph/1973/08/06/presidential-decree-no-269/>.
- PSALM. (2012a). *Liability Management*. Philippines Retrieved from <https://www.psalm.gov.ph/liability.asp>.
- PSALM. (2012b). List of Distribution Utilities by Region. Retrieved from https://www.psalm.gov.ph/liability_DU.asp
- PSALM. (2012c). The Privatization of the National Transmission Corporation. Retrieved from <https://www.psalm.gov.ph/Transmission.asp>
- Ranada, P. (2014). How practical is solar power for PH home owners? Retrieved from <http://www.rappler.com/business/industries/173-power-and-energy/64165-solar-power-ph-households-net-metering>
- Rappler. (2014). INFOGRAPHIC: Top power players in the Philippines. Philippines.
- Rappler. (2016). ERC approves NGCP's Visayas-Mindanao grid link study. Retrieved from <http://www.rappler.com/business/industries/173-power-and-energy/122564-visayas-mindanao-grid-interconnection-erc>
- Rivera, D. (2014). What you should know about WESM and the Meralco rate hike. Retrieved from <http://www.gmanetwork.com/news/story/344812/money/companies/what-you-should-know-about-wesm-and-the-meralco-rate-hike>

- Rivera, D. (2015). NGCP seeks new interconnection route for Visayas, Mindanao grids. *PhilStar Global*. Retrieved from <http://www.philstar.com/business/2015/11/20/1523757/ngcp-seeks-new-interconnection-route-visayas-mindanao-grids>
- TRANSCO. (2003). Specific “Timetable” to be used in the market as mentioned in the the submission detailing activities on each of the period specified. (October 21, 2003 ed., pp. 9). Philippines: ERC.
- WorldBank. (2016). *Electric power transmission and distribution losses (% of output)*. Retrieved from: <http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS>