A Study on Socio-Economic Impacts of a Sustainable Energy Flow System in the Philippines

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This study shall investigate and analyze the entire Philippine energy sector system. This is tackled by looking into three scopes of framework for sustainability; (1) electricity quality and reliability, (2) electricity price, and (3) carbon emissions. Present policy and regulation will be reviewed; back-casting method shall be applied, in addition to scenario analysis, to examine the sustainability of the entire system. Possible viable technology, economy and policy instruments to attain lower cost, better electricity quality, and lesser carbon emissions shall be provided.

Key Words : *back-casting, electricity quality, electricity price, carbon emissions, instruments*

1. BACKGROUND AND OBJECTIVES

Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) released in 2007[1)] asserts that the energy supply sector has to create policies and measures in order to mitigate and adapt to climate change. A number of strategies were identified; including reduced dependence on a single source of energy, and strengthening transmission and distribution structures for adapting to climate change; and reduction of fossil fuel subsidies and increase tariffs for renewable energy technologies for mitigation measures.

In relation to this assessment, the Philippine energy sector recently reformed itself towards attaining energy independence and reduction of carbon emissions by implementing the Renewable Energy (RE) Act of 2008, and to address the acute power supply problem and high energy prices by implementing the Electric Power Industry Reform Act (EPIRA) of 2001.

These two new laws are related to the general increase in population, GDP, and energy generation of the country. Historically, the population of the Philippines has been growing; rate at 2.3 to 2.5% from 68 million as of 1995 to 90 million as of 2009[2)]. GDP is generally increasing, averaging 5% annually, with 65.2 billion USD as of 1995 to 167 billion USD as of 2008[3)]. Energy generation has been steadily increasing from a sudden increase of 28.99 billion kWh as of 1994, to 57 billion kWh as of 2009, however these numbers comprise fossil fuels in the energy mix from 83% as of 2000, and 70% as of 2009[4)].

The objectives of this study are (a) to investigate the causes of power fluctuation, lack of electricity in some areas, power outage, and high electricity price that has persisted the Philippines for many years, (b) to provide one long-term strategic plan for a sustainable energy flow development in the country, and (c) to provide reference to the academe, investors, and local governments in the Philippines to address the dismal state of the power industry.

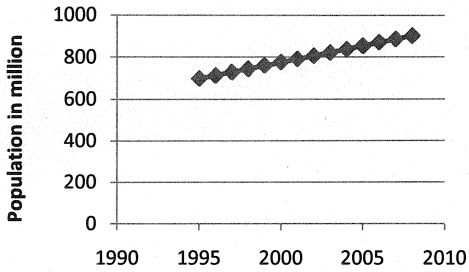

Fig.1 Population of the Philippines, midyear estimates of resident population.

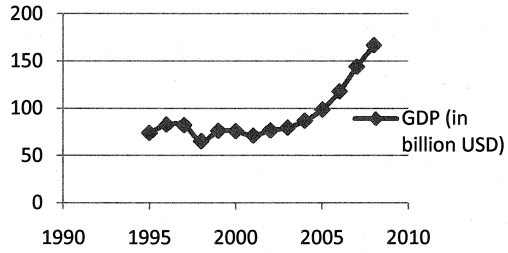

Fig.2 GDP of the Philippines in current US Dollars, not adjusted for inflation.

2. METHODOLOGY

Back-casting method is applied in order to examine the means to attain sustainable energy flow system. This shall be done by: (1) defining the scopes of framework to attain sustainable energy flow system (2) envisioning the future situation in three scenarios Business-As-Usual, High Growth, and Moderate Growth, and (3) assigning appropriate technology, economic, policy, and regulatory instruments for each scope of framework.

In order to define and evaluate the future, three scopes of framework for a sustainable energy flow system are identified as follows:

(1) Electricity Quality and Reliability

Quality and reliability are viewed in three ways: (a) power outages are experienced, averaging five to ten times a month, (b) measured in fluctuation – deviation in standard supply voltage, and (c) 5% of the population of the entire country have no access to electricity.

It is aimed that in ten years time, all Filipinos have access to electricity 24/7, wherein at present, approximately 5% of the population has no access[5], and the majority of the population experience power fluctuation incidences averaging 10 minutes a month. Another area is grid fluctuation – there is a need for a more stable adjustment from 180V to 260V fluctuation to 198V to 242V, given that the Philippines' power voltage is at 220V.

(2) Electricity Price

50% of the total price of electricity paid by consumers of all sectors is devoted to electricity generation capacity. This can be reduced substantially in 5 years' time by turning the electricity generation industry into a buyers' market through the privatization of formely governement-owned power generating assets. At present, privatized assets are at 70%[5]. Prices can be reduced at 0.25 USD/kWh to 0.16 USD kWh for the household sector, 0.21 USD/kWh to 0.11 USD/kWh for the commercial sector, and 0.16 USD/kWh to 0.09 USD/kWh for the industry sector. Lastly, system loss at present 13% should be decreased to 8% in 15 years.

(3) Carbon Emissions

Dependence from imported fossil fuels resulting to carbon emissions (50% of total carbon emissions in the country come from the energy sector) can be addressed by reverting the present power generation mix to 30% fossil fuel-based, and 70% renewable energy-based in 25 years' time. This shall decrease carbon emissions in the energy sector from 2007 level at 35,458 thousand metric tons, to 1990 level at 22,266 thousand metric tons[6].

(4) Scenario Analysis

Table 1 is a summary of the three scenarios forecasted economc development of the Philippines, and how such factors can affect the eneregy flow systems of the country.

An increase in GDP is directly related to the increase of electricity consumption[7], as observed in most countries, both developed and developing. In addition, it determines how much investment the energy sector can invest on resources like labor and equipment to expand RE. Electric consumption is the basis for forecasting required energy generation. Population (mainly increasing in trend) determines the demand of electricity.

All scenarios, except BAU operate in such a way that prices of fossil fuel are expensive, and volatile (as it is at present). Both high development and moderate development growth have increase their RE share of the power mix to 70%. The main difference is the source of the RE in which it will be allocated. The Philippine electricity generating sector increased the use of natural gas due to price decrease from development of natural gas reserves – the main one located in Malampaya, Palawan[8].

Despite this, concerns related to increasing price of fossil fuels in general make it appealing for most to develop alternative sources of energy.

Table 1 Summary of the three scenarios

Scenario A Business as usual	*Scenario B High Development*	*Scenario C Moderate Development*
1. GDP growth rate 4% 200 biliion USD at 2035 (nominal GDP)	1. GDP growth rate 10% 417 billion USD at 2035 (nominal GDP)	1. GDP growth rate 7% 292 billion USD at 2035 (nominal GDP)
2. Electric Consumption 52,001,000,000 kWh (2007) Average annual increase: 2%	2. Electric Consumption 77,000,000,000 kWh (as of 2035) Average annual increase: 5%	2. Electric Consumption 68,000,000,000 kWh (as of 2035) Average annual increase: 3.5%
3. Population 2.5% 90 million (as of 2009)	3. Population rate 3% 139 million (as of 2035)	3. Population rate 2.7% 135 million (as of 2035)
4. Investments for expanding RE slow due to decrease in price of natural gas and coal	4. Strong promotion and expansion of RE technologies into the energy mix	4. Conservative promotion and expansion of RE technologies into the energy mix

Nominal GDP of the Philippines as of 2008 is 167 billion USD, growth rate at 4%. Electric consumption as of 2007 is 52,001,000,000 kWh, having an average annual increase of 2%[9]. Population as of 2009 is 90 million, with growth rate at 2.5%.

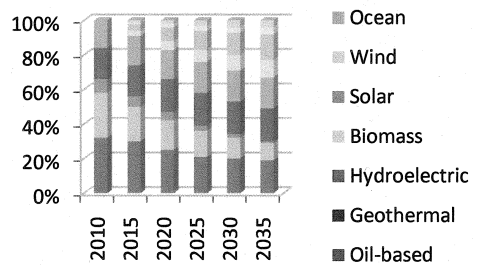

Fig.3 Forecast of the future power generation mix for high development growth

The results of this scenario show a more aggressive expansion of solar, biomass, wind, and ocean power. Particularly, solar, wind and ocean power are still expensive, and require more capital. Local biomass energy is still under development; present cost is still not competitive enough for mass market distribution. At present, a number of power projects are being approved for development, including a project to expand solar power in Bohol[10], and biomass wastes in Quezon[11]. If such projects expand and continue, this kind of scenario is foreseen.

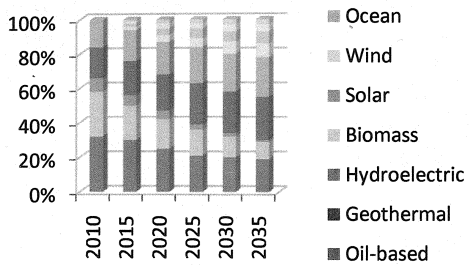

Fig.4 Forecast of the future power generation mix for moderate development growth

The results of this scenario show more investment on geothermal and hydroelectric power. At the time of writing, most investors are attracted to investing on these two technologies because of lower cost, compared to solar, wind, and ocean. Including such is a one of the largest private RE producer in the Philippines called AboitizPower – this firm currently acquires present hydroelectric and geothermal facilities, as well as investing on new equipment[12]. Such activities reflect the scenario described above.

3. INSTRUMENTS TO SUSTAINABLE ENERGY FLOW

The following are instruments that will bridge the gap between the present, and ideal future to a sustainable energy flow of the Philippine energy sector. Bearing the scenario analysis in mind, actions should be undertaken if expansion of RE sources are desired for a sustainable energy flow systems.

(1) Electricity Quality and Reliability

Electricity quality and reliability can generally be addressed by upgrading power plants and electricity generating equipment, updating standards, and strict regulatory control. At the time of writing, 70% of the once government-owned assets are now privatized. Operations and maintenance of power plants and equipment will be more efficient with this arrangement. The creation of the EPIRA law is a crucial step that aim to improve the efficiency of the electricity generating sector. There are annual reports published related to such that inform the public on the number of power plants sold to private firms, to how much electicity is produced, and the status or future goals of certain short-term projects.

To address the number of power failures that plague the country from time to time, besides efficient power plants, back-up reserves will be crucial to ensure electricity services are available 24 hours a day, 7 days a week.

Table 2 Summary of the instruments which address electricity quality and reliability

Technology (A)	*Economics (B)*	*Policy and Regulation (C)*
A1. Upgrade of transmission & Distribution lines, transformers, substations. A2. Installation of new lines in areas without electricity service. A3. New Power Plant Capacity Installation with back up reserves. A4. Maintenance up keep of Existing Power Generation, Transmission, and Distribution Facilities	B1. Performance Base Incentives. B2. Performance Guarantees from Generators, Transmission Company, and Distributors. (System of penalties for warranty failures) B3. Missionary charges to benefit far-flung service area	C1. Implementation and Enforcement, under good governance, of the EPIRA Law, and National Electrical Standards. - Privatization. - Open Competition. - Electrical Quality & Safety Standards. C2. Promotion of BOT Law (Build-operate-transfer) for the entry of new investments in Power Industry. C3. Strict regulatory control by the ERC (Energy Regulatory Commission) of its mandated function.

Build-Operate-Transfer arrangements has been used many times whenever the Philippine government wishes to attract investors for big projects. It is an arrangement wherein a private firm or a group of private firms engage in a long-term contracts with the government. The private firm or firms initially build the facilities and establish the operating systems of the project or business, and after the contract ends, this is turned over to the government. It is believed that this arrangement will work to encourage investors to invest in high cost power plants and equipment that will be used for long periods of time.

Missionary charge is a minimal fee (approximately 1 USD) that is collected through a consumer's monthly electric bill, that shall benefit consumers who have no access to electricity, usually residing in remote and rural areas.

Strict regulatory control is the most challenging in the instruments given at Table 2. This clearly should go along side with upgrading of standards, and any deviation that may result to inefficiency should be dealt with and controlled.

(2) Electricity Price

Making electricity prices competitive and affordable for all can be attained by providing economic incentives to investors, proper benchmarking of prices, and same with strict regulatory control.

A big chunk (at 50%) of what the consumers pay from their electric bill comes electricity generation. Generally, Table 3 addresses this concern. Another area in which prices can be reduced is system loss. 6% of what a Filipino pays for his bill goes to system loss, not directly benefiting the consumer through use of electricity.

Table 3 Summary of the instruments which address electricity price.

Technology (A)	*Economics (B)*	*Policy and Regulation (C)*
A1. High Efficiency Equipment for New Power Plants A2. Upgrades for efficiency improvement of Existing Power Plant A3. Balanced – Mix of Power Generation Equipment (Geothermal, Hydro, Coal, Natural gas, Oil, Biomass, Wind, solar, etc.)	B1. System loss cap to transmission company and Distributors. B2. Performance Base Incentives, and Performance Guarantees from Generators, Transmission Company, and Distributors. B3. Demand – Capacity Balance, with enough reserves. - No over supply - No shortage B4. Transparent information of Electricity price components. B5. Continuous Benchmarking of Electricity Price for competitive actions	C1. EPIRA LAW implementation. - Privatization - Open Competition C2. Good Governance - No corruption - No political favor - Stable policies - Peace and order - Infrastructure development C3. Strong Regulatory Enforcement by the ERC (Energy Regulatory Commission) of its functions. C4. Investment Promotions through the BOT Law and BOI – IPP, (Board of Investment's - Investment Priority Plan) C5. Enforcement of Electricity Pilferage Law C6. Enactment of Indigenous Energy Resources Law

Open competition will encourage electricity-generating firms to make their services competitive to the consumer, and thereby bring down prices as a result.

Peace and order issues, that go way back after World War II, still persists at this time, most especially in rural areas of the Philippines. Negotiating land uses with the community, and equal

sharing of benefits (most especially upon establishment of RE infrastructures) is important. It is even hoped that RE will provide income and employment to the community.

(3) Carbon Emisssions

Good quality and reliable electricity can be achieved, without sacrificing more carbon emissions. This can be done by mainly expanding renewable energies, and establish economic instruments like carbon taxes. The carbon taxes collected can be allocated for investing, operating or maintaining power-generating facilities, upgrading any equipment used to measure carbon dioxide emitted, or pay for services that offer environmental impact assessment. Below describes and summarizes other ways to decrease carbon emissions from the energy sector.

Table 4 Summary of the instruments which address carbon emissions.

Technology (A)	*Economics (B)*	*Policy and Regulation (C)*
A1. Development and use of RE technologies eg. Biomass, wind, Solar, Ocean, etc. A2. Adopt "waste to energy" technologies A3. Increase geothermal and hydroelectric sources. A4. Upgrades of Existing Fossil-base Power Plant for efficiency up and clean emissions	B1. Tariff Entry on RE Facilities. B2. Carbon Taxes B3. Carbon Credits and Carbon Trading B4. System of Incentives - Shift from fossil to RE - compliance awards B5. System of Penalties - Non-compliance to regulations - Decrease subsidy on Fossil based technology.	C1. Promotion and Enforcement of the RE Law C2. Tariff entry, investment through BOT, and Indigenous Resources Law C3. Enforcement of clean Air Act. - Emission/ monitoring - Impact assessment - Compliance Obligation C4. Balance – contributions to the RE entry in the Energy Mix from Investors, Government and Consumers. Everyone must contribute towards clean environment. C5. Priority Use of RE and Low emission facilities.

(5) Delimitations

RE technologies development is still in its infant stage, and it will depend on the development progress of RE technology producers to find the competitive advantage against fossil-fuel based technologies. Finding ways to make RE competitive is not included in this study.

There are other laws or initiatives that will complement, or trigger more encouragement to investors, to make the transition faster.

Other GHGs, such as NOx, SOx, and particulate matters are excluded. Related to Environment Impact Assessment (EIA), forecasting how much of the other GHGs should be calculated, in order to take action on minimizing or eliminating the emissions of the GHGs not mentioned.

Measures provided in this study all aim to bring down costs, make electricity quality better, and decrease carbon emissions. However, it is difficult to see if the general public shall accept such measures. It is also difficult to see the possible deviations on how these can be implemented – most especially if specific numbers and targets (time frame and costs) are defined. All instruments require trade-offs, financial or non-financial in nature. More importantly, the poor ideally should ultimately benefit the most from these measures. Sustainability should not only address the future generations, but also include the economically vulnerable.

4. RESULTS AND DISCUSSION

BAU scenario produces an electricity output of 60 billion kWh. This does not encourage more business activity, does not meet growing demands for electricity, and therefore, does not drive economic growth. BAU is most unlikely to happen among all scenarios because of volatile prices in fossil fuels, changes in policies that favor investments for RE, and heightened confidence for investors.

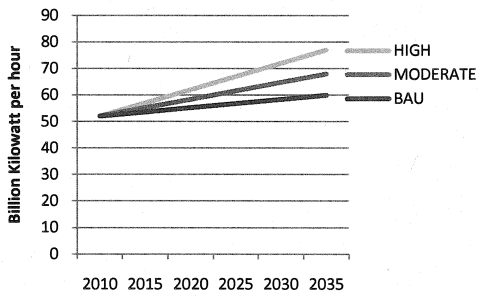

Fig. 5 Total energy output by 2035 for all three scenarios

High development scenario produces 77 billion kWh; favorable for businesses and governments to make investments (for expanding businesses), or collect revenues. High development scenario is

likely to happen, but not as confident as moderate scenario. There are instances when the Philippines hit a 10% GDP growth rate, but such cases are not consistent.

Moderate scenario is most likely to happen, given the fact that current GDP is picking up at 7.5%. By 2035, projected total electricity output will be 68 billion kWh. Grants on tax incentives for RE projects are currently increasing[13], and this shall fuel more investments to expand on RE.

5. CONCLUSION

This study is able to provide some answers why the Philippines has problems in its energy system; and has identified instruments to create sustainable energy flows, in reference to the Contributions of Working Group II of the Fourth Assessment of the IPCC. Policies that encourage or provide incentives create changes needed to strengthen generating capacity and transmission lines. Better quality electricity would translate to competitiveness, and thereby drive down prices for the benefit of consumers. Such result will gear on towards further economic growth. If properly implemented, the two new laws can attain the objectives of making the quality and price of electricity competitive. Carbon emissions will revert to at least to the 1990 level at 22,266 thousand metric tons. Related to future undertakings for this paper, more details for the scenaio analysis shall be done. This shall be tackled by verifying the targets the Philippines in expanding its RE.

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