Energy Security and Sustainable Transport: The Future of *Jeepneys* in the Philippines

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Abstract

This paper discusses the dynamics between energy security and land transportation system in the Philippines. With focus on the *Jeepney*, a cultural icon in the country, the paper will examine how trends in the promotion of alternative energy, in particular the utilization of electricity as fuel will transform one of the nation's primary modes of public land transportation. The paper argues that while the introduction of the electric vehicle technology to *jeepneys* would help achieve certain environmental and energy goals, a number of issues need to be addressed before successful mainstream implementation. The ultimate aim of the paper is to provide a comprehensive analysis of the relationship between energy security and sustainable land transport; through this lens, this paper hopes to bring clarity to the pursuit of the requisite groundwork for the deployment of sustainable land transport, while simultaneously ensuring energy security for the industry and the general public.

Keywords: Energy Security, Sustainable Land Transport, *Jeepneys*, Electric *Jeepneys*

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List of Acronyms

ADB	–	Asian Development Bank
APS	–	Alternative Policy Scenario
BAU	–	Business-as-Usual (Scenario)
COMET	–	City Optimized Managed Electric Transport
CIA	–	Central intelligence Agency
CO_2	–	Carbon Dioxide
DOE	–	Department of Energy
DOTC	–	Department of Transportation and Communications
GDP	–	Gross Domestic Product
GET	–	Global Electric Transportation, Ltd.
IEA	–	International Energy Agency
IEEJ	–	Institute of Energy Economics, Japan
JICA	–	Japan International Cooperation Agency
kWh	–	Kilowatt hour
LPG	–	Liquefied Petroleum Gas
LTFRB	–	Land Transportation Franchise Regulatory Board
MTOE	–	Million Tons of Oil Equivalent
MW	–	Megawatt
PhUV	–	Philippine Utility Vehicle, Incorporated
PM	–	Particulate Matter
VKT	–	Vehicle Kilometer Travelled

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Outline

Section 1 gives a background on the trends concerning electric vehicles, particularly electric *jeepneys* in the Philippines. Section 2 provides a brief background on the Philippine Economy, Energy and Power. Section 3 discusses *Jeepneys* and its role in the land transport system of the Philippines. Section 4 explores Electric *Jeepneys* as a successor to the *Jeepney*. Section 5 analyzes the impact of electric *jeepneys* to energy security in the Philippines. Thereafter, recommendations based on the analysis shall be discussed in Section 6. Finally, concluding remarks are discussed in Section 7.

I. Introduction

In April 2014, the President of the United States of America, President Barack Obama, made an official visit to the Philippines. Among the many activities that formed part of his 2-day trip to the country was a visit to the unveiling of the City Optimized Managed Electric Transport or COMET, an electric vehicle poised to succeed the *jeepney*, one of the mainstays of the Philippine public land transportation system. (Bacani 2014) The COMET is set to be manufactured and rolled out en masse in the coming years, having garnered interest and eventual sale agreements from *jeepney* operators and cooperatives.

The electric *jeepney* is part of the growing trend in the country which is gearing towards a more sustainable land transport system in the country. The introduction of the successor to the *jeepney* was lauded for the benefits that it will bring. On an environmental sustainability aspect, this project is seen as the right way to go to curb the ever-increasing contribution of the transport sector to air pollution in the country. On the other hand, the system that comes along with the introduction of the new system will remedy the woes of passengers and the motorists, as far as orderly transportation system is concerned. However, the overarching goal of providing a sustainable transport system cuts across a number of aspects, such as its effect to the energy security of the country, particularly the power grid, among others.

II. The Philippines: Economy, Energy and Power

A developing country of 97.4 million inhabitants, the Philippines has sustained a relatively high economic growth for the past 4 years. (Philippine Statistics Authority 2014) With an average GDP growth rate of 7.0%, the country is at par with the People's Republic of China, in terms of economic growth. (Sydney Morning Herald 2013) Coupled with a growing population, a growing economy entails growing energy demand, which powers the growing industries, as well as the households.

State of Philippine Energy

As shown in Figure 1, The Philippines' primary energy supply increased by 7.8 percent to 42.9 Million Tons of Oil Equivalent (MTOE) in 2012, from 39.8 MTOE the previous year. (DOE 2013) The country is well endowed with renewable energy, that it comprises a significant share of the total energy mix. Renewable energy, such as biomass, geothermal and hydro comprises 38.46% of the total primary energy mix. (DOE 2013) Moreover, indigenous energy resources amounted to 56.32% of the total energy mix. (DOE 2013)

The Philippines is currently a net fossil fuel importer and will continue to be so in the future. According to the International Energy Agency (2013), the country will increase its

importation of coal, oil and gas from now up until 2035. In terms of proven crude oil reserves, the Philippines rank 67 out of all the countries in world. (CIA Factbook 2013)

Furthermore, a study by the Institute of Energy Economics Japan (2011) shows that, in both Business as Usual (BAU) and Alternative Policy Scenarios (APS), fossil fuels such as coal, oil and natural will still be dominating the share of the total primary energy supply. (Figure 2) With regard to final energy consumption (Figure 3), oil is predicted to be the dominant fuel of choice due to the growth of the transportation sector, while electricity is expected to grow rapidly up to 2030. Likewise, the transportation sector consumption will still have the fastest growth, in terms of per sector energy consumption. (IEEJ 2011)

Philippine Power Sector

In terms of power generation (Figure 4), the Philippine power sector generates electricity through a variety of sources, of which roughly 28% are from renewables while a significant share of the power generation comes from coal at around 38%. The Philippine power generation is 58.78% self-sufficient as of 2012. (DOE 2013) While the share of oil as a fuel source for power generation has declined steadily, coal remains to be the most dominant power generation source. Natural gas, on the other hand is steadily increasing its share since 1994. (IEEJ 2011)

Renewable energy remains to be a promising source for power generation in the Philippines. Table 1 show that prospects are particularly bright for hydro, wind and geothermal energy. (Sinocruz 2012) As such, the government, as part of its National Renewable Energy Program (NREP), aims to increase the power output generated from renewable energy by as much as 9,900MW from now until 2030. (DOE 2012)

Power Grid

As an archipelago, the Philippines is subdivided into three (3) grids namely, Luzon, Visayas and Mindanao. With the exception of the Mindanao grid, the Luzon and Visayas grids are interconnected. While the three grids are not equal in terms of capacity, the similarity lies in their respective power supply-demand outlook. As seen on Figures 5 and 6, both the Luzon and Visayas grids are facing imminent power supply shortage in the near future, due to a lack of adequate power generating facilities, despite the committed power facilities which are set to be constructed in the coming years. Mindanao (see Figure 7), on the other hand, is already experiencing power shortages as the current power supply is already inadequate to meet the power demand.

Electric Power Liberalization

The Philippines is among the top 10 countries in the world with the highest electricity rates. (Visconti 2012) This has been so, even if the power industry underwent liberalization following the enactment of Republic Act No. 9136, otherwise known as the “Electric Power

Industry Act of 2001." The enactment of the said law has led to the opening of the industry to the private sector, with the privatization of the state-owned National Power Corporation, particularly the sale of its generation and transmission assets. It also led to the unbundling of the operations of the power sector into generation, transmission, distribution, and supply. The law paved the way to the entry of private sector players, in order to induce competition which will bring down the costs of electricity for end-users. Moreover, the law provides that the government will no longer engage in power generation, whose responsibility is left to the private sector.

III. *Jeepneys* in the Philippines

In terms of usage, vehicles for public transportation far outnumber private vehicles in the Philippines. According to the National Center for Transportation Studies (2011) 70% of the total person trips nationwide are done by means of public transportation. Of these, *jeepneys* comprise 39% of all the trips with users coming from various income groups. (Bacero and Vergel 2009) In terms of Vehicle Kilometer Travel (VKT), the *jeepneys* account for 80% of the total VKT in the Philippines in 2005. (Fabian and Gota 2009)

The *jeepney* traces its origins from World War II-era military vehicles called jeeps. After the war, a significant number of these jeeps were left in the Philippines by the Allied Forces. Due to the lack of necessities after the war, the jeeps served its purpose as the solution to the problem of transportation. (Chiu 2006) As the vehicles were introduced as public transportation, the jeeps gradually evolved in terms of dimension and image into what it is today. From lengthened chassis to glamorous ornaments, the *jeepney* transformed from a war icon to the trendy vehicle that Filipinos take pride of as a cultural icon.

Based on the data from the Land Transportation Franchising and Regulatory Board (2012), there are 234,406 registered *jeepneys* in the Philippines (Table 2) However, the government figure is surely lower than the actual number of operating *jeepneys* due to the prevalence of non-registered *jeepneys* operating around the country. Relative to the number of buses in the Philippines, there are approximately 8 *jeepneys* per bus in the country.

While *jeepneys* are categorized as a class of its own, there are no particular standards followed by manufacturers. In fact, *jeepney* manufacturers follow different specifications on the capacity, weight and dimensions for *jeepneys*, allowing for customization based on the preference of the buyer. (Bacero and Vergel 2009) In addition, the *jeepneys* receive no operating subsidy from the government on a regular basis. (Lau 1997) Moreover, *Jeepneys* are assembled using an estimated 50-80% brand new and 20-50% surplus materials, to which Japanese-made 4BC2 surplus or reconditioned second-hand engines are installed. (Bacero and Vergel 2009)

Like buses and taxis, *jeepneys* are regulated by the Land Transportation Franchising and Regulatory Board (LTFRB, a line agency of the Department of Transportation and Communications (DOTC). However, the day-to-day operations of *jeepneys* are regulated among the operators themselves. *Jeepney* fleets are mostly owned by individual operators but are leased to drivers. (Bacero and Vergel 2009) *Jeepney* Cooperatives are then responsible for licensing, insuring and dispatching *jeepneys* owned by their members. (Lau 1997) On the average, *Jeepneys* operate around 100-150 kilometers daily. (Gota 2014)

***Jeepneys*: Pros and Cons**

The *Jeepney* as a mode of transportation has proven its reliability and usefulness since its use after the Second World War. Bayan (1995) and Ebata et. al (1996) in Bacero and Vergel (2009) explains the reason for the popularity of the *jeepney* as a mode of transportation, to wit:

> "(1) local availability – manufacturing technology is locally available and parts such as second-hand engines and imported chassis are readily available; (2) the intermediate size or capacity – compatible to most Metro Manila road network and configuration, enabling it to easily move, stop, load and unload passengers as well as penetrate even the smallest interior areas; and (3) accessibility – providing a door-to-door service at practically any time and place"

JICA (1995), as quoted by Bacero and Vergel (2009), likewise enumerated a number of factors for the dominance of *jeepneys*, such as: abundance of low-cost labor; self-regulating industry; availability of local technology for vehicle supply, and; fare levels equivalent to public utility buses which provides generally lower service level.

On the other hand, a number of issues have been associated with the *jeepney* over the years. Foremost is the fare for use. While the *jeepney* fare is relatively inexpensive, it has increased by more than 500% since 1990, from P1.75 in 1990 to P8.00 in 2012. One reason for this is the continuous increase of retail oil prices, which directly increases the cost to operate *jeepneys*. As shown in figure 8, the average cost of Diesel per liter has skyrocketed over the past two decades. Along with the tricycle, *jeepneys* are the most sensitive in times of fuel price hikes due to its low fuel efficiency. (Gota 2014)

Moreover, *Jeepneys* in general are blamed for the worsening air pollution in the country. Most of the *jeepneys* use either surplus or reconditioned pre-owned Japanese engines which are not compliant under Philippine laws, such as the Clean Air Act. (Bacero and Vergel 2009) Moreover, Fabian and Gota (2009) concluded that "addressing emissions from *jeepneys* is tantamount to reducing the over-all contribution of the transport sector to CO_2 and PM emissions."

Given the problems pertaining to environmental degradation as well as the ever growing reality of continuous increase of global petroleum prices, the government has initiated a number of programs which aims to increase energy self-sufficiency and promote environmentally friendlier alternatives.

First of which is the National Gas Vehicle Program for Public Transport, under Executive Order No. 290, which aims promote the use of natural gas as a clean alternative fuel for transport systems, such as buses, *jeepneys*, taxis and other public utility vehicles. Among the various modes of transport that caught up with this program, taxis took advantage of the program the most. As of 2011, 19,052 taxi units were converted to run on auto-LPG. (DOE 2012).

Another program is a joint project with the Asian Development Bank (ADB), commonly known as the E-trike project. This project aims to replace 100,000 gasoline-fueled tricycles with electric tricycles (e-trikes) by 2017. The project shall be supported financially by ADB through a $300 million loan. (ADB 2012) However, as of the latest update by ADB, only the initial 20 units of the program are operating under the said project. (ADB 2012)

IV. Electric *Jeepneys*

The electric *jeepneys* were introduced as early as 2008, when it was launched in the Central Business District of City of Makati, in Metropolitan Manila. (PhUV 2014) However, it was only recently that electric *jeepneys* are making headways as the forthcoming successor to the conventional *jeepney* as a mainstream transport. First and foremost is the agreement between Global Electric Transport, a US-based automobile manufacturer, and Pasang Masda, a Philippine *jeepney* association, to purchase 10,000 units, to be deployed in in tranches every 3 years. (Ranada 2014). On the other hand, Philippine Utility Vehicle Inc. (PHUV), a Filipino firm engaged in the manufacture of electric vehicles, was able to secure an incentive package from the government as it aims to produce electric vehicles in the form of e-trikes and electric *jeepneys* locally. (Desiderio 2013)

The arrival of electric *jeepneys* to the Philippines is much welcomed by a number of sectors. It is poised as the successor to the conventional *jeepney*. In terms of utility, it will be similar to how *jeepneys* operate, although commitments were made by proponents that operational changes will be made. (Ranada 2014) Moreover, similar to its predecessor, electric *jeepneys* introduced to the market do not follow any standard specifications. While similar in terms of utility and configuration, electric *jeepneys* as introduced have less ornaments and a more standardized design: each unit closely resembles the other units of the same model. Its biggest difference to the *jeepney* is that it has a quieter engine, lesser moving parts, cheaper operating costs, has no tailpipe emissions, and it runs on electricity.

To date, there are a number of local and overseas automobile manufacturers who are engaged or have expressed interest to engage into the manufacture of electric *jeepneys*. For this study, two models from different manufacturers will be used as an example: the City Optimized Managed Electric Transport (COMET) by Global Electric Transport, Ltd.; and the E-*Jeepney* by Philippine Electric utility Vehicle.

The COMET is a product made by Global Electric Transport, Ltd., a US-based automobile manufacturing firm. The COMET (Table 3 for detailed specifications) features include: lithium ion batteries for power supply; top speed of 60 kilometers per hour, and; range of up to 100 kilometers on a full charge. (Ranada 2014) On the other hand, the Electric *Jeepney* or E-*Jeepney* (Table 4 for detailed specifications), manufactured by Philippine Utility Vehicle Inc. (PHUV), a local-based firm, features a maximum range of 55 kilometers on a single full charge, with a top speed of 35 kilometers per hour. (Desiderio 2013)

In the Philippines, as in the rest of the world, penetration of electric vehicles in the automobile market has been modest. In a survey conducted by KPMG (2012), automotive executives forecasted that globally, electrified vehicles will not go beyond 15% the annual car registrations. Official statistics In the Philippines paint a similar picture: the number of electric vehicles remains miniscule, numbering around 524 units as of 2012 nationwide. (DOE 2012)

With regard to the transition to electric vehicles, price has been a consistent point made by a number of experts in trying to explain why electric vehicles do not seem as a viable option. Using a simple cost analysis for a 10-year period, Jalotjot (2012) concluded that electric vehicles such as plug-in hybrid and battery electric vehicles are more expensive to operate by 47% and 79%, respectively, as against to conventional vehicles. Moreover, the 40% fuel savings are inadequate to make up for its expensive price tag. (Jalotjot 2012)

Table 5 shows an estimate of prevailing market prices of various electric vehicle models available in the market. As shown in the table, the purchase cost per unit of electric *jeepneys* (PHUV E-*jeepney* and GET COMET) are equal or lower than the price of the cheapest electric vehicle models in the market. While it is true that electric *jeepneys* are more expensive compared to conventional *jeepneys* by almost twice the amount of the latter (Roque 2012), the fact that the mass adoption of these vehicles could initiate a freefall of prices as vehicle construction will drop due to economies of scale. Moreover, firms such as GET also provide financing schemes which helps *jeepney* owners to transition to electric *jeepneys*. (Ranada 2013)

V. Analysis

In order to find the impact of the mainstreaming of electric *jeepneys* in the Philippines to energy security, this study shall look into (fossil) fuel displacement and load impact to the power grid.

Shifting Fuel Demand: Oil (Diesel) to Electricity

As electric *jeepneys* will replace the current fleet of *jeepneys* plying various routes nationwide, this study shall formulate a working estimate of the amount of diesel fuel that will be displaced as a result using the following formula:

[(*Jeepney* mileage per liter of diesel x average range] x number of operating days]

Using the *jeepney* mileage per liter data from Pokaharel et. al. (2013), average driving range of *jeepneys* from Gota (2014) and the number of operating days based on the assumption that *jeepneys* operate 6 times a week, it is estimated that 173,402 liters of diesel fuel is displaced per *jeepney* unit annually. (Table 6) That translates to 1.734 Billion liters of diesel fuel displaced per 10,000 *jeepney* units, or 17.34 Billion liters per 100,000 *jeepney* units annually.

At the same time, the study shall also provide an estimate on the amount of electricity that will be added to the total power demand, using the following formula:

[(electric *jeepney* battery capacity x average range] x number of operating days]

Using the battery capacity value and average driving range of the GET COMET, and the same number of operating days used in the previous equation, it is estimated that each unit shall add 5,634 kWHrs of electricity to the total demand annually. (Table 7) Using the same unit of measurement used in power supply-demand, 10,000 electric *jeepneys* will add 6.43MW to the annual power demand. Table (8) shows the estimated annual power requirement and fuel displacement for each *jeepney* replaced with an electric *jeepney*.

Impact to the Power Sector

Putting into perspective, assuming that the entire *jeepney* fleet will be replaced by their electric-powered counterparts, an estimated 160MW of electric power will be added to the total power demanded in the grid annually. This figure is equivalent to 9.9% of the total existing capacity of the smallest grid (Mindanao), 1.48% of the largest grid (Luzon), and 1.11% of the Luzon, Visayas and Mindanao grid combined (14,397MW) in 2012.

While the additional load burden is quite miniscule, the issue at hand is whether there is enough power supply in the grid. Looking at power supply-demand outlook from DOE

(2013) in Figures 5, 6, and 7, there is a current power supply shortage in the Mindanao grid by 150 MW, while there is a looming deficit for Luzon (500 MW) and Visayas (50 MW) grids by 2016. Despite the assumption that electric *jeepneys* will be charged during off-peak hours, deficits in the power supply should be a cause of alarm.

On the other hand, it is also worth noting that the sources of fuel for power generation at the present are still dominated by fossil fuels, with coal having the largest share. Moreover, both Business as Usual (BAU) and Alternative Policies Scenarios (APS) forecast a similar picture for the power generation mix until 2035. (IEEJ 2011) Given that, the benefits of reduced fossil fuel imports and air pollution impacts can be diminished without proper safeguards on the type of power plants to be constructed and utilized to meet existing and future power demand.

Aside from problems that can arise at the power generation level, a number of studies have raised serious concerns regarding the effect of charging electric vehicles to the power distribution network as well. Shao, et. al. (2009) argues that with the increase of plug-in electric vehicles in the power grid, new load peaks will form, which in some cases may exceed the capacity of distribution transformers. Moreover, Liu, et. al. (2011) argues that uncontrolled charging of electric vehicles particularly during peak summer hours can cause power grid overload. Other impacts of increased electric vehicle charging to the power distribution systems include: (1) phase imbalance; (2) power quality; (3) transformer degradation and failure, and; (4) circuit breaker and fuse blowout. As such, it is imperative that while promoting plug—in electric vehicles, mitigation strategies should be developed at the same time. (Liu et. al. 2011)

In the Philippine setting, Cano (2012) provided a number of scenarios wherein electric *jeepneys* were charged in a given distribution transformer. Using the example of a PhUV electric *jeepney* as an example, his model shows that two (2) plug-in electric vehicles charged at the same time in a given distribution network will lead to an overload in the distribution transformer. (Cano 2014)

Impact on Consumers: Fare rate

In the discourse of public transportation, one of the significant factors to consider is the fare. As previously mentioned, the retail oil price affects the fare of *jeepneys*. With the transition to electric *jeepneys*, it is commonsensical to say that the fare prices will be insulated to retail oil price increases since electric *jeepneys* feed on the power grid than to the diesel pump. However, it should be worth noting that the Philippines has one of the highest electricity costs in the world, as mentioned earlier. While promoters of electric *jeepneys* say that the current fare can be reduced due to lower operating costs (Raneda 2014), the possibility of fare hikes in the future looms over.

VI. Policy Recommendations

The introduction of a successor to the *jeepney* on a considerable scale comes at an opportune moment for the transport industry and commuters, in particular. As the trend towards the transition to electric vehicles has been slow among private vehicle users, the obsolescence of the *jeepney*, the availability of a suitable successor, the acceptance of operators to transition to the replacement, and the interest of various manufacturers to meet the demand created a growing market for electric vehicles in the form of public transport. Given the fact that most, if not all electric vehicles available in the market to date are still more expensive to their fossil fuel-powered counterparts, the growing demand for electric *jeepneys* in the Philippines can push the cost of the vehicle down through economies of scale.

As the Philippine government has shown its commitment to promote electric vehicles in the country through a number of programs, such as the e-trike program, it is imperative to also address the issues which could affect the attainment of the objectives of the program, such as providing sustainable transportation system, better air quality, and reliability.

In terms of power generation, the government, despite the inability to directly engage in power generation, should provide a clear-cut policy towards the promotion on the use of renewable, if not cleaner fuels. The fact that the there is still a huge renewable energy potential in the country, the government should, as far as practicable, exhaust these resources to the fullest.

With regard to the issue on power distribution, this study echoes the concerns raised by Liu et.al. (2011) and Shao et. al. (2009) on the possible impacts of electric vehicle charging to the power distribution networks. As such, studies on the impact of electric *jeepneys* to the power distribution grid, and mitigating efforts towards securing distribution networks expected to cater to electric *jeepney* charging is necessary.

VII. Concluding Remarks

The discussion provided in this paper has tackled a number of key issues regarding electric *jeepneys*, as successor for the traditional *jeepneys*, in an energy security perspective. While the mainstream use of electric *jeepneys* would yield beneficial impacts toward reducing oil dependence and improved air quality, there are a number of factors that need to be addressed, as in the case of power generation and distribution. The success or failure of this initiative towards sustainable land transport shall serve as a benchmark for mainstreaming electric vehicle use for public transport in other countries. Hence, a concerted effort from various sectors is needed in order to ensure its success.

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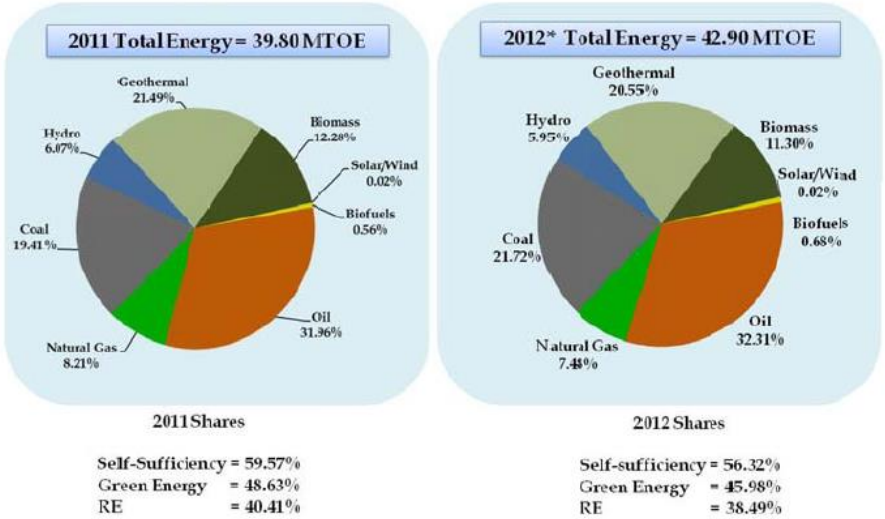
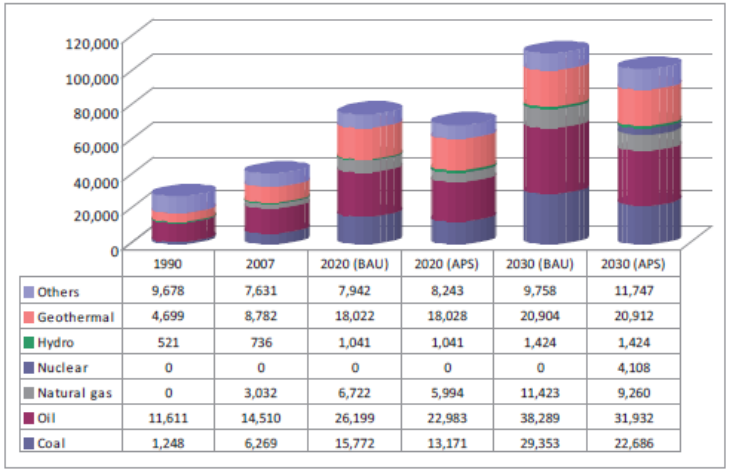
Annex: Figures and Tables

Figure 1: Philippine Primary Energy Mix 2011 and 2012



Source: Department of Energy. (2013) "Energy Sector Accomplishment Report 2013."

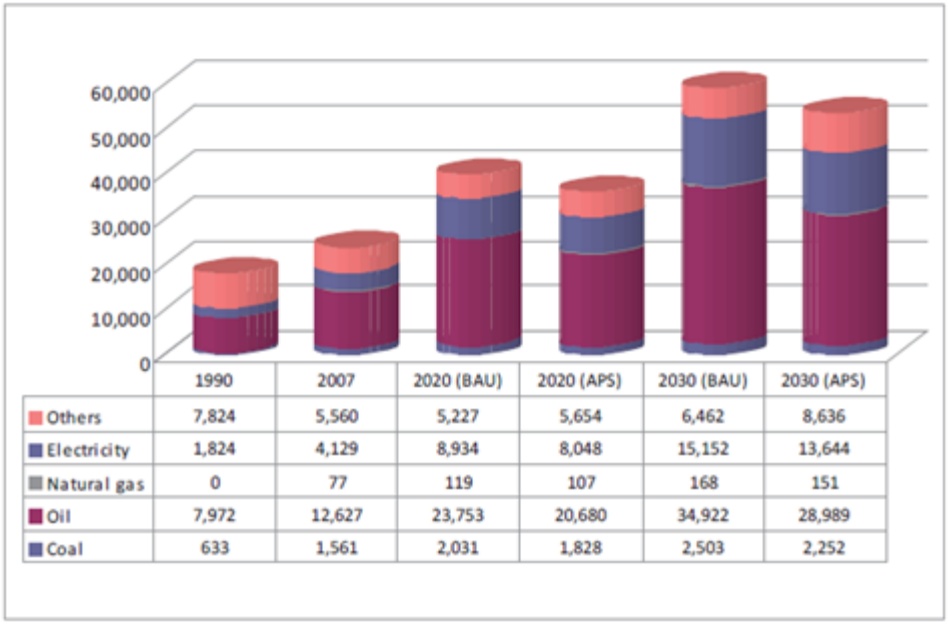
Figure 2: Total Primary Energy Supply 1990-2030



	1990	2007	2020 (BAU)	2020 (APS)	2030 (BAU)	2030 (APS)
Others	9,678	7,631	7,942	8,243	9,758	11,747
Geothermal	4,699	8,782	18,022	18,028	20,904	20,912
Hydro	521	736	1,041	1,041	1,424	1,424
Nuclear	0	0	0	0	0	4,108
Natural gas	0	3,032	6,722	5,994	11,423	9,260
Oil	11,611	14,510	26,199	22,983	38,289	31,932
Coal	1,248	6,269	15,772	13,171	29,353	22,686

Source: The Institute of Energy Economics, Japan. (2011)

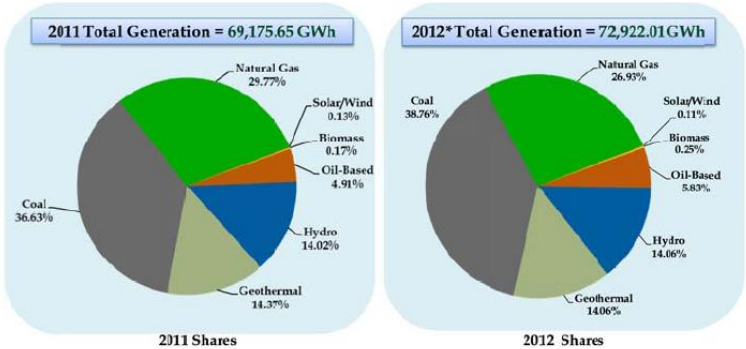
Figure 3: Total Final Energy Consumption by Fuel Type



	1990	2007	2020 (BAU)	2020 (APS)	2030 (BAU)	2030 (APS)
Others	7,824	5,560	5,227	5,654	6,462	8,636
Electricity	1,824	4,129	8,934	8,048	15,152	13,644
Natural gas	0	77	119	107	168	151
Oil	7,972	12,627	23,753	20,680	34,922	28,989
Coal	633	1,561	2,031	1,828	2,503	2,252

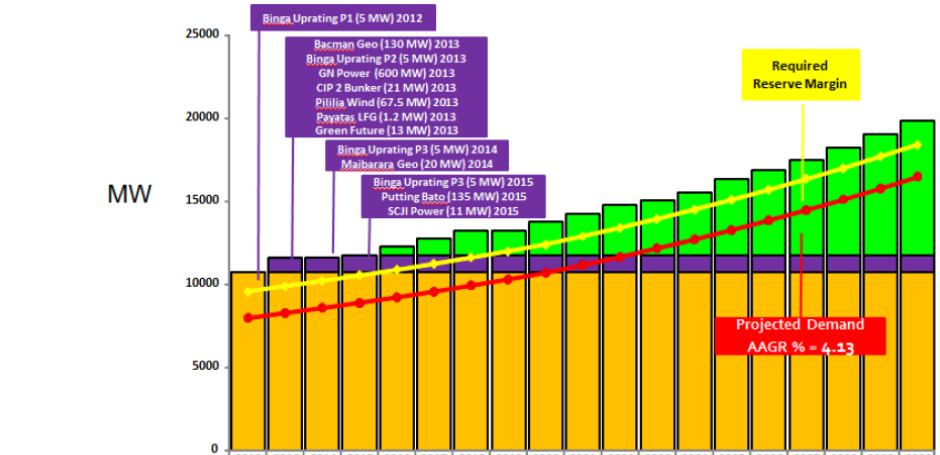
Source: The Institute of Energy Economics, Japan. (2011)

Figure 4: Total Power Generation 2011-2012



Source: Department of Energy. (2013) “Energy Sector Accomplishment Report 2013.”

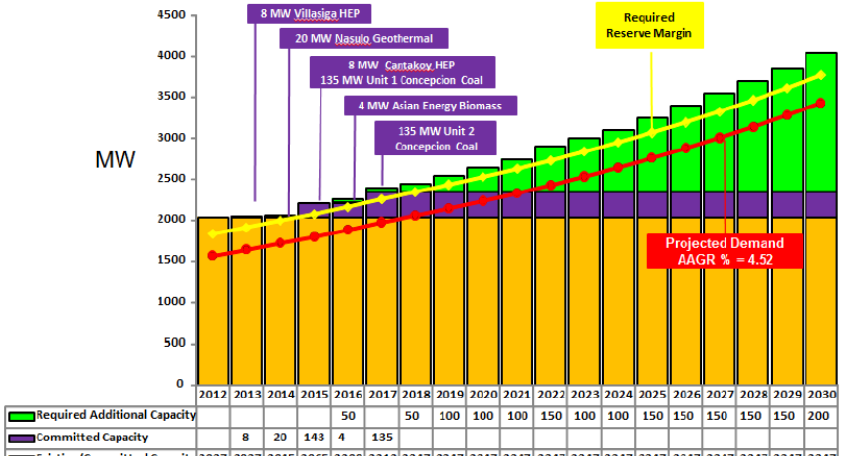
Figure 5: Luzon Grid Supply-Demand Outlook, 2012-2030



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Capacity					500	500	500		500	500	500	300	500	800	500	600	800	800	800
Committed Capacity	5	838	25	151															
Existing/Committed Capacity	10744	10749	11587	11612	11763	11763	11763	11763	11763	1763	11763	11763	11763	10744	11763	11763	11763	11763	11763
Required Reserve Margin	1613	1625	1637	1650	1663	1677	1691	1706	1722	1741	1760	1781	1802	1825	1848	1873	1898	1925	1953
Peak Demand Forecast	7969	8275	8575	8892	9217	9567	9929	10304	10693	11165	11659	12174	12712	13274	13860	14473	15112	15780	16477

Source: Department of Energy. (2013) “2013 Supply-Demand Outlook.”

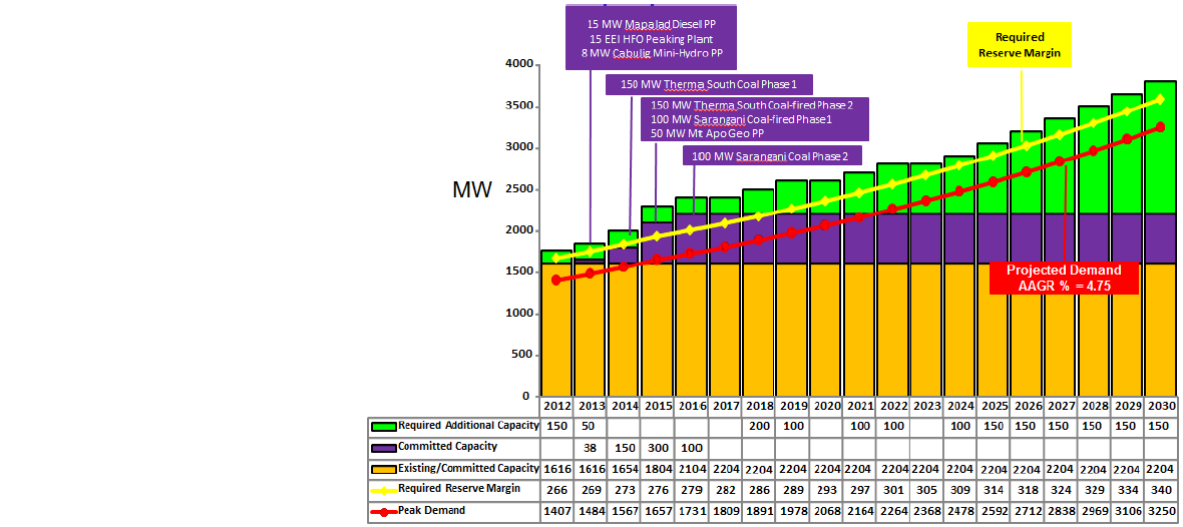
Figure 6: Visayas Grid Supply-Demand Outlook, 2012-2030



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Capacity					50		50	100	100	100	150	100	100	150	150	150	150	150	200
Committed Capacity		8	20	143	4	135													
Existing/Committed Capacity	2037	2037	2045	2065	2208	2212	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347
Required Reserve Margin	263	266	269	272	275	279	282	286	289	293	297	301	306	310	315	320	326	331	337
Peak Demand Forecast	1568	1643	1723	1799	1884	1976	2060	2147	2237	2331	2430	2534	2644	2759	2881	3008	3142	3283	3431

Source: Department of Energy. (2013) “2013 Supply-Demand Outlook.”

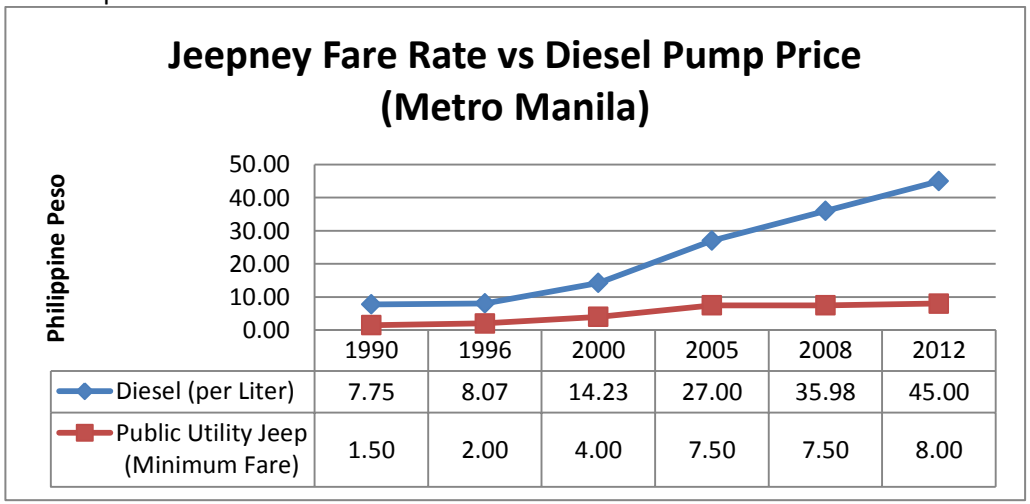
Figure 7: Mindanao Grid Supply-Demand Outlook, 2012-2030



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Capacity	150	50					200	100		100	100		100	150	150	150	150	150	150
Committed Capacity		38	150	300	100														
Existing/Committed Capacity	1616	1616	1654	1804	2104	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204	2204
Required Reserve Margin	266	269	273	276	279	282	286	289	293	297	301	305	309	314	318	324	329	334	340
Peak Demand	1407	1484	1567	1657	1731	1809	1891	1978	2068	2164	2264	2368	2478	2592	2712	2838	2969	3106	3250

Source: Department of Energy. (2013) “2013 Supply-Demand Outlook.”

Figure 8: *Jeepney* Fare Rate and Diesel Pump Price in Metro Manila



	1990	1996	2000	2005	2008	2012
Diesel (per Liter)	7.75	8.07	14.23	27.00	35.98	45.00
Public Utility Jeep (Minimum Fare)	1.50	2.00	4.00	7.50	7.50	8.00

Source: Land Transportation Franchising and Regulatory Board. (2012). "Metro Manila Fare Rates history."

Table 1: Clean Energy in the Philippines

Type of Technology	Estimated Capacity			
	Committed	**Indicative**	**Potential**	**Total**
Hydropower	27.80*	407.00	4,535.94	4,970.74
Geothermal	90.00	200.00	1,165.00	1,455.00
Wind		145.00	2,205.00	2,350.00
Biomass	23.00	190.30	107.60	320.90
Solar			284.05	284.05
Ocean			70.50	70.50
Total	**140.80**	**942.30**	**8,638.09**	**9,451.19**

*includes off-grid hydro committed projects

**includes own use

Source: Sinocruz, Michael. (2012) “Philippines Country Presentation.” June 2012. Presentation on Energy Policy Course - The Institute of Energy Economics, Japan.

Table 2: Distribution of Land Transport Services (as of December 2012)

Type	Total
Public Utility Bus	26,483
Mini Bus	6,193
Public Utility *Jeepney*	234,406
Taxi	45,621

Source: Land Transportation Franchising and Regulatory Board. (2012). "Distribution of Land Transportation Services as of December 2012."

Table 3: GET COMET Technical Specifications

Motor:	30 kW continuous with 56 kW peak power
Motor Torque:	150 Nm @ 200 RPM
DC:DC Converter:	12V 500W
Battery Chemistry:	Lithium Iron Phosphate (LiFePO4)
Battery Pack Capacity:	18 kWHr
Nominal Voltage:	115-144V
Charger:	4 kW onboard, 240 V input
Transmission:	13:15:1 total gear reduction to the wheels
Steering:	Rack and pinion
Wheels:	16 x 6.5 inches
Brakes:	Hydraulic dual circuit disk
Vehicle Range:	up to 100 km
Speed:	56 kph
Charge time:	5 hours on 220V
Occupancy:	16 passengers plus driver
Gross vehicle weight:	2700 kg
Net vehicle weight:	1360 kg
Vehicle Length:	5.75 m
Vehicle Height:	2.22 m
Vehicle Width:	2.05 m

Source: Global Electric Transport. (2014) “COMET: Technical Specifications.”

Table 4: PHUV Electric *Jeepney*: Detailed Product Description and Technical Specifications

Passenger Capacity	14 persons
Dimensions (LxWxH)	4069mm x1492mm x 1980mm
Wheelbase	2080mm
Rear truck width	1210mm
Minimum ground clearance	180mm
Tare weight	Approx. 1,250kg
Gross vehicle weight	Approx. 2,230kg
Top speed	40km/hr
Maximum gradeability (full load)	20%
Wheel size	155/80 R12
Braking distance (full load, 20km/hr)	7m
Minimum turning diameter	5m
Motor rated power	7kw
Voltage/batteries	84V (6 x 14), 225Ah
Consumption time per charge	8-10 hours
Maximum continuous mileage after recharging batteries (one time, full load, plain road condition)	55kms

Source: Philippine Utility Vehicle Incorporated. "The Electric *Jeepney*: Detailed Product Description and Technical Specifications."

Table 5: Price Estimates of Selected Electric Vehicles

Model/Type	Cost		Cost	Cost	Source
	Currency	Amount	in Philippine Peso	in US Dollar	
Beijing Auto E150EV	CNY	249,800	1,748,600	39,968	China Auto Web
BYD e6	CNY	300,000	2,100,000	48,000	China Auto Web
Geely EK-2	CNY	100,000	700,000	16,000	China Auto Web
Chery Riich M1	CNY	149,800	1,048,600	23,968	China Auto Web
2013 Tesla Model S	USD	69,900	3,044,844	69,900	Davis and Nudelman 2013
BMWi3	USD	41,350	1,801,206	41,350	Davis and Nudelman 2013
2013 Chevrolet Volt Plug-in Hybrid	USD	39,145	1,705,156	39,145	Davis and Nudelman 2013
2013 Nissan Leaf	USD	28,800	1,254,528	28,800	Davis and Nudelman 2013
Chevrolet Spark EV	USD	27,495	1,197,682	27,495	Davis and Nudelman 2013
GET Comet	PHP	800,000	800,000	18,400	Ranada 2013
PhUV E*jeepney*	PHP	700,000	700,000	16,100	Roque 2012

Conversion Rate (as of May 14, 2014)

Chinese Yuan (CNY) to Philippine Peso (PHP)	CnY 1 = PhP 7
Chinese Yuan (CNY) to US Dollar (USD)	CnY 1 = USD 0.16
Philippine Peso (PHP) to US Dollar (USD)	Php 1 = USD 0.023
US Dollar (USD) to Philippine Peso (PHP)	USD 1 = PhP 43.56

Table 6: Annual Fuel Requirement of *Jeepneys* (per unit)

Fuel Efficiency (*Jeepney*)	5.54	Liters
Range	100	Kilometers
Operational Days (Annual)	313	Days
Annual Diesel Requirement per Unit	173,402	Liters/Year

Data Source: Pokharel, et. al. (2014); Gota (2014)

Table 7: Annual Power Requirement – E-*Jeepney*

Battery Capacity GET COMET (Daily)	18	KiloWatt-Hour
Range	100	Kilometers
Operational Days (Annual)	313	Days
Annual Power Requirement per unit	5,634	KiloWatt-Hour per year

Data Source: Global Electric Transport (2014)

Table 8: Estimated Annual Power Requirement and Fuel Displacement of Electric *Jeepneys*

Number of E-*Jeepney* Units	Annual Power Requirement		Annual Fuel Displacement (in Liters of Diesel)
	(in KiloWatt-Hour per year)	(in MegaWatt)	
10,000	56,340,000	6.43	1,734,020,000
20,000	112,680,000	12.86	3,468,040,000
50,000	281,700,000	32.16	8,670,100,000
100,000	563,400,000	64.32	17,340,200,000
150,000	845,100,000	96.47	26,010,300,000
200,000	1,126,800,000	128.60	34,680,400,000
250,000	1,408,500,000	160.80	43,350,500,000