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Power Generation Investment and Electricity Pricing in Deregulated Energy Markets

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Abstract: ***This paper discusses deregulated electricity markets with a focus on highlighting the factors that have constrained generation investments, kept prices up and possible ways of mitigating them. The pricing structures adopted in electricity markets were ex-rayed and comparisons of generation investment mix were made between case nations to ascertain effectiveness. This study concludes that a wholesale competitive market, cost reflective pricing and right generation mix are essential for improved electricity availability, reliability and sustainability.***

Keywords: Electricity Market, Deregulation, Generation Capacity, Electricity supply and demand, Wholesale.

I. INTRODUCTION

Electricity consumers are becoming increasingly sceptical about the much benefits that deregulation of the electricity market have promised to bring. The reasons are not farfetched – increased tariff, epileptic power supply and sometimes total back-out. To address these obvious displeasures, there is need to tackle a major structural problem - a disconnection between wholesale and retail energy markets, and make accelerated transition into a competitive wholesale market.

During the transition from a vertically integrated company to a deregulated company, vesting contracts are mostly adopted with the new Gencos by regulatory agencies in effort to provide a viable and robust tariff policy (NERC, 2012). This pricing structure is always shrouded with a number of market imperfections and institutional constraints that have the effect of keeping wholesale prices for energy and operating reserves below their efficient levels during hours when prices should be very high, and thereby provide insufficient net revenues to support the capital costs of an efficient portfolio of generating facilities (Joskow, 2006). The incomplete transition to a stable retail competition often leads to instability in the market. These have in turn lead to underinvestment in generating capacity and also will not attract investors in sustainable renewable generation mix e.g. solar, wind, biomass, etc needed in response to climate change policy as well as security of supply (Hattori and Tsutsui, 2004).

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The concerns about investments in new generating capacity reflect one or more of the several interrelated problems with markets operating under vesting contracts. First, it has been argued that electricity markets built on vesting contract for energy and operating reserves do not and perhaps cannot credibly provide sufficient net revenues to attract adequate investment.

In generation to meet conventional operating and investment economic efficiency and reliability criteria (Joskow, 2006). According to this view, spot wholesale electricity market prices for energy and operating reserves will simply not be high enough to cover both the operating costs and the capital investment cost required to attract new investment in long-lived generating capacity (Steven, 2002). Also spot market prices are too low and volatile to support new investments in capital intensive generating capacity without support from long term contractual agreements between generators and wholesale or retail supply intermediaries (Steimikiene, Bruneckiene and Cibinskiene, 2013).

II. ELECTRICITY GENERATION DETERMINANTS

One of the primary functions of regulatory agencies in a deregulated market is to ensure that the prices charged by licensees are fair to consumers, and are sufficient to allow the licensees to finance their activities and to allow for reasonable earnings for efficient operation [Hattori and Tsutsui, 2004). Also Methodologies are to be established for regulating electricity prices and adopt approaches to ensure a fair and cost-reflective tariff regime capable of sustaining the electricity supply industry while at the same time attract investment into the sector.

Adequate pricing regime is critical to achieving the desire of creating an industry that provides reliable and quality service to electricity consumers thus developing an efficient market that will meet the increasing energy demands. Investors' apathy in new generation capacity investments, lack of private sector participation and inadequate generation mix is unconnected to the fact that there has been a very slow transition into a wholesale market where bilateral contracts are negotiated between generating companies and the retail market with the system operator ensuring that the transmission capacity is made available. The existing Vesting Contracts between the Gencos and Discos does not always provide adequate incentive for new generation capacity investment because a large fraction of the net revenues earned to compensate investors for the capital they have committed to generating capacity relies on spot market prices realized during a very small number of hours each year.

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The potential opportunity for market rules and regulatory actions to keep prices from rising to their appropriate levels even in a few hours each year when efficient prices would be fairly high can seriously undermine investment incentives (Steven 2002).

III. FACTORS AFFECTING GENERATION INVESTMENT

Electricity differs from other products in that it cannot be economically stored as it is produced. The implication of this instantaneous supply and consumption is that price has to be sufficient to cover the cost of production; otherwise supply will be jeopardised (Crew et. al, 2006). Electricity demand is also uncertain in both the long and the short run and this uncertainty has affected investment and operating decisions in many ways. The key factors that have far reaching effect on generation capacity investments are:

i) Electricity Pricing Method
ii) Rate of inflation
iii) Unstable Gas Prices
iv) Foreign Exchange Rates
v) Unclear Demand trajectory
vi) Revenue collection inefficiencies
vii) Government policies

All the above itemized factors are mostly dependant on external dynamics which the power industry can not directly influence except the pricing method, thus the need to develop a very efficient pricing method is sacrosanct.

IV. ELECTRICITY GENERATION INVESTMENT MIX AND ELECTRICITY PRICES IN SOME DEVELOPING COUNTRIES

To ascertain the impact of generation investment mix on electricity prices, the share of hydroelectricity, gas and oil, nuclear and renewable energy (solar, wind, biomass, geothermal) investments in some developing nations with comparable population and gross national income per capita are evaluated.

Table 1: Nigeria Generation Mix and Unit Price

Generation Source	Installed Capacity (MW)	Available Capacity (MW)	Percentage Share %	Cost per kWh (US cent/kWh)
1. Hydro	1900	1350	27.1	8.60 for Residential, 12.94 for commercial while 12.56 for industrial consumers
2. Gas	23255.2	3628	72.8	
3. Coal	0	0	0	
4. Nuclear Energy	0	0	0	
5. Other Renewable sources (Wind)	100	0	0	
Average Hours of Power Outages Monthly: 8.2hrs				

Table 2: Philippines Generation Mix and Unit Price

Generation Source	Installed Capacity (MW)	Available Capacity (MW)	Percentage Share %	Cost per kWh (US cent/kWh)
1. Hydro	3,491	1900	20.2	24.85 for residential, 20.43 for commercial and 17.28 for industrial
2. Gas and Oil	2,861	2337	24.7	
3. Coal	4,917	3731	39.4	
4. Nuclear	621	0	0	
5. Other Renewable Sources	1,900	1480	15.67	
Average Hours of Power Outages Monthly: 0.91hrs				

Source: (KPMG, 2014)

Table 3: Indonesia Generation Mix and Unit Price

Generation Source	Installed Capacity (GW)	Available Capacity (GW)	Percentage Share %	Cost per kWh (US cent/kWh)
1. Hydro	2.5	1.65	18	11.69 for residential, 12.21 for commercial and 11.18 for industrial
2. Gas and Oil	14.5	11.02	45.8	
3. Coal	11.6	8.58	40	
4. Nuclear	0	0	0	
5. Other Renewable Sources	0.6	0.5	4.2	

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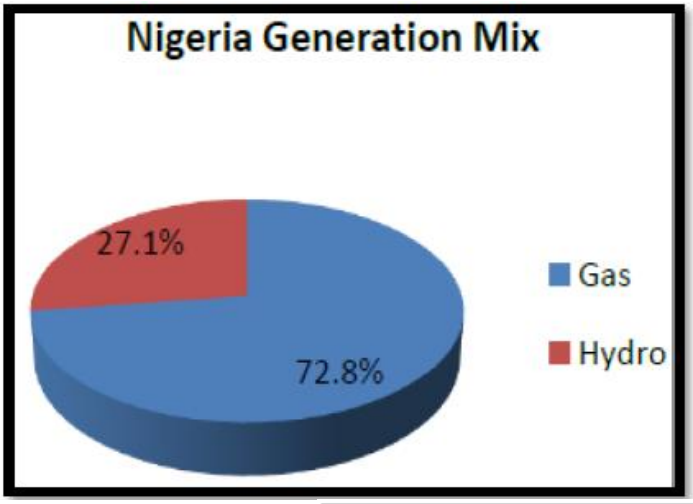
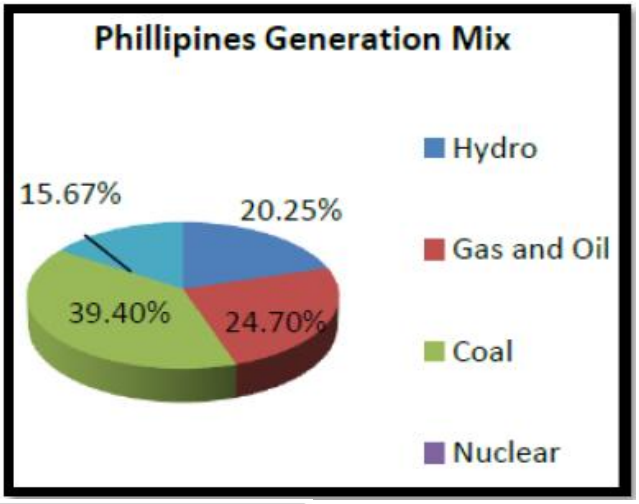
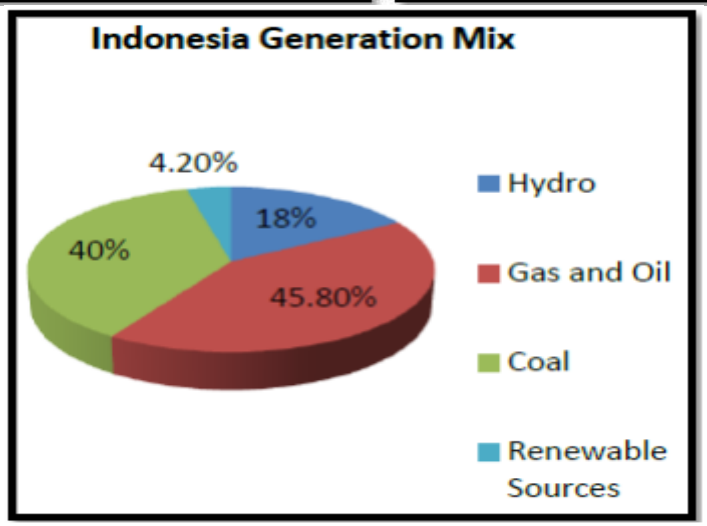
Average Hours of Power Outages Monthly: 2.3hrs

Source: (PWC Indonesia, 2015)







From the tables above, it can be seen that there is a correlation between electricity price and generation investment mix. The inadequate mix of generation technologies could be because of low electricity price that is not cost reflective bearing in mind that this is what goes to paying the cost of generation and transmission in addition to the cost of distribution. Comparing the share of generation mix in Table 1 and Table 2 as shown in the tables above, it is evident that Table 1 does not have the right mix of generation because only gas powered plants account for about 75% of its generation and these are peak load type of power plant which have lowest capital cost but highest cost of operating per unit of capacity. They are only economical to operate for a few hours per year up to about 25% of the yearly hours. The case countries in Table 2 and Table 3 have a fair mix of generation technology of power plants. Thus for reliability of electricity more investments are needed in base load power plants (Coal, Hydro, Nuclear e.t.c) as though they have high capital cost, these facilities have low operating cost and are economical to operate for a large fraction of hours of each year as compared to peak load plants (Gas, Oil e.t.c).

V. WAYS OF BUILDING A SUSTAINABLE ELECTRICITY MARKET

To ensure the sustainability of an electricity industry, deliberate measures should be set up towards developing methodologies that will attract investments so as to increase generation capacity and also maintain a reasonable price. The following among others will contribute towards achieving this:

a) Speedy transition into a wholesale competitive market with a stable and cost-reflective pricing structure that provides a modest return on investment and provides financial incentives for urgently-needed increased investments in the industry. These investments will in turn, lead to a significant and continuous improvement in the quantity of energy and quality of service enjoyed by the consumer.

b) Appropriate mix of base load, intermediate load and peak load generators is needed to ensure a sustainable and reliable power supply.

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c) Adopting a bilateral market model so as to give generators and suppliers the freedom to trade via contracts.
d) Honesty in tackling corruption and stability in government policies.
e) Ensuring that the regulatory agency is transparent and fair to all participants in the industry so as to enjoy sufficient support needed to attract investors.
f) Set up an effective environmental agency for carbon emission control in response to climate change policy.
g) Incentives are required to encourage investors in renewable generation mix (solar, wind, tidal and biomass).
h) Modular renewable sources as embedded or captive generation should be encouraged as it would help to ensure electricity supply for rural communities and will reduce pressure on supply from the Grid.

VI. CONCLUSION

The deregulation of electricity market is in tandem with global trends but effective implementation of a competitive wholesale and retail market structure, and a cost reflective pricing is imperative to attracting new investments that will boosts the generation capacity in line with growing demand. Also appropriate generation mix is needed so as to ensure sustainability of supply.

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