Economic impact of IFI investments in power generation in the Philippines

steward redqueen

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About Steward Redqueen

Company profile
Steward Redqueen is a strategy consultancy firm that aims to make business work for society. It is represented in Amsterdam, Barcelona and Princeton and executes projects around the world. As specialists since 2000, Steward Redqueen focuses on integrating sustainability, quantifying impact and facilitating change for (multinational) corporations, (development) financial institutions and public sector organisations. In 2015 Steward Redqueen won CFI.co magazine's *Best Emerging Markets ESG team – Global, 2015* award.

Socio-economic impact assessments (SEIA)
In the long run, business cannot succeed in societies that fail or fail to share the fruits of economic growth. The private sector therefore must include societal interests in its decision making and look for shared benefits. The better stakeholders understand how the private sector contributes to economic development, the more they will support its strategic goals. Steward Redqueen quantifies direct and indirect socio-economic impact in a particular country or region and analyse the myriad of ways through which firms are connected to the economy.

The Authors
Dr René Kim is founder and partner of Steward Redqueen. He has worked with many multinational companies and private equity funds in both developed and emerging markets. Previously, he worked for the Boston Consulting Group in Amsterdam and as an academic at the Massachusetts Institute of Technology. He holds a cum laude PhD in Hydrology and Meteorology and is the author of many academic articles.

Prof. dr Ethan B. Kapstein is an associate partner of Steward Redqueen. He is also visiting fellow at the Center for Global Development and senior director for research at the McCain Institute for International Leadership, both in Washington, DC and a visiting researcher at Princeton University. For many years he held the chair in political economy at INSEAD, and has taught as a Visiting Professor at Wharton, Georgetown, and Oxford.

Track record
Steward Redqueen has completed more than 100 socio-economic impact studies and evaluations for multinational mining companies, development finance institutions, multinational food & beverage firms, agricultural companies, banks and recreational organisations, in Asia, Africa, North & South America and Europe.

Executive summary

Employment creation is one of the main objectives of international development finance institutions (IFIs). Many IFIs have joined forces in the World Bank lead *Let's Work* partnership as a concerted effort to share and develop approaches and methods to measure the impact of their interventions on the creation of jobs.

The lack of electric power is considered a major hurdle to economic development in many countries. Many IFIs have therefore build up substantial portfolios of investments in generation, transmission and distribution of electric power. The measurement of the impact of these investments is rather complex however. The reason for this is that whereas for companies employment creation can be measured by 'counting' jobs along the supply or value chain, the main impact of power investments does not come from the actual production or distribution of power but rather from how it is used in the economy.

The *Let's Work* partnership therefore initiated this study to analyse the economic and employment impacts of IFI investments in the power generation sector in the Philippines. This study follows on other IFI initiated impact studies like the PIDG-commissioned study on the Bugoye power plant in Uganda and the study on Powerlinks transmission in India/Bhutan conducted by IFC. This report explains how the impact of IFI investments in Philippine power generation largely travels through its effect on electricity price. Unlike the situation in a number of other emerging markets (notably in Africa) where demand (far) outstrips generation capacity, power supply in the Philippines has historically been able to satisfy demand, albeit at prices which likely constrain demand.

Residential electricity consumption depends much more on income than on electricity price (i.e. is elastic with respect to income and inelastic with respect to price). In most commercial sectors electricity use is also rather price inelastic because it constitutes a fixed production cost. In the manufacturing sector, however, electricity is largely a variable cost and electricity consumption has thus been found to be more price elastic. For that reason and because the manufacturing sector is responsible for about a third of electricity consumption, this study focusses on the marginal price decreasing impact of IFI-attributable power generation and thereby on increasing manufacturing sector output. Apart from a direct increase of value added (incomes), more manufacturing output also requires other sectors to increase their output and value added (incomes), which in return will increase electricity consumption, thereby increasing electricity prices.

The analysis of IFI power generation investments on employment consists of four steps:

1. Attribution of the generation capacity of the power plants to IFIs based on the equity and debt finance provided;
2. Formulation of a detailed electricity price model based on the power supply and demand situation in the Philippines to determine difference between electricity prices with and without the IFI-attributable capacity as determined under point 1;
3. Quantification of the electricity price elasticity of manufacturing output using World Bank Enterprise Survey data, which can be used with the price results from point 2 to quantify the change of manufacturing output;
4. Quantification of the direct and indirect economic and employment effects of the larger manufacturing output determined under point 3 using the Philippine Social Accounting Matrix.

The main findings of this report are:

1. Electricity in the Philippines is expensive when compared to other Asian countries, especially in purchasing power terms. Prices have increased since the market was liberalised following the EPIRA legislation of 2001. The high prices are due to a number of factors, among which the expensive infrastructure (reflecting island geography and extreme climatic conditions), the absence of government imposed tariffs and subsidies, electricity taxation as well as tight supply conditions;
2. Until 2015, power generation capacity has under normal conditions been sufficient to meet electricity demand. However reserve margins have been decreasing as demand growth has outstripped the growth of generation capacity. As a result generation charges have increased as expensive peak capacity has been used more often to meet demand;
3. International Financial Institutions (IFC, ADB and Norfund) have been pioneering and important players in the privatisation of generation assets. Specifically, the IFI-attributable power generation capacity is 400 MW, 2.9% of the dependable power generation capacity of the Philippines as per year end 2013;
4. The detailed model of power supply and demand that has been constructed is shown to accurately reproduce observed power prices in the Philippines over 2013-2014. The model is therefore deemed adequate for determining the marginal effect of IFI-attributable power generation on electricity prices;
5. Using the power supply model in conjunction with actual (2013) and forecasted (2014 – 2016) demand profiles, the marginal effect of IFI-attributable generation capacity is a decrease of generation prices of between 7.2% and 10.8%. Because generation charges are some 55% of the pre-tax end user tariffs, this is equivalent to a marginal decrease of electricity prices 3.9% - 6.0%. These lower generation charges translate into electricity cost savings of USD 484m – 1,046m per annum for residential, industrial and commercial users;
6. Based on the World Bank Enterprise Survey the output-weighted average factor share of electricity in manufacturing output is determined at 0.279. There are large differences between sectors however, ranging from 0.15 for non-metallic minerals to 0.35 for the food & beverage sector, which makes up 50% of the manufacturing sector;
7. In absence of panel data, based on a review of relevant literature the output price elasticity of electricity demand has been estimated at between -0.75 with a range of -0.50 to -1.00. The factor shares and the price elasticities together imply an electricity price elasticity of manufacturing output that varies between -0.115 and -0.300, with an output-weighted average of -0.209;
8. Lower electricity tariffs (point 5) and the weighted average price elasticity of output (point 8) cause manufacturing output to increase with 0.82% - 1.25%;
9. Using the input–output table for the Philippines, this increase of manufacturing output causes an increase of GDP of 0.21- 0.32% (USD 594 - 901 million). The largest increase is found in the manufacturing sector (1.10% - 1.67%) whereas the electricity sector GDP decreases by 5.31% - 8.04% due to the decrease of generation charges;
10. The corresponding increase of employment is in between 72 and 110 thousand jobs which is equivalent to 0.20% - 0.30% of the total labour force;
11. The results be captured in three indicators:
    - 1 MW capacity addition yields USD 1.86 million GDP and 226 jobs;
    - 1% capacity increase leads to 0.091% more GDP and 0.085% more jobs;
    - USD 1 million IFI investment causes USD 0.68 million GDP and 83 jobs.

12. Although base-load additions generate most development impact per MW capacity addition, the substantially higher price per MW of coal or geothermal base-load technologies can cause the development impact per dollar to be higher for mid-merit or peaking capacity. This means that IFIs can optimise their investments in power generation depending on the prevailing supply curve and demand profiles in a country along the analysis lines presented in this report.

1. Introduction

Let's Work is a global partnership of 27 organisations that are dedicated to providing effective solutions to the global jobs crisis by harnessing the potential of the private sector to help create more and better jobs. Many of the world's leading international (development) financial institutions (IFIs) are members.

The partnership aims to generate new methods and approaches to measure, understand, and strengthen the creation of more and better jobs. One of the areas where the partnership believes that employment effects need to be better understood is electric power. The power sector provides a foundation for economic growth and through that for generating employment. A lack of or expensive power can hamper the job creation potential of private sector companies. At the same time, the private sector plays an important role in addressing the large power infrastructure deficit in low-income countries.

Although much academic research has focussed on the causal link between economic growth and electricity consumption, not much is known about the transmission channels through which investments in power create employment. The Let's Work partnership has, therefore, initiated this study to analyse the economic and employment impact of IFI investments in the power generation sector in the Philippines under Pillar 2 (methodology) of its work programme. This study follows on other IFI-initiated impact studies like the PIDG-commissioned study on the Bugoye power plant in Uganda and the study on Powerlinks transmission in India/Bhutan conducted by IFC.

The power situation in the Philippines is particularly interesting because it has since 2001 been deregulated and for a considerable part privatised. This development was driven by the huge indebtedness of Napocor, the public electric power monopoly, following the Asian crisis which ensued in 1997. In fact, large creditors of the Philippines such as the World Bank and the Asian Development Bank made passage of the legal deregulation framework, the so-called EPIRA act, a condition for the approval of new loans. Although deregulation has not brought the anticipated decrease of electricity prices, which in fact have gone up, it has resulted in a market-based price mechanism which to a large extent reflects the real cost of electricity. This is in contrast with many other developing countries where power is still heavily regulated and often subsidised.

The objective of this study is *the quantification of the impact of IFI investments in power generation on economic growth and employment in the Philippines*. After overviews of the Philippine economy and the power situation in Sections 2 and 3, the macro-economic and employment impacts are quantified in Section 4. Building on the macro-economic framework, in Section 5 the impacts of two specific investments are analysed in more detail. Conclusions and recommendations are provided in Section 6.

This study was overseen by Brian Casabianca (Senior Economist, Global Infrastructure Department, IFC), Namita Datta (Global Head, Let's Work) and Evgenia Shumilkina (Results Measurement Specialist, Development Impact Department, IFC).

2. Comparative overview of the Philippine economy

2.1 Macro-economy

According to World Bank statistics, the Philippine economy was the 39th largest in the world in 2013. Since 2000, the country has achieved an average 5.0% annual economic growth. This puts it behind most of the Asian Tiger countries, including Vietnam and Indonesia; two countries which are in a similar development phase (see Exhibit 1). The Philippines were among the hardest hit Asian countries during the financial crisis of 2008. From 2012 onwards economic growth has sped up to 7% and the Philippines are now known as the next Asian Tiger.

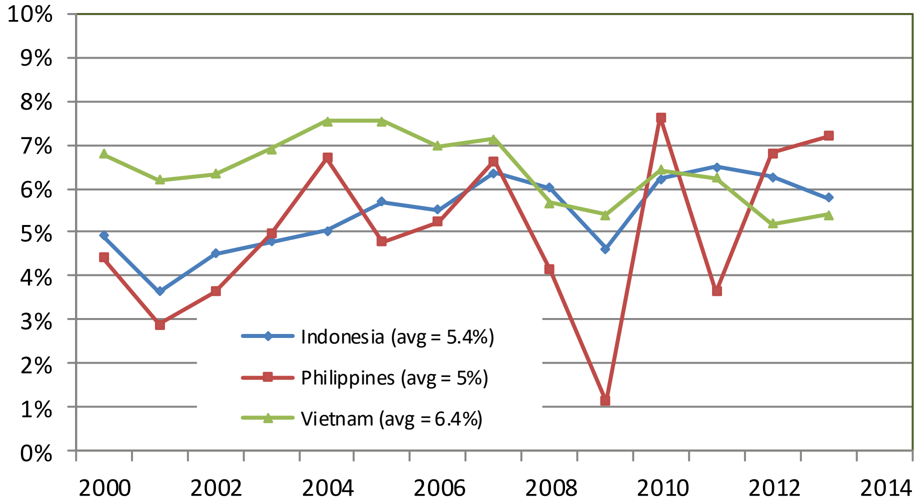

Exhibit 1: Economic growth in the Philippines, Indonesia and Vietnam.

The Philippine economy has transitioned away from agriculture (11% of GDP in 2013) towards industry (32%) and services (57%). However, the share of industry has already been declining for almost 35 years from its peak of 41% in 1980. The Philippines thus seem to suffer from what is commonly called premature deindustrialisation. Although the decline of the manufacturing sector is markedly slower than the overall industry sector, it has been faster than in many other Asian peers, notably Vietnam. On the supply side the economy is thus mostly driven by services.

Economic growth is mostly driven by consumption, which is spurred by remittances from overseas. Total remittances of USD 26 billion in 2013 (9.8% of GDP) are the third highest in the world, after China and India. Despite the Philippines being a relatively open economy, investment, as measured by gross fixed capital formation, has been consistently below peers such as Vietnam and Indonesia (see Exhibit 2). A first reason for this is that the government's fiscal pressure does not allow it to invest sufficiently. Secondly, the private sector (both domestic and foreign) is less inclined to invest mainly because of the perceived weakness of the country's institutions and the inadequate infrastructure, which reflects the lack of public investment. A third reason is that the fast growing service sector is not very capital intensive. In short, economic growth is led by consumption and services and not investment. This raises the question to what extent the current economic growth is sustainable.

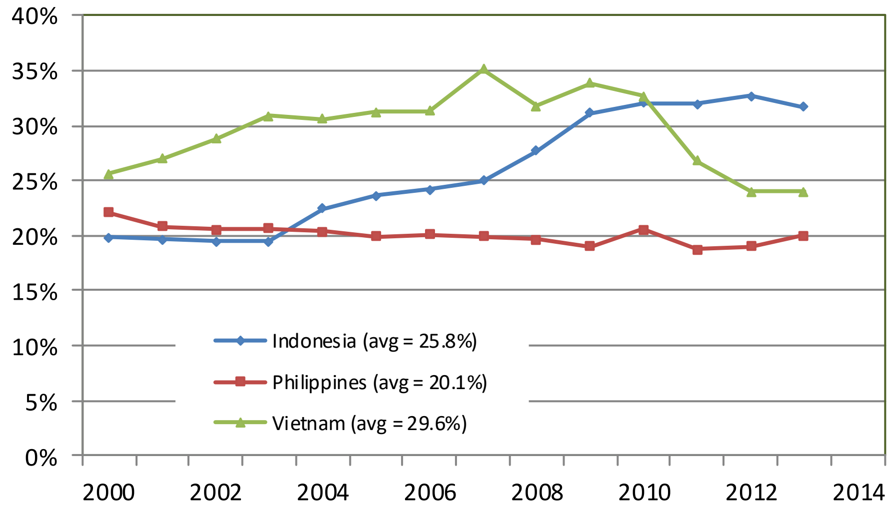

Exhibit 2: Gross Fixed Capital Formation as % of GDP in the Philippines, Indonesia and Vietnam.

2.2 Electric power intensity of the economy

Since 2000 the consumption of electricity in the Philippines has grown yearly by on average 4.3%, from 38,945 GWh to 67,525 GWh. This implies an elasticity of electricity consumption for economic growth of 0.86. Going forward the Department of Energy (DOE) assumes a weighted average factor of 0.69[1], which with the projected 7% economic growth translates into a 4.8% yearly increase of electricity consumption.

The growth of electricity consumption in the Philippines has been slower when compared to Indonesia (+6.0%) and Vietnam (+12.5%). These two economies also displayed a larger elasticity of electricity consumption with respect to GDP growth (1.1 and 1.9 respectively). The net result is that the power intensity of the Philippines' economy has decreased from 0.47 to 0.43 kWh per dollar of GDP whereas Vietnam's power intensity increased from 0.55 to 1.13 kWh per dollar of GDP, as is shown in Exhibit 3.

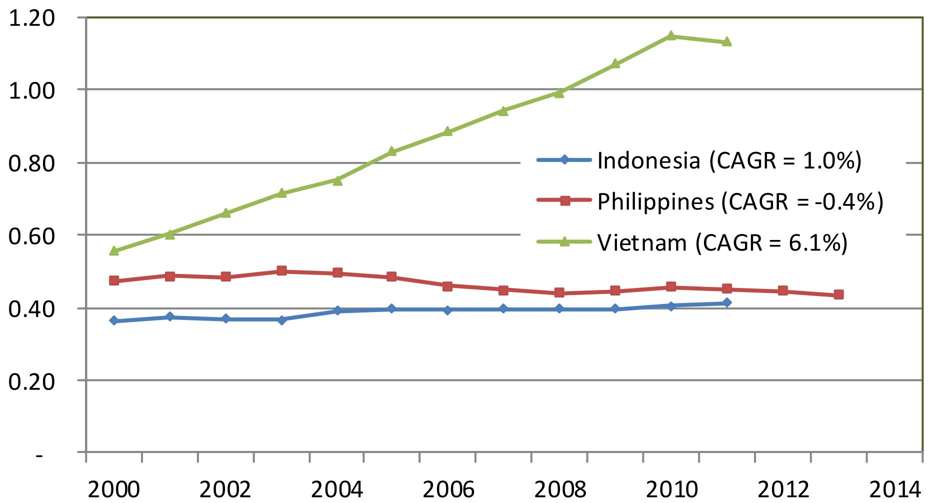

Exhibit 3: Electric power intensity of the economy (kWh / Constant 2005 GDP in USD).

[1] Demand elasticities with respect to GDP are 0.6; 1.0; and 0.8 for Luzon, Visayas and Mindanao respectively.

3. Power generation, consumption and economic growth

3.1 Overview of the electric power sector

The return of political stability in 1986 increased investor confidence which brought strong economic growth and thus demand for electric power. Hampered by its weak operational and financial performance, the National Power Company did not expand power supply and a severe power crisis precipitated in the early nineties. In response, then President Ramos set up the Department of Energy and encouraged the entrance of Independent Power Producers (IPPs) using government guarantees and take-or-pay contracts. As a result the demand and supply balance improved and was restored in 1996.

But the government guarantees and take-or-pay contracts became a burden when the Asian economic crisis hit in 1997. IPPs had to produce much less than the minimum contracted 85% capacity utilisation. Because the associated costs were not passed in full to the end users, the NPC accrued large losses. These losses made worse by the almost 50% depreciation of the Peso against the Dollar, in effect doubling the outstanding obligations incurred before the crisis.

The Electric Power and Reform Act (EPIRA) was passed in 2001 in order to restructure the power sector. The main objectives of EPIRA were to:

1. Separate the generation, transmission and distribution functions;
2. Introduce competition in generation;
3. Assure open access to the monopoly and transmission and distribution networks;
4. Reform electricity tariff structures.

In line with second objective, the Private Sector Assets and Liability Management (PSALM) Corporation was established in 2001 with the goal of privatising generation assets. But it took essentially until the middle of 2006, when the Wholesale Electricity Spot Market (WESM) became operational, for privatisation to really commence[2].

Exhibit 4 shows the current organisation of the power sector in Luzon and Visayas[3] as a result of the EPIRA legislation. The WESM takes a central role in matching power supply and demand. Although more than 90% of the power is sold through bilateral contracts between generation and distribution companies, all supply and demand must be offered through the WESM. Retail competition and open access is another key component of EPIRA. While still only the large users can be contested, over time smaller customers will be able as well to choose their own power provider.

[2] Until the first large privatisation of Pantabangan-Masiway in 2006, four small plants with a total capacity of 8.5 MW were sold; see Table 1.

[3] The spot market started in Luzon in 2006 and the Visayas spot market was integrated in 2011. In Mindanao a separate interim spot market is operational.

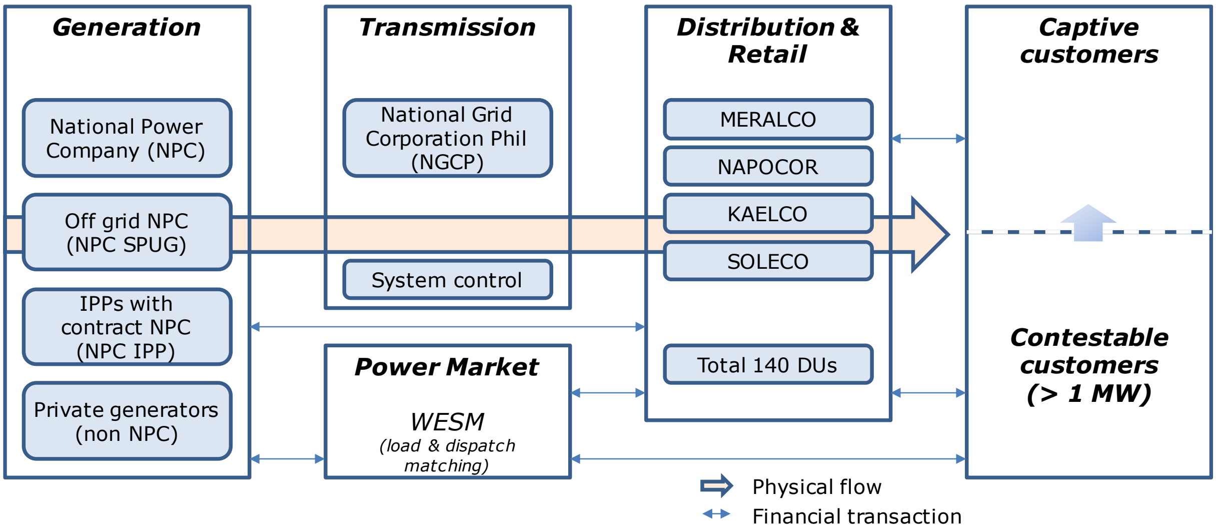

Exhibit 4: Overview of the electric power sector after EPIRA.

3.2 Overview of power generation

As per year end 2013 there were 129 functioning[4] power plants operating in the Philippines, of which 56 in Luzon, 39 in Visayas and 34 in Mindanao. Power generation is fairly diversified with respect to the fuel used. As shown in Exhibit 5, coal power plants make up some 32% of total capacity, followed by hydro and oil-based plants. In 2001 natural gas coming from the Malampaya field caused a lot of old and expensive oil-based generation capacity to be retired. The Philippines boast the world's second largest amount of geothermal power, half of which is located in the Visayas region. Although seasonal, hydropower is another important resource, especially in Mindanao where it makes up almost half of the installed capacity. The country does not import electricity.

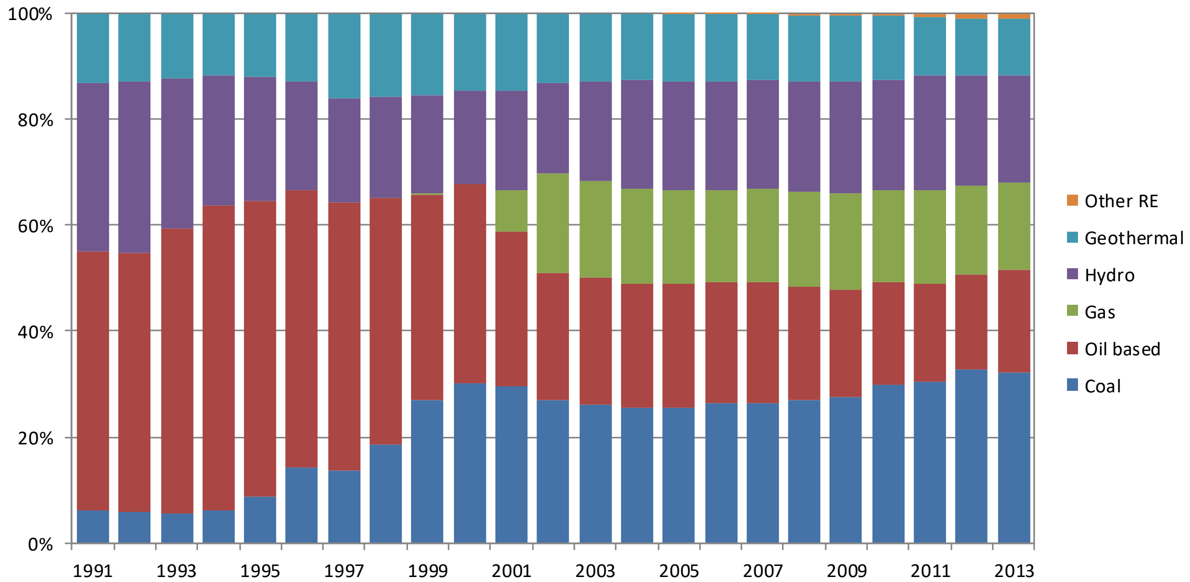

Exhibit 5: Breakdown of installed power generation capacity by fuel type.

Reflecting the size of the economy and the number of inhabitants, the bulk of electric power (72%) is generated in Luzon while Visayas (16%) and Mindanao (12%) make up the rest.

[4] Meaning a dependable capacity larger than 0 MW.

The Luzon and Visayas grids are interconnected[5]. On average power produced in the Visayas flows to Luzon, which consumes some 2% more than it produces.

Coal plants generate some 43% of the country's power, followed by natural gas[6] (25%) and geothermal (13%). Together these three constitute the country's base load power, although in Mindanao hydropower serves as base load capacity as well[7]. Capacity utilisation of coal, geothermal and natural gas are about 70% of installed capacity (around 75% of dependable capacity). Due to the essentially zero marginal cost for geothermal and take-or-pay natural gas these plants are typically run at their maximum. Coal has increased markedly over the last five years as demand for base load power increased thereby eliminating the need for coal plants to shut down during hours of low demand.

In terms of ownership, the power generation industry is fairly concentrated. Exhibit 6 shows that nationwide four companies control 72% of the generation assets. In the three grids, the concentration is even larger. In Luzon and Visayas, the four largest (but not the same) companies own 79% and 80% of the generation assets respectively and in Mindanao the largest three[8] own 97%.

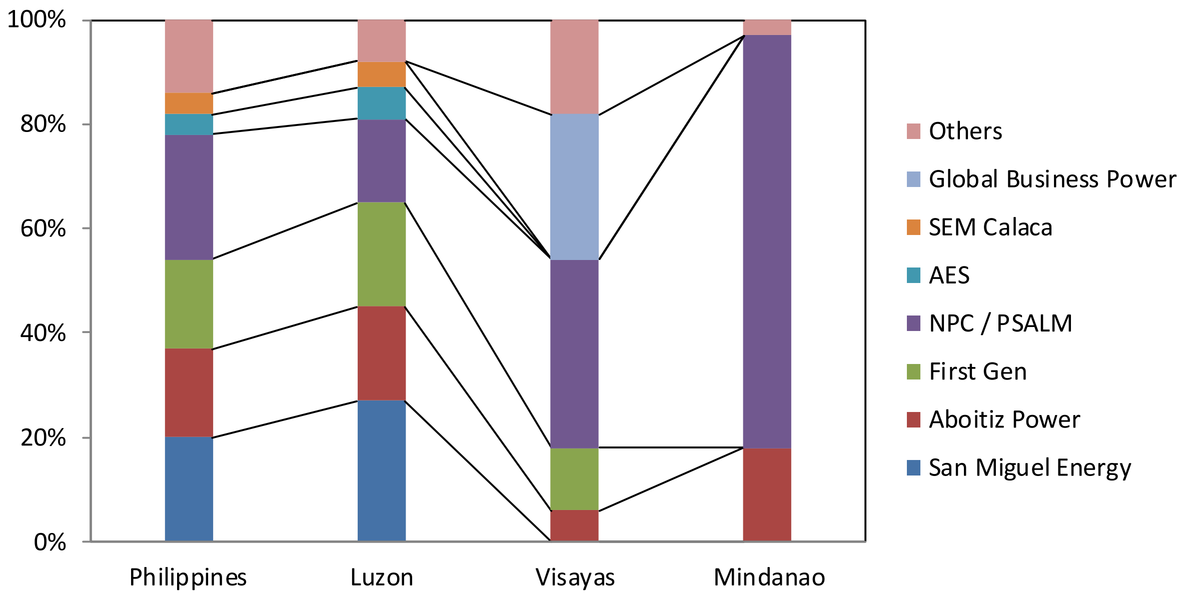

Exhibit 6: Ownership of power generation assets at the national level and the three individual grids.[9]

Exhibit 6 shows that privatisation has progressed furthest in Luzon; in Luzon, Visayas and Mindanao the NPC and PSALM together own respectively 16%, 36% and 79% of the generation assets. As mentioned in Section 3.2 and as shown in Table 1, the first substantial privatisation deals were done in 2006, after the WESM was established. Privatisation has become more difficult as of 2010 with several failed attempts by PSALM to dispose of assets. In total 7,704 MW of generation assets have been privatised or put

[5] The interconnection has a capacity of 300MW and on average some 100MW flows from Visayas to Luzon.
[6] Although across the world natural gas is mostly used as mid-merit capacity, because of the take-or-pay contract for Malampaya gas the economic cost of gas are essentially zero causing gas plants to supply base load. The contract expires in 2024 after which one can expect that these plants will become mid-merit plants.
[7] This explains the many outages in Mindanao, especially in summer when water levels in Lake Lanao are low.
[8] NPC and PSALM are separate though state-owned entities.
[9] *The Energy report Philippines*, KPMG, 2014.

under private contracts for a combined deal value of USD 6,693m. As can be seen in Table 1, IFIs have played a substantial and pioneering role in the privatisation.

Table 1: Overview of power generation privatisation deals.

Asset	Deal type	Date	Fuel	Capacity (MW)	Deal value (USD m)	IFI equity	IFI debt (USD m)
Talomo	Generation Asset	2004-03-25	Hydro - small	3.5	1.37		
Agusan	Generation Asset	2004-04-04	Hydro - small	1.6	1.53		
Barit	Generation Asset	2004-06-25	Hydro - small	1.8	0.48		
Cawayan	Generation Asset	2004-09-30	Hydro - small	0.4	0.41		
Loboc	Generation Asset	2004-11-10	Hydro - small	1.2	1.43		
Pantabangan- Masiway	Generation Asset	2006-09-06	Hydro - large	112.0	129.00	3.03%	*
Magat	Generation Asset	2006-12-14	Hydro - large	360.0	530.00	20.00%	105
Masinloc	Generation Asset	2007-07-26	Coal	630.0	930.00	8.00%	453
Ambuklao-Binga	Generation Asset	2007-07-28	Hydro - large	175.0	325.00	20.00%	100
Tiwi-Makban	Generation Asset	2008-07-30	Geothermal	748.0	446.89		
Panay and Bohol	Generation Asset	2008-08-12	Diesel	168.5	5.86		
Amlan	Generation Asset	2008-12-10	Hydro - small	0.8	0.23		
Calaca	Generation Asset	2009-07-08	Coal	600.0	361.71		
Power Barge 117	Generation Asset	2009-07-31	Diesel	100.0	13.50		
Power Barge 118	Generation Asset	2009-07-31	Diesel	100.0	16.00		
Limay	Generation Asset	2009-08-26	Gas Turbine	620.0	13.50		
Palinpinon-Tongonan	Generation Asset	2009-09-02	Geothermal	305.0	220.00	5.05%	*
Sual	Contracted Capacity	2009-10-01	Coal	1,000.0	1,070.00		
Naga	Generation Asset	2009-10-16	Gas turbine	61.9	1.01		
Pagbilao	Contracted Capacity	2009-11-06	Coal	700.0	691.00		
San Roque	Contracted Capacity	2010-01-26	Hydro - large	345.0	450.00		
Bakun-Benguet	Contracted Capacity	2010-02-26	Hydro - large	100.8	145.00		
Ilijan	Contracted Capacity	2010-04-16	Natural gas	1,200.0	870.00		
Angat	Generation Asset	2010-04-28	Hydro - large	218.0	440.88		
BacMan	Generation Asset	2010-05-05	Geothermal	150.0	28.25	5.05%	*
Subtotal	***Generation Asset***			***4,357.7***	***3,467.05***	***7.6%***	***658.00***
Subtotal	***Contracted Capacity***			***3,345.8***	***3,226.00***	***0%***	-
Total				**7,703.5**	**6,693.05**	**3.9%**	**658.00**

Source: PSALM Corporation.
Note: This table lists only the assets of PSALM that were privatised. 40% of state-owned PNOC-EDC, which also holds generation assets, was privatised in 2006 and IFC acquired a 5.05% stake for USD 49 million
* IFC has a 5.05% equity stake in Energy Development Corp (EDC) which in turn has a 60% equity stake in Pantabangan-Masiway) and has provided USD 159m debt capital (not just for the three deals in this table).

3.3 Overview of electricity consumption

3.3.1 Grid-based consumption

As mentioned in Section 2.2, the Philippines consumed 67,525 GWh[10] of electricity in 2013. When subtracting the utilities' own use of 5,959 GWh, a total of 61,566 GWh were sold to end users. Table 2 shows that about three quarters of the electricity was consumed in Luzon with Visayas and Mindanao splitting the remaining quarter. Growth rates have been highest in Visayas. Industrial and residential consumption both are one third of total consumption while commercial use is slightly smaller but grows faster.

[10] This excludes power losses, which fluctuate around 14% of actual consumption.

Table 2: Geographic and sector breakdown of the 61,566 GWh electricity consumption in 2013 and the corresponding compound annual growth rates (CAGR) since 2003.

	Share of total sales	CAGR 2003-2013
Grid		
Luzon	74.4%	3.2%
Visayas	12.8%	4.8%
Mindanao	12.8%	3.3%
Sector		
Residential	33.5%	2.7%
Commercial	29.7%	4.6%
Industrial	33.6%	2.8%
Other	3.2%	5.7%
Philippines	100.0%	3.4%

Per capita consumption of electricity has increased in the Philippines by on average 1.9% per year since 2003 to 686 kWh per year, as is shown in Exhibit 7. Compared to its peers Vietnam and Indonesia the electricity consumption per capita is smaller and grows slower[11]. When only considering residential energy use, Exhibit 7 shows that the average Philippino used just 210 kWh in 2013 compared to 186 kWh in 2003. From 2011 to 2004 the percentage of households using electricity declined slightly, from 87.6% to 87.2%.[12]

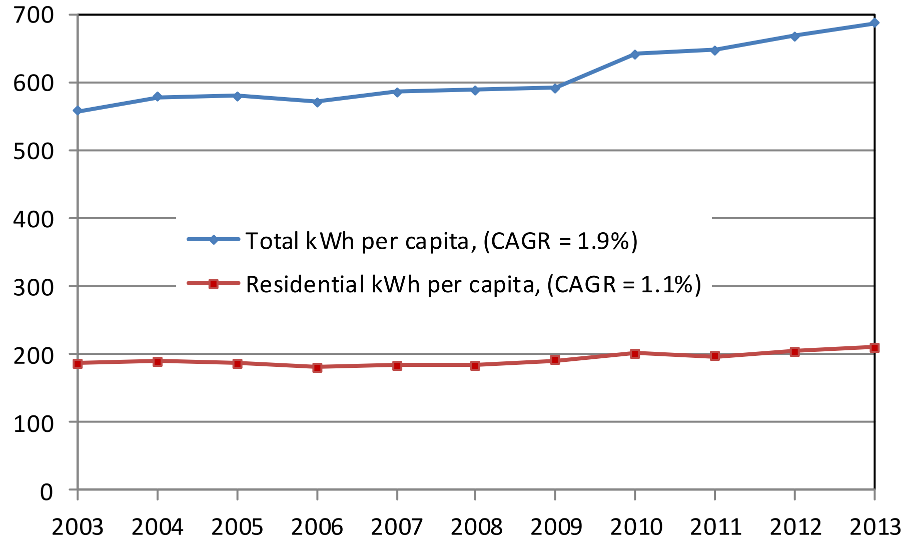

Exhibit 7: Total and residential electricity consumption per capita.

Non-residential, i.e. industrial and commercial, electricity consumption makes up 63.3% of the country's electricity consumption (see Table 2). The electricity consumption of the various economic sectors is driven by their economic size and electricity intensity. Using information from the Philippine input-output table (see Section 4.5.1), Exhibit 8 demonstrates that the manufacturing is by far the largest consumer of electricity, with 44.3% of non-residential consumption on a cost basis. Under the assumption that all

[11] In 2011, the last year for which the World Bank has data, per capita electricity use in Vietnam was 1,073 kWh, growing at 11%; In Indonesia the figures were 680 kWh and 5% respectively.

[12] According the Household Energy Consumption Surveys (Philippine Statistics Authority). The percentage of households using electricity for lighting decreased from 78.5% to 74.0% while the percentage using it for cooking went up from 13.8% to 17.5%.

sectors pay the same price per kWh this would be equivalent to 28.0% of the total electricity consumption. However, because large users, many of them in manufacturing incur lower tariffs[13] it is safe to assume that the manufacturing sector alone is responsible for some one third of all electricity consumption. Exhibit 8 also shows that the electricity intensity of mining is rather low. This is because most mines generate their own electricity because they cannot rely on the grid to deliver it reliably and in sufficient quantities to the remote areas in which they operate.

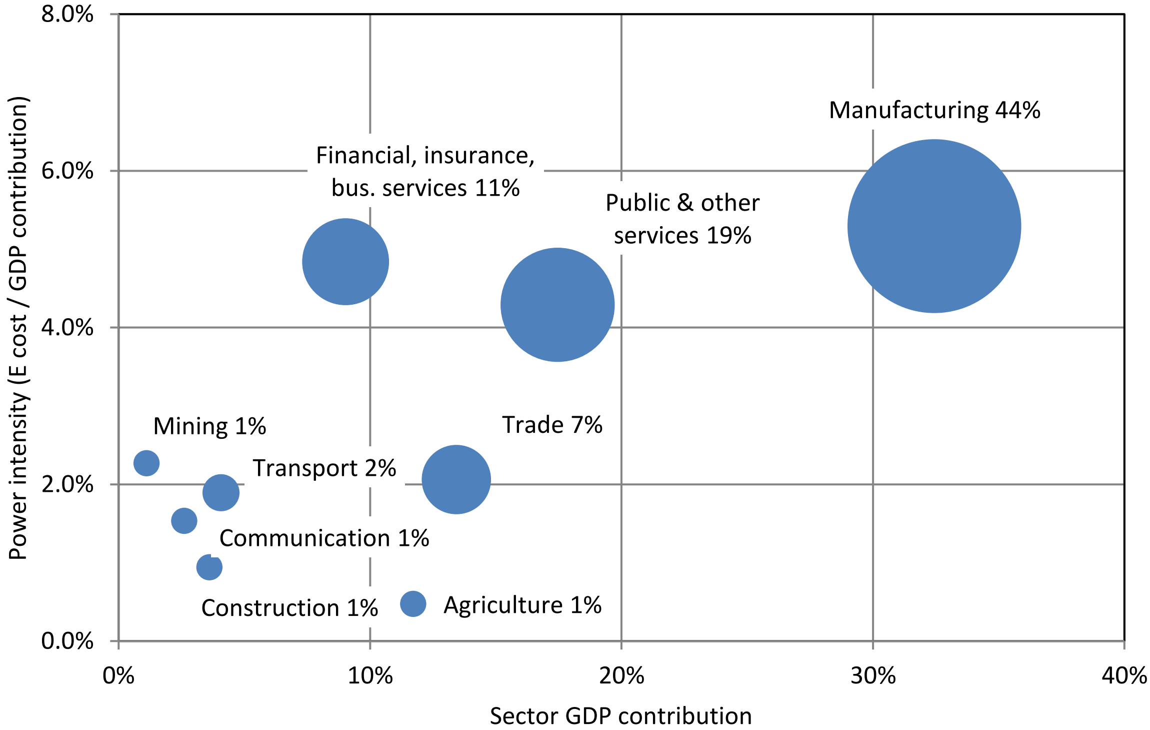

Exhibit 8: Non-residential power consumption per sector as driven by their GDP contribution and power intensity for 2006.[14]
Labels indicate the fraction of total non-residential power consumption of the various sectors.

3.3.2 Self-generated consumption

Based on the World Bank Enterprise survey, 24%[15] of all manufacturing firms indicate that electricity is a major or very severe obstacle, although it seems that the economic damage due to power outages is fairly small. Of the firms that suffer economic damage from outages, the sales lost are 0.44%, 0.64% and 0.35% for large, medium and small firms respectively.[16] The limited economic damage seems to indicate that firms are able to recoup lost production time or that they maintain operations using their backup power generation. Table 3 shows that 26% of the large companies, 14% of medium-sized companies and 12% of small companies partly self-generate. 14 (4%) companies, generate all their electricity themselves, of which the four largest, all in the electronics sector, produce electricity equivalent to 12% of the total consumption of all firms in the

[13] MERALCO tariffs for large users are some 20% lower than the average tariff.
[14] Most recent input output table is for the year 2006, when manufacturing constituted 24% of GDP according to the World Bank. The slightly larger GDP contribution here (32%) is due to differences in sector allocation.
[15] The percentages for large, medium and small manufacturing firms are all 24%. For the different manufacturing sectors the range is from 18% to 30%.
[16] When including the firms that do not indicate to suffer from outages these percentages would respectively be 0.15%, 0.40% and 0.25%).

survey. The cost of self-generation, typically using diesel generators, is high (comparable to the peaking plants in Exhibit 12).

Table 3: Percentage of companies in seven groups of self-generation.

Self generation	0%	< 10%	< 25%	< 50%	< 75%	< 100%	100%	# firms
Large firms	74%	14%	4%	1%	3%	2%	2%	268
Medium firms	86%	7%	3%	1%	0%	2%	1%	441
Small firms	88%	6%	2%	1%	1%	0%	1%	308

Source: World Bank Enterprise Survey 2009.

3.4 Electricity tariffs

Electricity tariffs in the Philippines are among the highest in the world. Exhibit 9 shows that tariffs in the Philippines are on par with Singapore (and similar to Japan), which means that as a fraction of income levels they are much higher. The liberalisation of the market under the EPIRA legislation in 2001 was expected to have brought down power prices, whereas they actually went up by some 60% between 2004 and 2012.

There are many reasons for this. An important one is that in the Philippines electric power is hardly subsidised (and is actually being taxed). Subsidies, especially for residential users, are significant in countries like Indonesia, Malaysia and Thailand, as can be inferred from Exhibit 9. Subsidies on electricity and fuel are deemed untenable in the long run and many countries (among which Indonesia) are currently trying to roll them back. But the absence of subsidies is only one among several factors which explain the high price of electric power. Other factors are that the Philippines comprises some 7,000 islands and suffers regularly from severe weather conditions, two factors that increase costs of transmission and distribution. Some have suggested that the tight supply situation and concentrated ownership (Exhibit 6) fosters collusion in power generation, although this has not been proven beyond reasonable doubt.

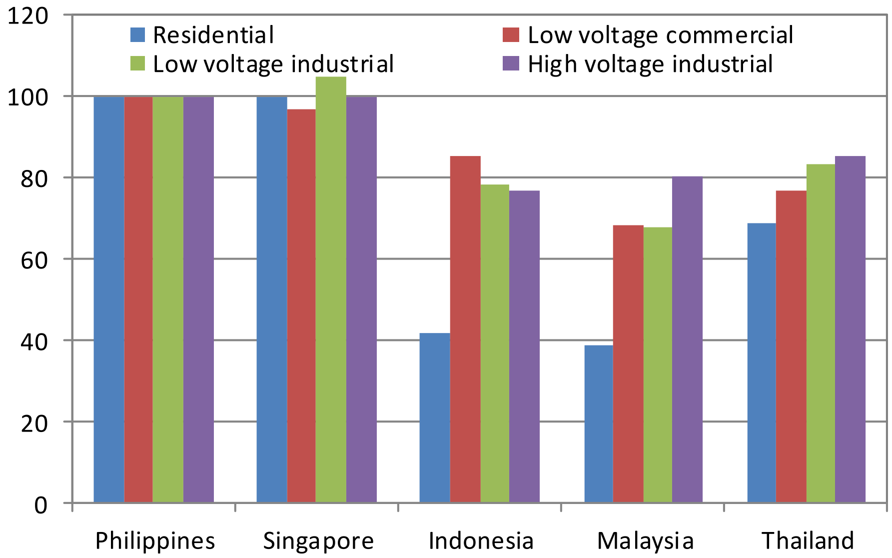

Exhibit 9: Electricity tariffs[17] in 2011 for four different client types in four ASEAN countries relative to Philippine tariffs (set at 100).

[17] USAID, *Challenges in pricing electric power services in selected ASEAN countries*, April 2013.

Note: Residential, Low voltage commercial, low voltage industrial and high voltage industrial tariffs in 2011 were respectively 10.25; 10.81; 9.70; and 8.37 PHP/kWh.

Electricity tariffs for end users depend on the rates for power generation, transmission and distribution (see Exhibit 4). The charges for transmission and distribution for captive customers are effectively set by the Energy Regulatory Committee (ERC) but the generation charges are to a large extent free market outcomes. The breakdown of a representative electricity tariff is shown in Exhibit 10. The generation charge makes up in between 55% and 59% of the pre-tax tariff. It decreased by 7% from 2005 to 2009, only to increase by 20% in 2010, due to increased demand and a tighter supply situation. The transmission and especially the distribution charge are other factors that explain the increase of tariffs. Although constant over time, system losses represent some 8% of the total electricity price. The introduction of VAT in 2006 caused tariffs to increase by 9%.

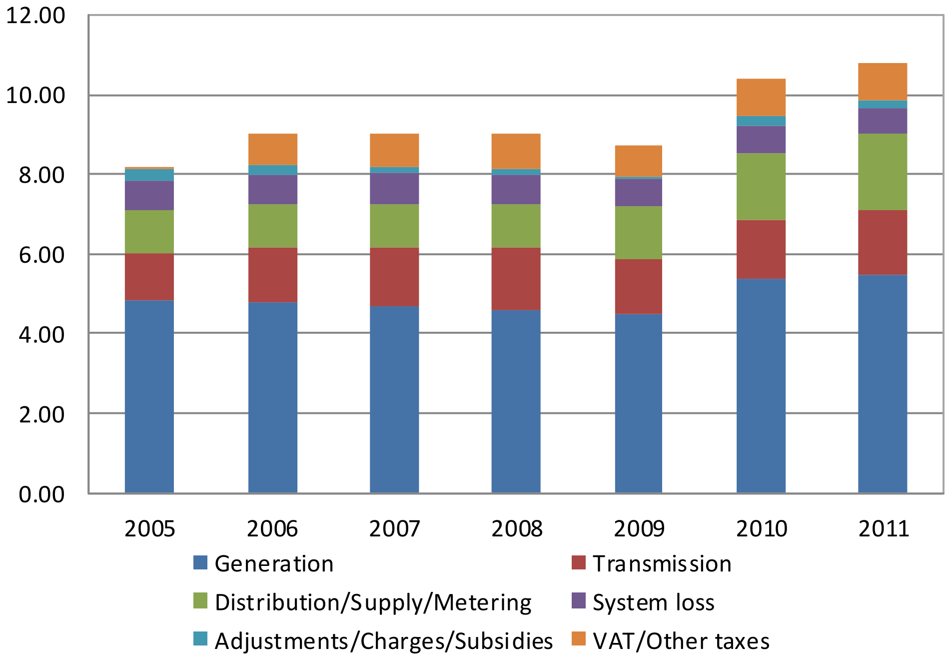

Exhibit 10: Evolution of electricity tariffs[17] (PHP/kWh) for low voltage commercial clients.

3.5 Relationship between power consumption and economic growth

There exists a large body of academic literature on the relationship between energy or electricity consumption and economic growth and which one causes the other. Typically the findings depend on country, analysis methodology[18], selected variables and the period under consideration. Unsurprisingly, no consensus has been reached; all four possible relationships between electricity consumption EC and GDP have been found:

1. Growth hypothesis: electricity consumption causes GDP growth (EC $\Rightarrow$ GDP);
2. Conservation hypothesis: GDP growth causes electricity consumption (GDP $\Rightarrow$ EC)
3. Feedback hypothesis: electricity consumption and GDP growth cause each other (EC $\Leftrightarrow$ GDP);
4. Neutrality hypothesis: electricity consumption and GDP growth are uncorrelated (EC $\not\Leftrightarrow$ GDP).

Specifically, for the Philippines, Lau et al (2012)[19] used panel data for 1980-2006 to find that energy consumption (Granger) causes GDP growth in the short run and vice versa in

[18] Notably Granger causality and co-integration analysis, applied in bivariate or multivariate ways.
[19] Lau, E., Chye, X.Y. and Choong, C.K. *Energy-Growth Causality: A Panel Analysis*. J. Eur. Econ. (11), 2012.

the long run. Chontanawat et al. (2006)[20] concluded that energy consumption causes growth for the period 1971-2000 but did not find evidence for the feedback hypothesis in the longer run. For the period 1965-2006, Rafiq (2008)[21] determined long-run uni-directional causality from energy consumption to economic output. This was confirmed by Aslan and Kum (2010)[22] who concluded that in the Philippines, unlike in all other East Asian countries bar Indonesia, energy consumption causes economic growth. In contrast, Chiou-Wei et al. (2008)[23] concluded that for the period 1954-2006 GDP growth caused energy consumption. Asafu-Adjaye (2000) for energy and Chen et al. (2007)[24] for electricity found evidence for the feedback hypothesis. To complete the evidence for all four possible relationships, Masih and Masih (1996)[25] confirmed the neutrality hypothesis for the Philippines. Analysing a larger sample of countries, Adhikari and Chen (2012)[26] found a strong relation running from energy consumption to economic growth for upper middle income countries and lower middle income countries, and a strong relation which runs from economic growth to energy consumption for low income countries. In a recent meta-analysis of 133 studies, World Bank economists concluded that there exists no reliable statistical evidence that an increase in energy consumption contributes to economic growth[27].

Despite the lack of econometric consensus for a single hypothesis regarding the nexus of economic growth and electricity it is hard to deny the importance of energy in production. Economic production in its essence is the transformation of material inputs into material outputs through the addition of energy and knowledge and organisation (i.e. labour and capital). In this thermodynamics-based view of the production process, energy and materials are the primary factors of production in contrast to mainstream economics which considers capital, labour and land as the primary factors. And because electricity has become the dominant carrier of energy, one might extend this statement that electricity is a primary factor. It is clear that electricity cannot be (entirely or considerably) substituted by capital or labour. In fact, the industrial revolution was made possible by extracting thermodynamic work from energy sources other than humans.

Viewed in this way, energy and thus electricity play an especially important role in manufacturing. A number of studies have confirmed this. Inglesi-Lotz and Blignaut (2011)[28] concluded that in South Africa only industrial output exhibits statistically

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[20] Chontanawat, J., Hunt, L.C. and Pierse, R., *Causality between Energy Consumption and GDP: Evidence from 30 OECD and 78 Non-OECD Countries,* Surrey Energy Economics discussion paper, 2006.

[21] Rafiq, S., *Energy consumption and income in six Asian developing countries: a multivariate cointegration analysis.* In: 2nd IAEE Asian Conference: Energy Security and Economic Development under Environmental Constraints in the Asia-Pacific Region, 5-7 Nov, 2008.

[22] Aslan, A., and Kum, H., *An investigation of cointegration between energy consumption and economic growth: Dynamic evidence from East Asian countries*, Global Economic Review 39(4), 431-349, 2010.

[23] Chiou-Wei, S.Z. et al., *Economic growth and energy consumption revisited — Evidence from linear and nonlinear Granger causality*, Energy economics 30(6), 2008.

[24] Chen, S.T., Kuo, H.I. and Chen, C.C., *The Relationship Between GDP and Electricity Consumption in 10 Asian Countries*, Energy Policy, 35, pp. 2611-2621, 2007.

[25] Masih, A. M. M. and Masih, R., *On the temporal causal relationship between energy consumption, real income, and prices: some new evidence from Asian-energy dependent NICs based on a multivariate cointegration/vector error-correction approach.* Journal of Policy Modeling 19: 417-440, 1997.

[26] Adhikari, D. and Chen, Y., *Energy Consumption and Economic Growth: A Panel Cointegration Analysis for Developing Countries*, Review of Economics & Finance (submitted), 2012.

[27] Only three of the 133 studies did not suffer from econometric estimation problems and two of those have potential data measurement issues.

[28] Inglesi-Lotz, R and Blignaut, J.N., *Estimating the price elasticity of demand for electricity by sector in South Africa*, South African journal of economic and management sciences, 14(4), 2011.

significant price elasticity. Soytas and Sari (2007)[29] found that causality runs from electricity consumption to manufacturing value added in Turkey and seems to affect value added somewhat more than the labour and investment inputs. They also find that manufacturing output responds positively to positive shocks in electricity consumption. For manufacturing in Malaysia, Bekhet and Harun (2012)[30] observe long-run (but not short-run) uni-directional causality from energy consumption to production for the period 1978-2009. Harun and Ishak (2014)[31] also find that compared to capital and labour, energy is a more important factor for the manufacturing sector in Malaysia. Qazi et al. (2012)[32] draw the same conclusion for electricity consumption and industrial output in Pakistan from 1972-2010 and even conclude that "energy shortage is one of the main reasons of the downturn of the industrial sector, particularly in the large-scale manufacturing. As a result, plenty of small-scale industries are shut down and many of large-scale industries are moving out of Pakistan." Kwakwa (2012)[33] found that although in Ghana economic growth (uni-directionally) Granger causes energy consumption, electricity consumption and manufacturing Granger cause each other. In Kenya, Nelson et al. (2013)[34] found short and long-run bidirectional causality between electricity consumption and manufacturing output. Electricity consumption was found by Abid and Mraihi (2014)[35] to Granger cause industry GDP in the long run in Tunisia. Most recently, in a working paper of the IMF, Alvarez and Valencia (2015)[36] conclude that a 1% decrease of electricity price would cause an increase of 0.28% of manufacturing value added (i.e. a price elasticity of -0.28).

The reason that the manufacturing output response to cheaper electricity is found to be stronger than that of commercial sectors is because electricity is largely a variable cost for manufacturing and largely a fixed one in most other sectors. (Put very simply, an office needs to be lit or cooled independent of the number of employees present whereas increasing manufacturing output requires more electricity, although many sectors fall somewhere between these two extremes.) This is probably the main reason why the World Bank Enterprise Surveys (and the Philippine Census on Business and Industry for that matter) only ask information on electricity use from companies in the industrial sector.

Based on the literature overview presented above we conclude the following:

1. Although the econometric evidence is not clear cut, the balance of evidence from the Philippines and countries in a similar development stage points to a causal relationship that runs from energy and electricity consumption to economic growth or a relationship that is bidirectional in causation;
2. This causal relationship runs primarily through manufacturing, which as shown in Section 3.3 represents roughly one third of the country's energy use;

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[29] Soytas, U. and Sari, R., *The relationship between energy and production: evidence from Turkish manufacturing*, Energy Economics, 2007.

[30] Bekhet, H.A. and Harun, N.H.B., *Energy Essential in industrial manufacturing in Malaysia,* International Journal of Economic and Finance, 4(1), 2012.

[31] Harun, N.H. and Ishak, M.S., *Analysis of the production theory for manufacturing industry and construction industry in Malaysia*, Proceeding of the Global Summit on Education GSE 2014.

[32] Qazi, A.Q., Ahmed, K. and Mudassar, M., *Disaggregate Energy Consumption and Industrial Output in Pakistan: An Empirical Analysis*, Economics E-Journal, 2012.

[33] Kwakwa, P.A., *Disaggregated energy consumption and economic growth in Ghana*, International Journal of Energy Economics and Policy, 2(1), 2012.

[34] Nelson, O., Mukras, M.S. and Siringi, E.M., *Causality between disaggregated Energy Consumption and manufacturing growth in Kenya: an Empirical Approach*, J. Econ. and Sust. Development 4(16), 2013.

[35] Abid, M. and Mraihi, R., Energy consumption and industrial production: Evidence from Tunisia at both aggregated and disaggregated levels, J. Knol. Econ, 2014.

[36] Alvarez, J. and Valencia, F., *Made in Mexico: Energy Reform and Manufacturing Growth*, IMF WP/15/45, 2015.

3. The increase of manufacturing output induces an increase of non-manufacturing output due to its additional demand for intermediary products and services.

4. Macro-economic impact of IFI investments in power generation

4.1 Economic impact analysis framework

Based on the overview presented in Section 3.4, the analysis framework for the economic impact of IFI in Exhibit 11 depicts the many pathways through which an increase of power supply causes an increase of GDP and employment.

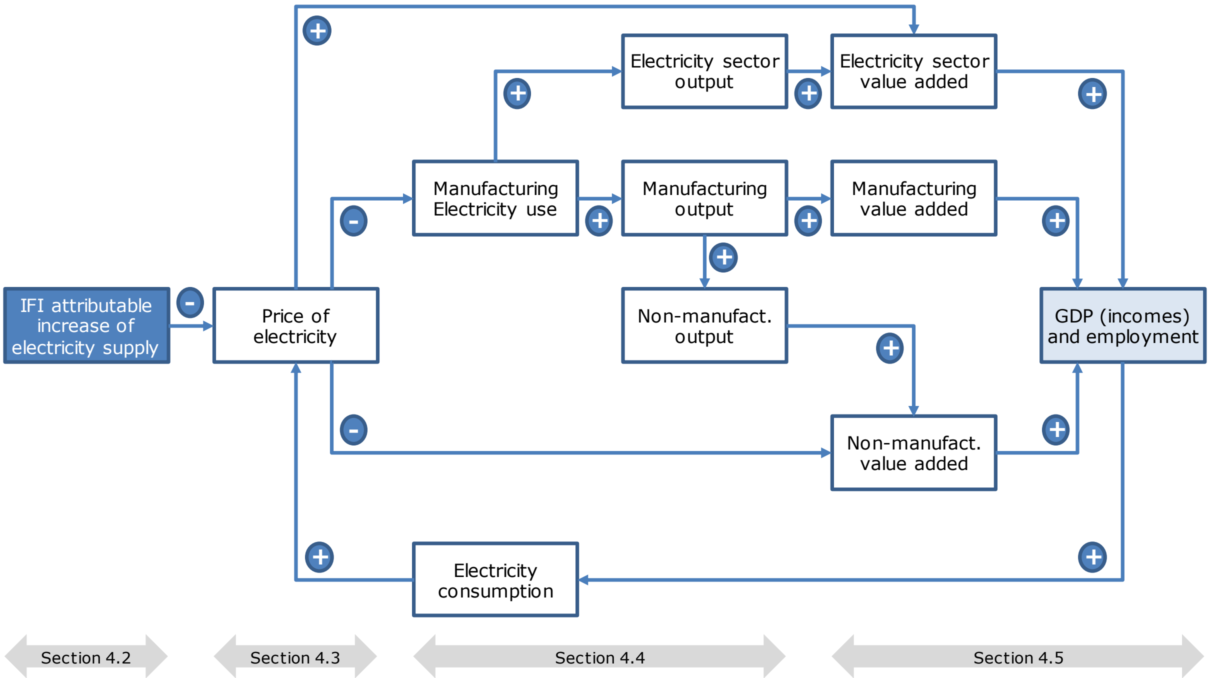


Exhibit 11: Analysis framework for the impact of IFI investments in power generation on GDP (value added) and employment.

Positive (+) and negative (-) relationships are indicated. Blue box are exogenous, white boxes are endogenous and light blue box is intended result.

The framework indicates the direction of relationships between the variables. For example, an increase of (IFI attributable) power generation capacity causes a reduction of electricity price because of the negative relationship between supply and price. This lower price subsequently causes lower profits for power generators as well as an increase of manufacturing electricity consumption because of the negative relationship between price and consumption. This higher electricity consumption increases manufacturing output and value added and thus GDP growth. Because of economic interlinkages, higher manufacturing also increases the demand for non-manufacturing output and hence value added, which constitutes a second pathway for GDP growth. This larger electricity consumption also positively affects value added of the power generators. Lower electricity prices do not increase non-manufacturing output but merely lower cost and thus only increase value added; value added shifts from the electricity sector to the non-manufacturing sector[37]. Finally, as was described in Section 3.4, GDP growth also drives

[37] This description is not entirely complete. A second-order effect is that the increase of manufacturing output increases non-manufacturing output which in return increases electricity consumption in the non-manufacturing sector. Although not shown in Exhibit 11 this effect is included in the actual impact calculations.

an increase of electricity consumption in the entire economy, which of course would increase the electricity price and thus offset some of the effects. This negative feedback (on price and thus on consumption) is included in the analysis[38]. The framework does not include the effect of lower electricity price on investment (either directly or indirectly), a feedback that may be relevant in the longer run. In the following sections the steps of the analysis framework presented in Exhibit 11 will be elaborated upon.

4.2 IFI attributable power generation capacity

The first step in Exhibit 11 is to determine the power generation capacity that can be attributed to IFIs. Table 4 lists all the power generation investments made by IFIs in Luzon and Visayas. IFIs provided USD 162m equity and USD 923m debt financing to companies which together have a dependable capacity of 2,506 MW, of which 821 MW (32%) was added after IFI financing was committed.

Table 4: Overview of power generation investments made by IFIs.

IFI	Company	Power plant	Grid	Fuel	a. Dependable capacity (MW)	b. Capacity addition (MW)	c. Total deal value (USD m)	d. Equity stake	e. IFI equity (USD m)	f. IFI debt (USD m)	IFI attributable capacity (MW) (a·d + b·f/c)
IFC	EDC	Bacman	Luzon	Geothermal	130	130	204	5.05%	5	18	18
IFC	EDC	Leyte GPP	Visayas	Geothermal	107	18	168	5.05%	4	14	7
IFC	EDC	Nasulo GPP	Visayas	Geothermal	40	40	63	5.05%	2	5	6
IFC	EDC	Palinpinon GPP	Visayas	Geothermal	189	27	296	5.05%	8	25	12
IFC	EDC	Unified Leyte	Visayas	Geothermal	481	-	753	5.05%	20	65	24
IFC	EDC	Pantabangan-M	Luzon	Hydro large	132	20	207	3.03%	5	18	6
IFC	SNAP	Magat	Luzon	Hydro large	360	60	542	0.00%	-	105	12
IFC	SNAP	Ambuklao	Luzon	Hydro large	105	105	255	0.00%	-	44	18
IFC	SNAP	Binga	Luzon	Hydro large	132	20	320	0.00%	-	56	3
IFC	AES	Masinloc 1 & 2	Luzon	Coal	630	190	1,100	8.00%	22	253	94
Norfund	SNAP	Magat	Luzon	Hydro large	360	60	542	20.00%	77	-	72
Norfund	SNAP	Ambuklao	Luzon	Hydro large	105	105	255	20.00%	8	-	21
Norfund	SNAP	Binga	Luzon	Hydro large	132	20	320	20.00%	10	-	26
ADB	AES	Masinloc 1 & 2	Luzon	Coal	630	190	1,100	0.00%	-	200	35
ADB	KEPCO	KEPCO Coal	Visayas	Coal	200	200	520	0.00%	-	120	46
Subtotals											
IFC					2,306	611	3,907		67	603	200
Norfund					597	185	1,117		95	-	119
ADB					830	390	1,620		-	320	81
	EDC				1,079	236	1,690		45	145	72
	SNAP				597	370	1,117		95	205	153
	AES				630	190	1,100		22	453	129
	KEPCO				200	200	520		-	120	46
			Luzon		1,489	710	2,627		128	693	305
			Visayas		1,017	286	1,799		34	230	95
				Geothermal	947	216	1,483		39	128	66
				Hydro large	729	390	1,324		100	223	159
				Coal	830	390	1,620		22	573	175
Total					**2,506**	**811**	**4,427**		**162**	**923**	**400**

Sources: IFI documentation; DOE statistics; Company information; Steward Redqueen analysis.
Notes: Subtotals *dependable capacity*, *capacity addition* and *total deal value* for IFC, Norfund and ADB do not add up to totals due to overlaps; *Capacity addition* EDC estimated as difference of dependable capacity between 2010 and 2013; *Total deal value* EDC estimated as total assets EDC 2011; IFC debt of USD 159m to EDC allocated to individual power plants in proportion to plant capacity; Equity finance Norfund taken from Norfund 2007 annual report at applicable exchange rates.

Attribution of 400 MW of power capacity to IFIs has been established using two rules:

1. For equity financing the power generation capacity is multiplied by the percentage ownership equity ownership (222 MW);

[38] The magnitude of the feedback is material but not very large, as will be shown. It reduces the electricity price effect by some 4-12% as will be shown in Section 4.5.3.

2. For debt financing, the capacity addition is multiplied by the IFI debt financing as a percentage of the total deal value (178 MW).

This means that of the total power capacity of the companies that received IFI finance, 15.7% (400/2,506) is attributed to IFI. The IFI-attributable capacity is equal to 2.9% (i.e. 400/13,675) of the total dependable capacity in Luzon and Visayas.

4.3 Impact of IFI-attributable power generation capacity on electricity price

As was shown in Exhibit 10, the generation charge constitutes more than half of the end-user electricity tariff and is the result of the ever changing balance between electricity demand and supply. In order to understand the impact of IFI-attributable power on the generation charge a model has been constructed which juxtaposes the supply curve for electricity with the electricity demand curve. The power supply curve[39] is discussed in Section 4.3.1 and the power demand profile[40] in Section 4.3.2. In Section 4.3.3 the supply and demand curves are combined into a predictive model.

4.3.1 Electric power supply curve

The electric power supply curve is constructed by analysing capacity and cost information for all the 95 power plants in Luzon and Visayas with dependable capacity larger than 0 MW (see Section 3.2) as per year end 2013. According to the Philippines' Department of Energy, these plants together represent an installed capacity of 15,460 MW of which 13,675 MW is rated as dependable. Based on historic cost information and generation charge rulings for individual plants, the so-called short-run and long-run marginal costs per kWh (SRMC and LRMC[41]) were determined for 46 plants which together represent 77% of the dependable capacity. SRMC and LRMC for the remaining 49 plants, mostly smaller ones that together make up 23% of dependable capacity, were determined using information from the United States Energy Information Agency (EIA[42]) and the results for similar plants (fuel, technology and size) in the sample of 46. The resulting power supply curve is shown in Exhibit 12.

[39] The electric power supply curve is better known as the power dispatch curve in the industry.
[40] The power demand profile is often referred to as the load profile or curve.
[41] Long-Run Marginal Cost is also known as Levelised Cost of Energy or LCOE. It is defined as the total life-cycle cost of a power plant divided by the total life cycle electricity production. LRMC includes SRMC
[42] http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

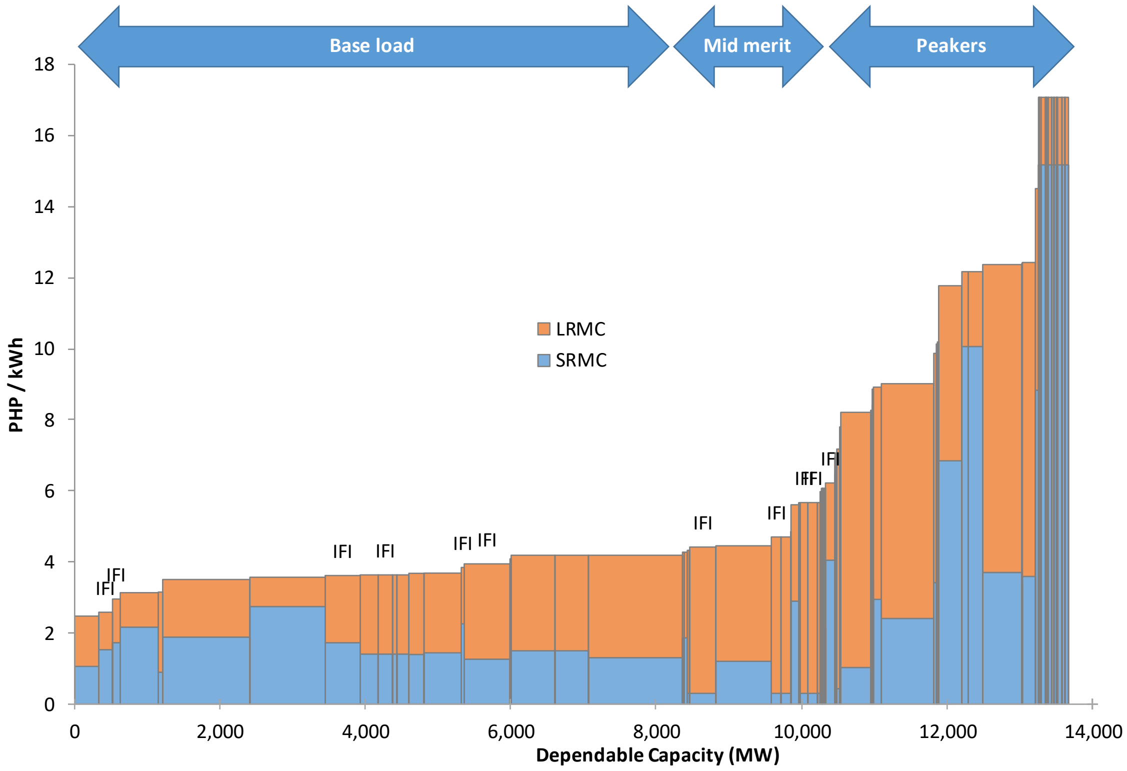


Exhibit 12: Electric power supply curve for Luzon and Visayas. Plants in which IFIs have invested are indicated.

The graph shows that when electricity demand increases beyond what base-load plants can provide, prices will spike up sharply; base load, i.e. the plants that provide the cheapest power provided that they run 24/7, generate power at less than PHP 4 per kWh, but prices rise fast beyond that[43]. The situation regarding base load power in the Philippines is somewhat remarkable because gas plants, which are typically mid-merit elsewhere, are being run as base load (e.g. the Ilijan and Sta. Rita plants with dependable capacities of 1,200 and 1,036 MW, the second and third largest plants after the Sual coal plant). The reason for this is the take-or-pay[44] contract that the Philippines have with Shell for the production of the Malampaya gas field. In addition to natural gas, coal plants (which have low fuel cost but high fixed cost due to large investments) and geothermal plants provide base power. Although in terms of LRMC large hydro plants like IFI investments Magat and Pantabangan-Masiway (see Table 1) are close to base load plants, in practice these are being run as mid-merit and peaking plants due to the opportunity cost of losing hydro pressure (head) at times when prices are low. The price signals received from the spot market have thus induced a more optimal allocation of hydro power generation assets and thereby a more efficient overall dispatch of power. Pumped hydro, gas turbine, diesel and oil plants are located towards the higher end of mid-merit and in the peaking part of the supply curve. The LRMC of these plants are harder to determine exactly because they are highly dependent on the time that they are being run. In fact, the recent introduction of a

[43] Because electricity consumption by the power plants themselves, capacity on scheduled or forced outage and water levels for large hydro, mid-merit and peaking capacity will be needed at smaller system electricity loads than indicated in Exhibit 12.

[44] This means that even when the gas is not taken off it still needs to be paid, thereby greatly reducing the marginal cost of fuel. The fact that SRMC of these gas plants are still quite high is because of the commercial rates used in transfer pricing, but it would be very uneconomical to turn these plants off. The take-or-pay contract ends in 2024.

price cap[45] of PHP 32 per kWh by the ERC has possibly rendered new investment in these types of fast-response generation unattractive as they might not recoup investment cost over the small time intervals they will likely be employed.

Exhibit 12 may give the impression that the power supply curve is static in time. However, due to scheduled and unscheduled outages of power plants and seasonality[46] of the water levels of large and small hydro plants, the power supply curve is rather dynamic. Based on past records regarding capacity on outage per generation technology and observed water levels in hydro reservoirs these dynamics can be incorporated in a statistical manner.[47,48] Over 2013, average capacity on outage was 2,051 MW, or 15% of dependable capacity.

The power supply curve allows the study of the effect of IFI-attributable capacity, as given in Table 4. With the statistical treatment on plant outages included and for a month with maximum hydro availability, Exhibit 13 shows the power supply curve with and without IFI-attributable capacity included. The inclusion of IFI-attributable capacity essentially stretches the supply curve to the right. Especially for system loads above 8,000 MW this considerably reduces the generation charge.

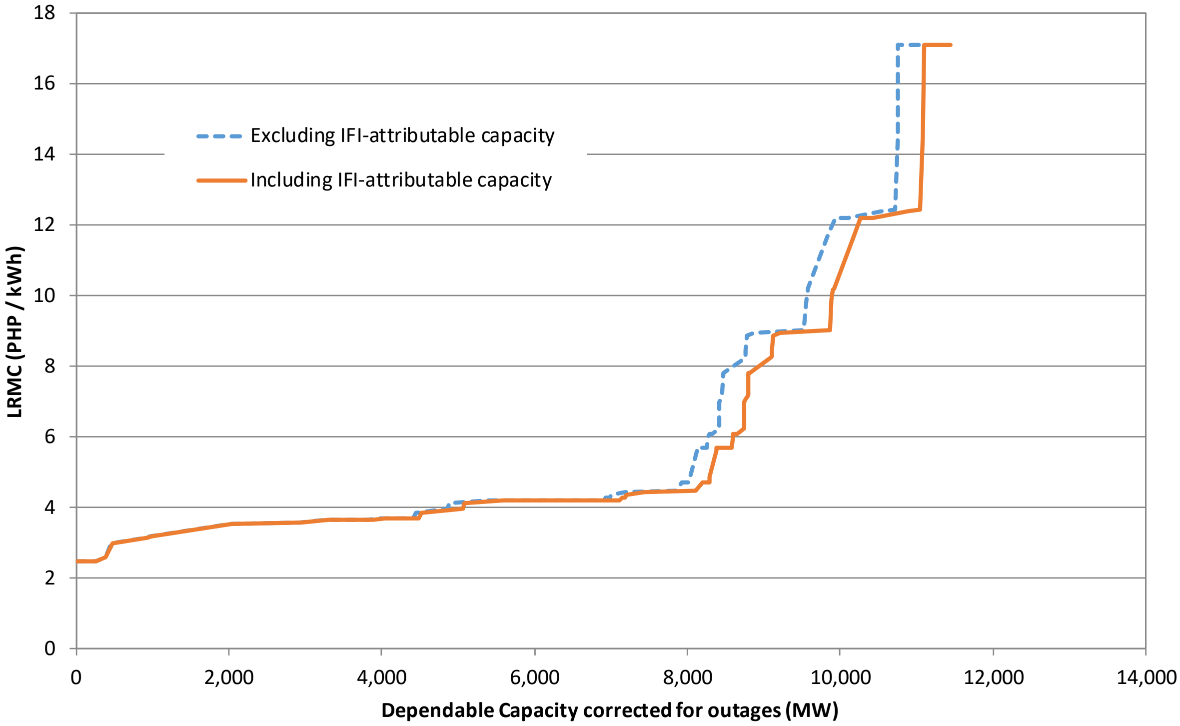


Exhibit 13: Power supply curve with and without IFI-attributable capacity included

4.3.2 Electric power demand curve

Electricity consumption (in MWh) was discussed in Section 3.3. However, in order to determine electricity prices one needs to know the system power demand in terms of MW.

[45] In December 2014 the ERC introduced an additional secondary price cap of PHP 6.25 per kWh which takes effect when the seven day average spot market price reaches PHP 9.00 per kWh.
[46] Water levels also exhibit inter-annual variability (e.g. El Niño / La Niña cycles) but this has not been incorporated in this study because unlike seasonality it cannot be adequately or statistically predicted.
[47] Outage data have been obtained from the annual WESM Annual Market Assessment report 2013 and hydro power generation per month from DOE power statistics 2003-2013.
[48] For completeness it must be noted that solar (and to a much lesser extent wind) energy exhibit and diurnal cycle as well. Because of the negligible installed base this variation has not been incorporated in this study.

As will be shown in Section 4.3.3, this power demand inserted on the horizontal axis of the (dynamic) supply curve then yields the 'market clearing' generation charge[49].

Electricity demand fluctuates, both over the course of the day as well as seasonally as shown in Exhibit 14. There are three daily peaks, at 11:00, 14:00 and 19:00 and the difference between off-peak and peak demand each day is about 2,500 MW and the difference of peak demand between the months of lowest (January) and highest (May) demand some 1,600 MW. Seasonality is largely driven by weather conditions.[50]

The Department of Energy projects growth in the Luzon and Visayas grids to be 0.6x and 1.0x GDP growth[1]. Assuming GDP growth of 7% and taking into account the energy consumption in the two grids yields a projected power demand growth of 4.8%. This figure is used to project the 2013 electricity consumption pattern forward to 2014, 2015 and 2016.

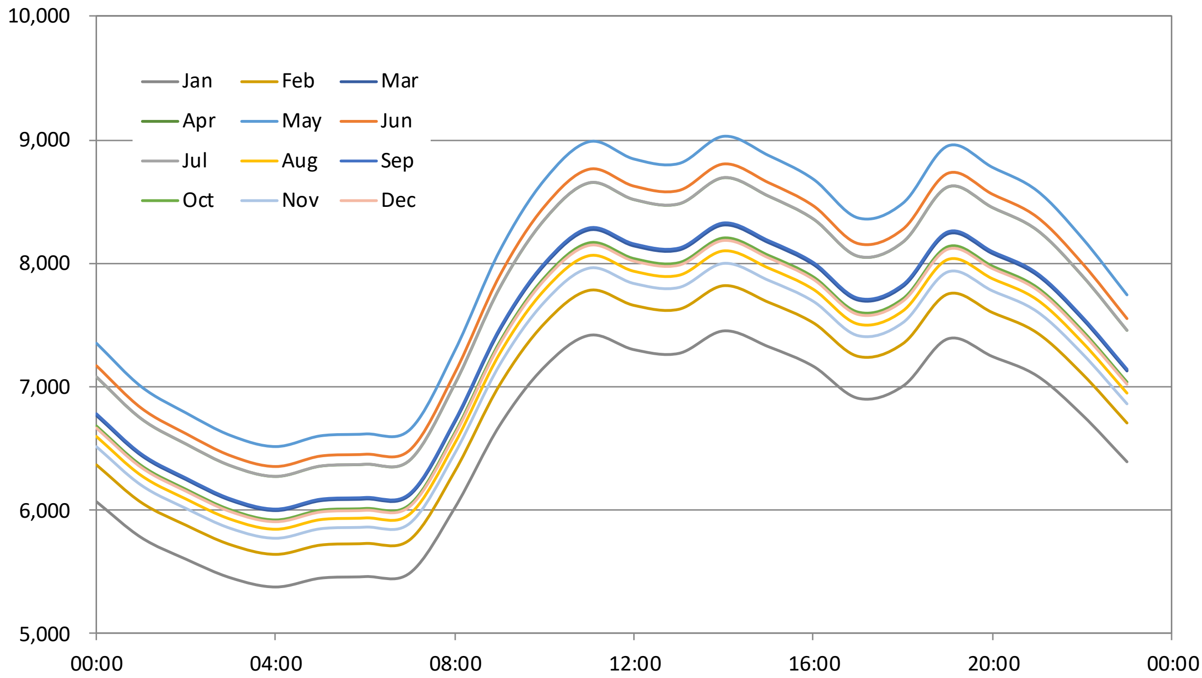


Exhibit 14: Average daily course of electric power demand (MW) in Luzon and Visayas for all months.[51]

4.3.3 Electricity generation price model based on supply and demand

With the power supply and demand curve defined as described in the sections above, a model has been constructed that combines the supply curve (including statistical incorporation of plant outages and seasonal behaviour of hydro capacity) with the demand

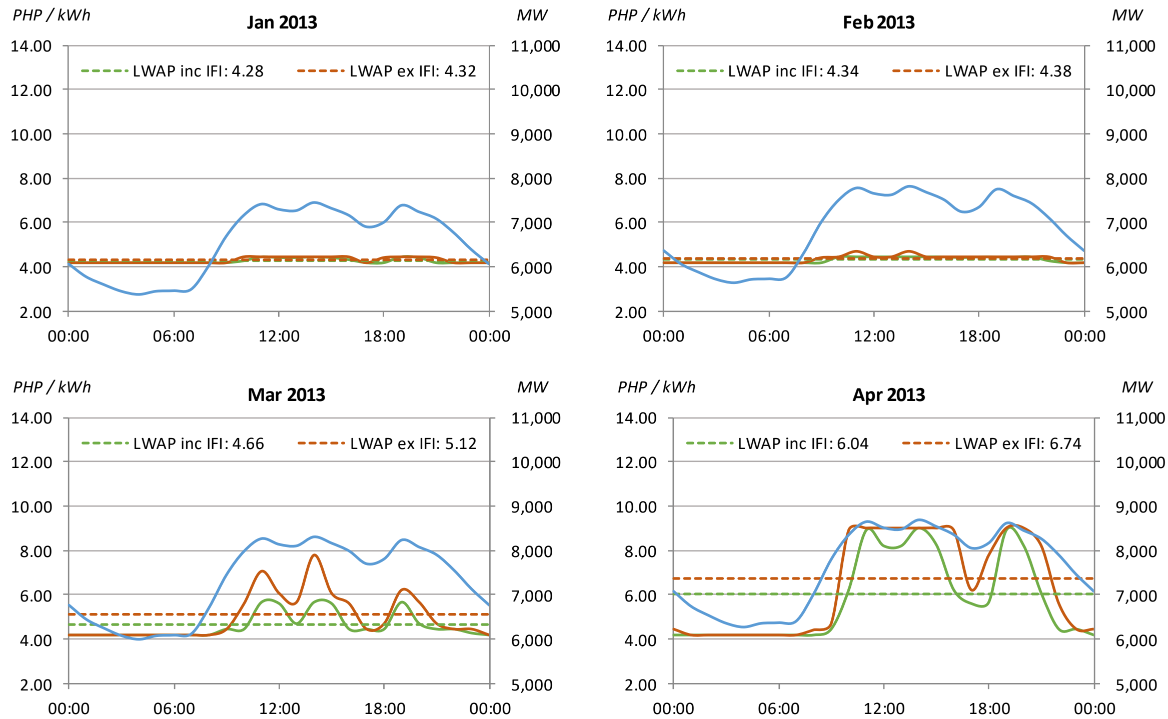
[49] The WESM spot market works in very much the same way. It essentially matches generation bids with demand forecasts to determine the market clearing price. Because some 90% of the power generated is sold through bilateral contracts we have to resort to long-term average power supply curves rather than observed bidding behaviour of power plants because the latter only reflects residual capacity and is thus not representative for the price setting of its total capacity.

[50] Average temperatures in Manila vary between 26.5°C in January and 29.5°C in May.

[51] Source: WESM Annual Market Assessment report 2013 and Steward Redqueen interpolations (which explains the identical diurnal cycle in each month whereas in reality there are slight deviations from that. Power demand includes system losses.

profiles[52]. Average daily demand profiles can be selected for each month for the year 2013. Demand profiles for subsequent years are modelled using a projected electricity consumption growth rate[53]. Outage statistics for 2013 have been incorporated but can be increased or decreased by a constant factor. In addition, IFI-attributable capacity can be turned on or off for each individual IFI in order to determine the marginal effect of each of them.

Exhibit 15 shows for each of the daily demand (load) profiles the simulated price behaviour. When demand is low, i.e. from 22:00–07:00 and/or during the months January and February, IFI-attributable capacity hardly has an influence on price. This is because demand is less than 8,000 MW, for which it was shown in Exhibit 13 that the supply curves with and without IFI-attributable generation capacity are virtually the same. When demand rises above 8,000 MW, the highly non-linear price behaviour becomes visible: small fluctuations in demand cause large fluctuations in price and the impact of IFI-attributable generation capacity becomes very clear. Although demand in April is slightly below that in May, prices are higher because water levels are normally lower and less hydro power is available, thus shifting the supply curve to the left and inducing higher prices.



[52] For the supply curve we use the LRMC. Although bidding actual behaviour will be driven more by SRMC than LRMC we use here the supply curve based on LRMC because in the long run bidding behaviour will be such that plants can recoup their LRMC. The long-term average behaviour of hydro plants, with their negligible SRMC, will be driven to maximize the revenue on the water available for power generation.

[53] Of course, the further in time demand profiles are projected the larger the uncertainty. Moreover, the model does not incorporate the arrival of new plants.

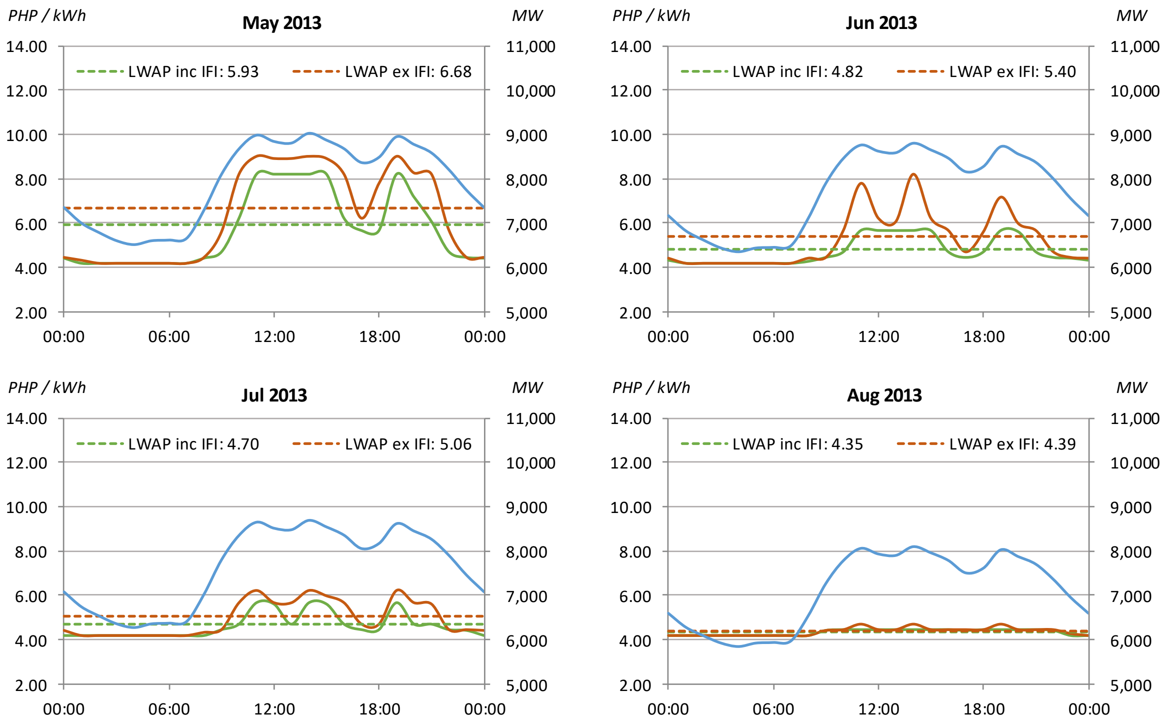
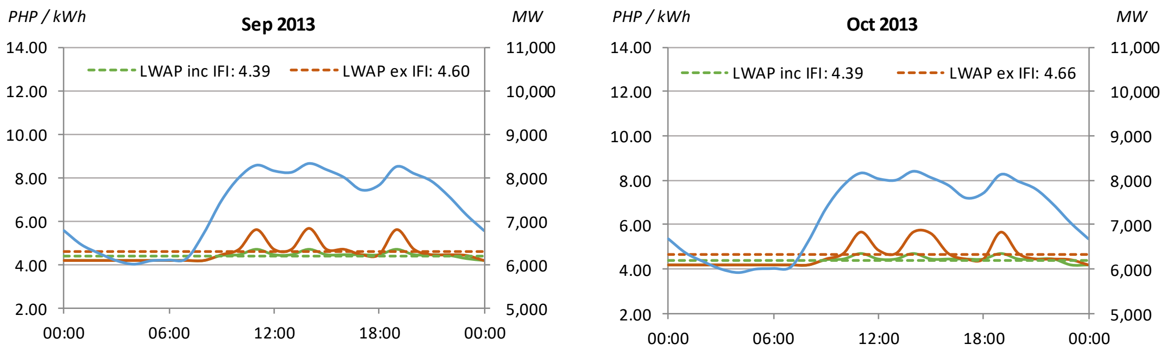


Exhibit 15: Daily average load and price profile for all months in 2013.

Blue lines indicate energy demand (right axis, MW). Red and green lines indicate generation charge, respectively without and with IFI-attributable power generation capacity (left axis, PHP / kWh). Red and green dotted lines indicate load weighted average price (LWAP)[54], respectively without and with IFI-attributable capacity.



[54] The GDP to electricity demand feedback effect shown in Exhibit 11 is included

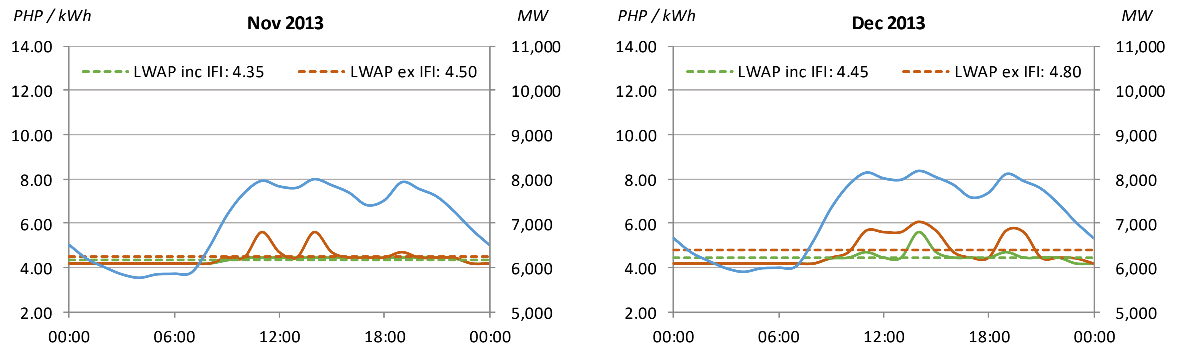


Exhibit 15: Daily average load and price profile for all months in 2013. (continued)

Discarding the daily cycle and including only the load weighted average prices (LWAP) in Exhibit 15, results can be shown for full years, as is done in Exhibit 16.

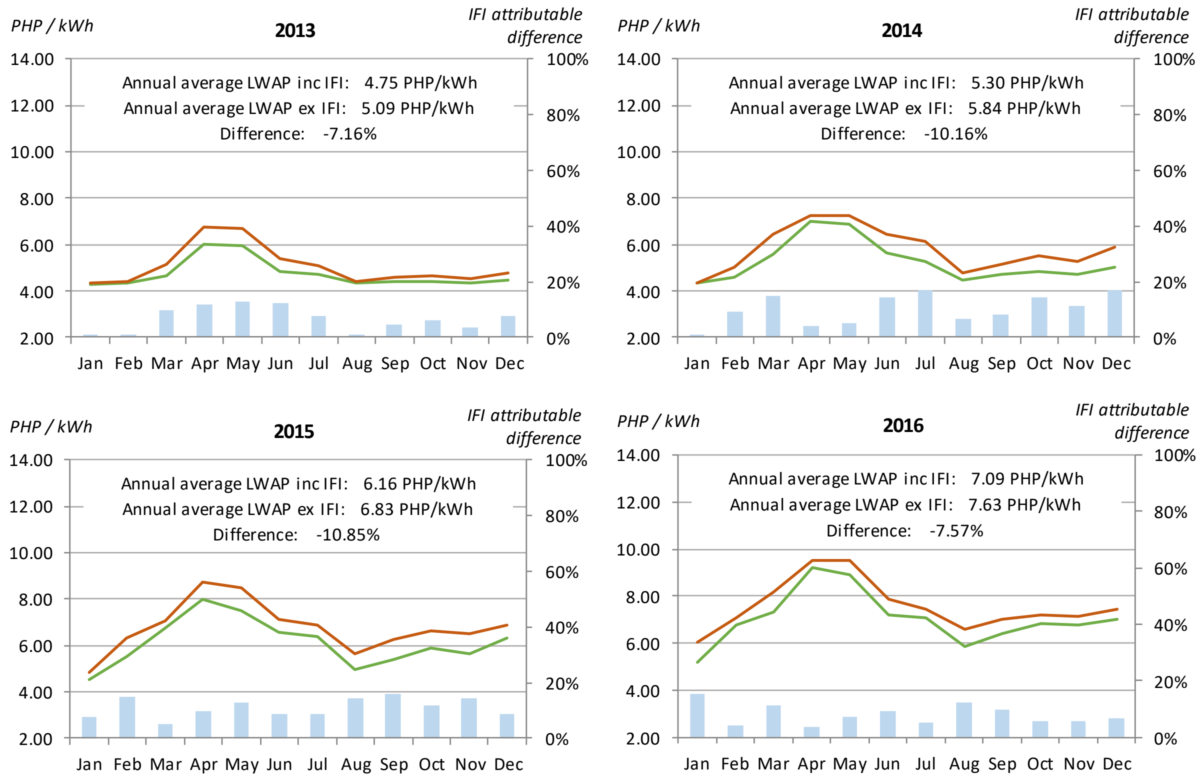


Exhibit 16: Annual price profiles and impact of IFI-attributable capacity for four years.
Red and green lines indicate monthly LWAPs in Exhibit 15, respectively without and with IFI-attributable power generation capacity (left axis, PHP / kWh). Bars indicate difference (right axis). Annual growth of energy consumption per years assumed as 4.8% (see Section 4.3.2).

The four years shown in Exhibit 16 differ from each other only in terms of energy consumption, which is assumed to grow by 4.8% a year starting in 2013. As a result, prices increase. However the annual average difference between the situations with and without IFI-attributable generation moves in a fairly narrow band between 7.16% and 10.85%, with higher demands not necessarily increasing the difference, as can be inferred from the results for 2016. When expressed in monetary terms, these lower IFI-attributable generation charges amount lower annual electricity cost for residential, commercial and industrial end users of USD 484m; USD 804m; USD 1,046m and USD 880m for the years 2013 – 2016[55].

Finally, the results shown in Exhibit 15 and Exhibit 16 can also be depicted as so-called load and price duration curves, as is done in Exhibit 17. These curves show the amount of time that system load (demand) and prices are above a particular level[56]. As load goes up over the years, the price curves move to the right, indicating ever shorter periods with low prices. The impact of IFI-attributable capacity on the duration curves can be clearly seen.

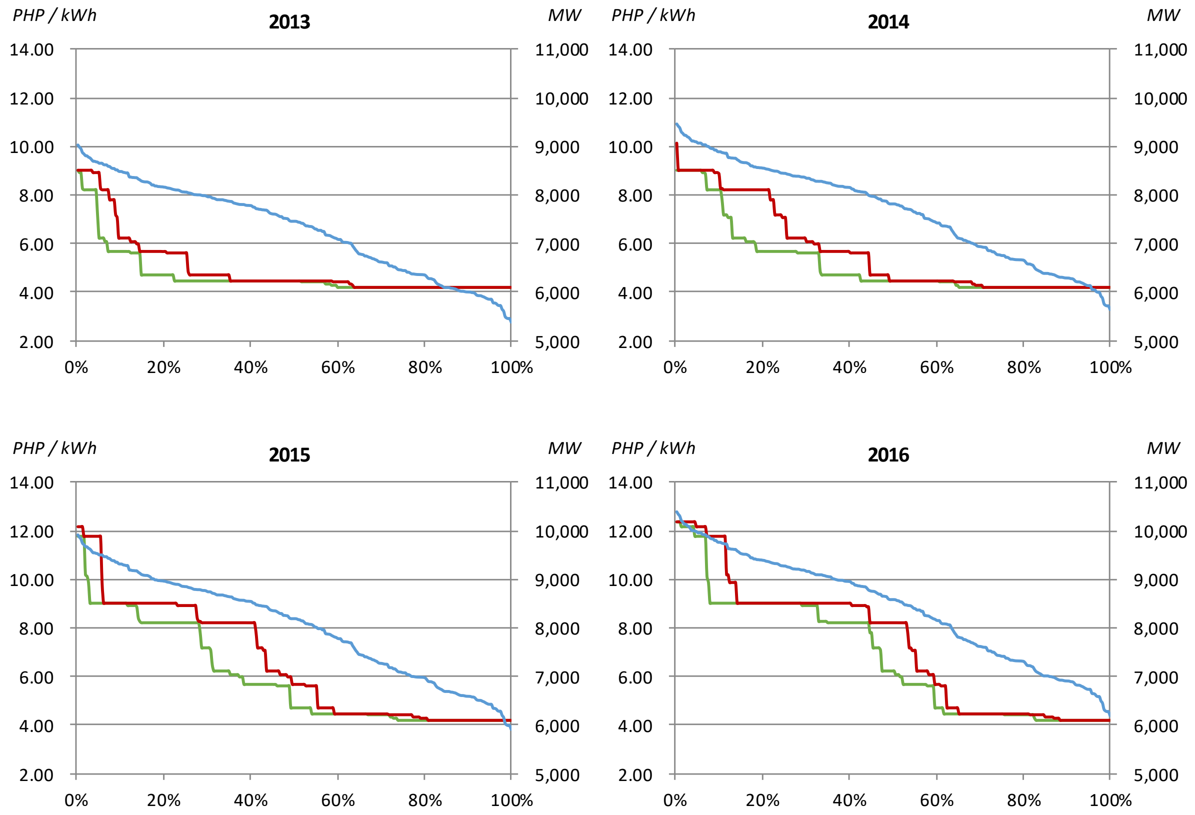


Exhibit 17: Price and load duration curves and the impact of IFI-attributable capacity.
Red and green lines indicate generation charge, respectively without and with IFI-attributable power generation capacity (left axis, PHP / kWh). Blue lines indicate the duration.

The results shown so far indicate that the model captures the essential dynamics of the power generation market. However, the ultimate proof of the model's validity is the extent to which it can reproduce observed behaviour. In order to make such a comparison, much depends on what will constitute a realistic market price. As was mentioned already in Section 3.1, about 90% of the power is sold through bilateral contracts with the remainder at spot market prices. Bilateral contracts typically long-term and have fairly stable prices, as opposed to spot market prices which can fluctuate widely (and even be negative). Not a single market price prevails at any one moment and assumptions need to be made in order determine a representative generation charge. Because Meralco is by far the largest distribution company, an average is constructed of the Meralco monthly average generation charge and the WESM load weighted average (monthly) price[57]. This

[55] Assuming an exchange rate of USD/PHP = 45.
[56] The duration curves are derived by ordering all 288 hourly demand values (i.e. the 24 average hourly values for 12 months shown in Exhibit 14) and model prices outcomes from highest to lowest.
[57] The Meralco generation charge is weighted for 2/3 and the WESM LWAP for 1/3 to heuristically balance the 90% bilateral volumes and the universality of the WESM price.

representative price is compared with model predictions in Exhibit 18. As can be seen, the model adequately captures the dynamics of the markets. During November and December in 2013, the Malampaya gas platform was being serviced which caused the unavailability of 2,700 MW of natural gas power generation capacity and large increases of spot market prices which were later annulled by regulator ERC. In the model this event was mimicked by knocking out the natural gas capacity[58]. The model's ability to adequately reproduce observed market prices is particularly encouraging because it does incorporate statistical average outage capacity and hydro power availability, rather than the actual ones (except for the Malampaya event).

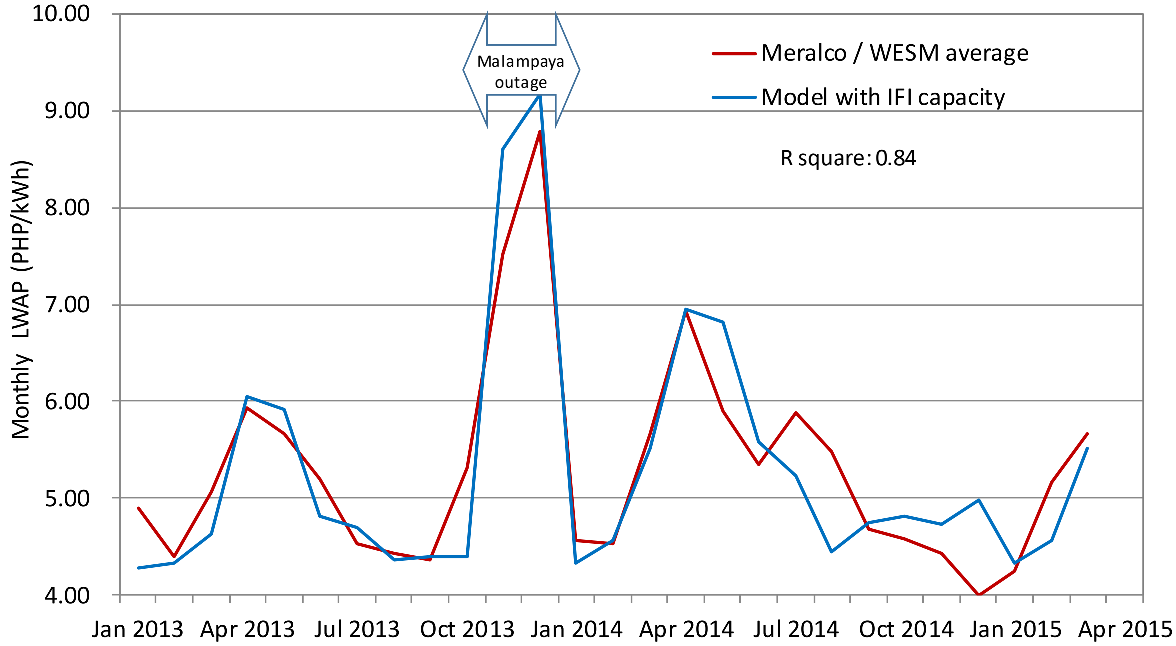


Exhibit 18: Comparison of model LWAP (including IFI capacity) and monthly average of Meralco and WESM prices.

4.3.4 IFI-attributable change of generation charge

The main conclusions of the analyses in the previous sections are:

1. The supply-demand model of generation charges captures the essential market dynamics of the generation market in the Philippines;
2. The model can therefore be used to determine the marginal price reduction of IFI-attributable generation capacity;
3. This marginal reduction of generation charge is in the range 7.16% - 10.85%.
4. Because the generation charge makes up 55% of the pre-tax electricity tariff (see Section 3.4), it causes end-user electricity prices to decrease by 3.94% - 5.97%.

4.4 Impact of IFI-attributable change of electricity price on economic output

Upon having established the IFI-attributable change of electricity, the objective of this section is to determine the effect of this price change on manufacturing output. In Section 4.4.1 the relationship between electricity price and manufacturing output will be established. Using that relationship together with the IFI-attributable price change, in Section 4.4.2 the impact of IFI power generation investment on manufacturing output will be determined.

[58] The Malampaya event was so large that it surpasses normal outage fluctuations by an order of magnitude and thus need to be explicitly rather than statistically accounted for in the model.

4.4.1 Electricity price elasticity of manufacturing output

In order to determine the relationship between electricity price and manufacturing output one would ideally deploy a longitudinal analysis using panel data[59] of output and cost attributes of individual manufacturing firms. Unfortunately, such data are not available. As an alternative, a cross-sectional analysis, which considers a sample of manufacturing firms at a single point in time, can be applied.

The most recent Census of Philippine Business and Industry (CPBI 2012) was the first to ask for electricity use and costs and would have been the preferred data set since it is recent and covers a larger sample of companies. However, data policies of the Philippine Statistical Authority prohibit the use of these data outside of its premises. Therefore the World Bank Enterprise Survey[60] was used. The World Bank Enterprise Surveys for countries routinely asks electricity cost data and was most recently conducted in the Philippines in 2009.

In order to determine the elasticity of output with respect to electricity cost one can apply the extended Cobb Douglas[61,62] production function:

$$Y = A \cdot L^{\alpha} K^{\beta} M^{\gamma} F^{\delta} E^{\varepsilon}$$

With Y firm sales; L labour (number of employees); K capital (here replacement capital[63]), M annual cost of materials (USD), F annual fuel costs (USD) and E annual electricity use (MWh)[64]. A is the so-called total factor productivity (TFP)[65] and $\alpha, \beta, \gamma, \delta$ *and* ε the factor elasticities. In case of constant returns to scale, the elasticities sum up to 1. The elasticities can be determined using multiple linear regression analysis on the logarithmic form:

$$\log(Y) = \log(A) + \alpha \log(L) + \beta \log(K) + \gamma \log(M) + \delta \log(F) + \varepsilon \log(E)$$

When performing the regression analysis, the sample size is restricted by the number of companies for which all variables are available. It thus makes sense to eliminate the variables with the least explanatory value in order to obtain statistically meaningful results for the entire manufacturing sector as well as sub sectors or size segments. Specifically, if a regressor could not be determined with more than 95% confidence (i.e. P-values larger than 0.05) it is omitted from the regression. This means that the sample size increases because not all inputs are known for all firms. This procedure is repeated until all remaining regressors are estimated with more than 95% confidence, although most are within the

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59 Panel data is a time series of two or more variables from which allows the determination of co-integrating relationships between them.

60 The advantage of using World Bank Enterprise Survey is that it allows for this study, or parts of it, to be replicated elsewhere.

61 Charnes, Cooper, W.W., and Schinnart, A.P., *A theorem on homogeneous functions and extended Cobb-Douglas forms*, Proc. Natl. Acad. Sci. USA 73(10), 1976.

62 Constant Elasticity of Substitution (CES) production functions may be preferable in theory but nesting forms for factors make determination less reproducible. Moreover, given limited importance of capital it would lead to unconventional 'nests'. Transcendental Logarithmic (Translog) production functions (which are generalised Cobb Douglas functions) become too unwieldy in terms of parameters that need to be estimated when more than two variables are considered.

63 The Enterprise Survey has two indications for capital: book value and replacement value of which the latter is deemed more representative, although the analyses are hardly affected by the choice between the two.

64 The enterprise survey captures annual electricity costs. Using the three commercial tariffs summarised in the USAID study,[17] the electricity use for each firm was determined (<3 MWh -> 8.72 PHP/kWh; > 200MWh -> 6.86 PHP/kWh and 7.79 PHP/kWh for all others.

65 TFP is a dimensionally meaningless 'fudge' factor to account for changes in productivity unexplained by changes of factor inputs. It does not feature in this study.

99% confidence interval. Shown in Table 5 are the results for the entire manufacturing sector as well as six subsectors.

Table 5: Manufacturing sector and sub-sectors: factor shares for labour (L), material cost (M), electricity use (E) and capital (C).

	All LMEC	All LME	Electronics	Food	Garments	Non Met Min	Chem & Plas	Various
log *Employees*	0.355	0.330	0.453	0.131	0.592		0.308	**0.259**
log *Material costs*	0.443	0.503	0.394	0.463	0.363	0.754	0.365	0.484
log *Electricity use*	0.211	0.256	0.266	0.346	0.225	**0.153**	0.173	0.169
log *Capital*	0.116						0.164	0.227
log *Fuel*				**0.129**				
Sum of factors	1.125	1.089	1.114	1.069	1.180	0.906	1.010	1.138
Number of firms	351	674	98	77	43	55	218	71
Adj. R square	0.85	0.81	0.80	0.89	0.85	0.88	0.77	0.83

Note: Labour defined as number of employees; Material costs in USD; Electricity use in MWh/year; and Capital as replacement value in USD. All factor shares significant at the 1% level except for the bold numbers which are at the 5% level. "All LME" indicates regression performed for sample of manufacturing firms with available information on Labour, Material cost and Electricity use. "All EMPC" indicates regression performed for the subsample of manufacturing firms for which information Capital is available as well.

The sum of the factor shares is slightly larger than 1 for all samples except for Non-Metallic Minerals, indicating the presence of slightly increasing returns to scale. Only for the sample of firms in the Food sector do fuel costs meaningfully explain firm output. The factor share of capital is significant for the overall manufacturing sector and the Chemical & Plastics and 'Various' sectors. The relatively small factor share of capital for the entire manufacturing sample is explained by the fact that capital goes to financing a firm's fixed assets and is thus much less elastic, at least in the short term. Other factors are the small size of the capital intensive manufacturing sectors and impediments that hamper a productive use of capital[66]. It is important to note that Saliola and Seker (2011)[67] using Enterprise Surveys and a similar methodology arrive at the same conclusion for the Philippines and for virtually all emerging markets[68]. Two other conclusions can be drawn from Table 5:

1. When controlling for capital, the factor share of electric power use across all manufacturing sectors ("All LMEC") is 0.211 (n=351). When not controlling for capital the electricity factor share is slightly larger 0.256 (n=674);
2. For the Food sectors the factor share of electricity is around 0.346 while for the remaining sectors the factor share fluctuates around 0.20.

When weighing the electricity factor shares for the size of the manufacturing subsectors in the Philippine input-output table, the factor share is 0.279. This is higher than the sample average of 0.211 in the Enterprise Survey because the food manufacturing, with its high factor share of 0.346, makes up almost half of the entire manufacturing sector.

The weighted average factor share of electricity use of 0.279 is considerably larger than the cost share of electricity of 0.039.[69] This has been observed throughout literature (see Section 3.5) and is explained by the fact that especially in the industrial sector, which comprises the largest users, electricity use, unlike capital and labour, is a variable

[66] Indeed, the capital elasticity is around 0.10 for large companies and 0.04 for small ones.
[67] Saliola, F. and Seker, M., *Total Factor Productivity Across the Developing World*, Enterprise Note No. 23, World Bank Group, 2011.
[68] When performing the regression entirely on the cost shares of all factor inputs and not on the physical quantities, the factor share of capital is 0.08, the same as found by Saliola and Seker (2011).
[69] Defined as electricity costs divided by the sum of wages, material costs, and fuel and electricity costs. Capital costs and depreciation cannot accurately be determined from the Enterprise Surveys.

production cost. The observation also corresponds to intuition: shut down electricity (or similarly water) supply and one realises that its economic contribution is substantially larger than its cost share[70].

By multiplying the factor share of electricity use in manufacturing, ε, with the price elasticity of electric power consumption, θ, one arrives at the elasticity of economic output with respect to electricity price P:

$$\frac{dY}{dP}\frac{P}{Y} = \frac{dY}{dE}\frac{E}{Y} \cdot \frac{dE}{dP}\frac{P}{E} = \varepsilon \cdot \theta$$

However, the price elasticity of electricity use cannot be determined in the absence of panel data of electricity costs of firms. A realistic range must thus be established based on past research.

It is important to note that in the literature a distinction is made between short-term and long-term elasticities, the latter reflecting the adaptation by firms of their production technologies. Long-run elasticities tend to be significantly larger than short-run elasticities. Eskeland et al. (1994)[71] found price elasticities of -0.98 and -1.02 for Chile and Indonesia respectively. Chaudhry (2010)[72] found the price elasticity of electricity for manufacturing firms in Pakistan to be -0.57. In South Africa, Inglesi-Lotz and Blignaut (2011)[28] found an elasticity of -0.869 for the industrial sector. In a related analysis, Inglesi-Lotz (2012)[73] found a value of -0.95 for the industrial sector which was very constant after it changed from -1.0 in the 1970s, The authors noted that given the historically low electricity prices in South Africa, electricity demand may become elastic (i.e. an elasticity larger than -1 (in the negative sense)) when prices go up. In the more developed markets of Germany and the UK, Agnolucci (2009)[74] found a value of -0.64. Hill and Cao (2013)[75] found the short term price elasticity of electricity demand in the Australia manufacturing sector to be -0.24. Bernstein and Madlener (2010)[76] found short term price elasticities for manufacturing sector to range from insignificant to -0.57, while indicating that long-run elasticities are considerably larger. Using a 150 year time series, Stern and Enflo (2013)[77] found price elasticities of energy demand of -0.28 to -0.73 in Sweden, for different econometric model formulations.

Based on this non-exhaustive review and considering (i) that the Philippine economy has more in common with other developing economies such as South Africa and Indonesia than more developed countries like the UK, Germany and Sweden and (ii) that electricity in the Philippines is very expensive (and price elasticity thus probably towards the higher end of

[70] For an in-depth discussion see Kümmel, R. Ayres, R.U. and Lindenberger, D., *Thermodynamic Laws, Economic Methods and the Productive Power of Energy*, J. Non-Equilibrium Thermodynamics, 35 (2), 2010.
[71] Eskeland, G.S., Jiminez, E. And Lieu, L., *Energy pricing and air pollution – economic evidence from manufacturing in Chile and Indonesia*, Policy research Working paper 1323, World Bank, 1994.
[72] Chaudhry, A.A., *A panel data analysis of electricity demand in Pakistan*, Lahore Journal of economics (15), 2010.
[73] Inglesi-Lotz, R., *The sensitivity of the South African industrial sector's electricity consumption to electricity price fluctuations*, University of Pretoria Department of Economics Working Paper Series 2012-25, 2012.
[74] Agnolucci, P., *The energy demand in the British and German industrial sectors: Heterogeneity and common factors,* Energy Economics (31), 2009.
[75] Hill, C. And Cao, K., *Energy Use in the Australian Manufacturing Industry: An Analysis of Energy Demand Elasticity,* Australian Bureau of Statistics, Analytical Services Branch, 2013.
[76] Bernstein, R. and Madlener, R., *Short- and Long-Run Electricity Demand Elasticities at the Subsectoral Level: A Cointegration Analysis for German Manufacturing Industries*, FCN working paper 19/2010, FCN, 2010.
[77] Stern, D.I. and Enflo, K., *Causality between energy and output in the long-run,* Lund Papers in Economic History 126, 2013.

the range), it seems reasonable to assume a price elasticity of electricity demand in the range of -0.50 to -1.00. Using the midpoint value of -0.75 together with the electricity factor shares for the manufacturing subsectors yields a price elasticity of output range of 0.115 – 0.329 with a weighted average of -0.218.

It is important to note that it is particularly difficult to distinguish between ε and θ. Agnolucci (2009)[74] and Bernstein and Madlener (2010),[76] for example, found output elasticities with respect to electricity use of around 0.5. This causes their manufacturing output elasticities with respect to electricity price to be in the range 0.2-0.3, quite comparable with the 0.115-0.329 range found here. Combining the previously mentioned -0.57 price elasticity of Chaudhry (2010)[72] with the 0.502 factor share of electricity in manufacturing which he also found, yields an electricity price elasticity of manufacturing output in Pakistan of -0.29. Similar to this study, he found the food and textile sectors to have the highest price elasticity of output. The IMF[36] applied panel analysis to find that in Mexico a 1% decrease of electricity prices would increase manufacturing output by 0.114% - 0.283%, meaning that output elasticity with respect to electricity price is between -0.114 and -0.283, which corresponds very well with the range determined for the Philippines. The IMF study also finds that the output elasticity with respect to electricity is much larger than for other energy forms, which confirms the negligible factor share found for fuel above.

4.4.2 IFI-attributable change of manufacturing output

The electricity-price elasticity of manufacturing output determined in the previous section ($\varepsilon \cdot \theta$) can now be applied to predict the response of manufacturing to a change of electricity price:

$$\frac{dY}{dE} = \varepsilon \cdot A \cdot L^{\alpha} K^{\beta} M^{\gamma} F^{\delta} E^{\varepsilon-1} = \varepsilon \cdot \frac{Y}{E} \quad \Longrightarrow \quad \Delta Y \approx \varepsilon \cdot \left(\frac{\Delta E}{E}\right) \cdot Y = \varepsilon \cdot \theta \cdot \left(\frac{\Delta P}{P}\right) \cdot Y$$

Using the range of IFI-attributable lower electricity tariffs of 3.94% — 5.97% determined in Section 4.3.4; the electricity factor shares of the manufacturing sub sectors; and the price elasticity of electricity demand of -0.75, we can determine the increase of manufacturing output which is summarised in Table 6. These increases are not repeated year on year; rather the cheaper power lifts manufacturing output to a higher permanent level once, after which trend growth resumes. The different values for the four years indicate a range for this one-time increase. To put the manufacturing output increase of 0.82% - 1.25% into context, the cumulative increase of manufacturing value added (and thus approximately output) from 2007 until 2013 was 34.3% (average annual increase of 4.3%).

Table 6: Increase of manufacturing output as a result of IFI-attributable decreases of end-user electricity tariffs.

	2013	2014	2015	2016	% of Manufacturing GDP
Δ Generation charge	-7.16%	-10.16%	-10.85%	-7.57%	
Δ Electricity tariff	-3.94%	-5.59%	-5.97%	-4.16%	
Δ Manufacturing output	0.82%	1.17%	1.25%	0.87%	
Food	*1.02%*	*1.45%*	*1.55%*	*1.08%*	*45.6%*
Beverage & Tobacco	*1.02%*	*1.45%*	*1.55%*	*1.08%*	*4.6%*
Textiles	*0.66%*	*0.94%*	*1.01%*	*0.70%*	*1.9%*
Garments	*0.66%*	*0.94%*	*1.01%*	*0.70%*	*2.8%*
Leather	*0.66%*	*0.94%*	*1.01%*	*0.70%*	*0.4%*
Wood products	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*0.7%*
Paper	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*0.6%*
Petroleum & Coke	*0.48%*	*0.69%*	*0.73%*	*0.51%*	*5.9%*
Chemical & Plastics	*0.48%*	*0.69%*	*0.73%*	*0.51%*	*12.1%*
Non-metallic minerals	*0.45%*	*0.64%*	*0.68%*	*0.48%*	*2.5%*
Basic metals	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*1.7%*
Fabricated Metals	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*1.0%*
Transportation equipment	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*1.4%*
Electronic equipment	*0.79%*	*1.11%*	*1.19%*	*0.83%*	*14.8%*
Other machinery	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*1.2%*
Other manufacturing	*0.67%*	*0.95%*	*1.02%*	*0.71%*	*2.8%*

Note: All values indicated are for an assumed price elasticity of electricity demand of -0.75. Electricity tariff decreases are equal to the generation charge decrease indicated in Exhibit 16 multiplied by 55%, the fraction of the tariff which is for power generation. Δ Manufacturing output is average of manufacturing subsector increases, weighted by their relative economic size, i.e. % of manufacturing GDP.

4.5 Impact of IFI-attributable output change on value added and employment

Having determined the IFI-attributable change of manufacturing output, the final step in Exhibit 11 comprises the determination of the associated value added and employment. The Philippine input-output table is well suited for this since it allows one to trace the knock-on effects of changes in manufacturing output on other sectors. It should be noted that one of the main criticisms of input-output modelling –the inability to consider demand induced price changes- hardly applies here: the impact of IFI power generation investments have been determined using detailed supply-demand analysis which together with the output elasticities have resulted in output changes[78]. The input-output table is used here solely to trace the impact of that output increase on other sectors[79].

4.5.1 Philippine input-output table and treatment of output changes

The most recent input-output table for the Philippines is for the year 2006.[80] The table contains 206 sectors but in this report an aggregated 36 sector version will be used.[81] The

[78] In fact, it would be very difficult to include the intricate treatment of the highly non-linear behaviour of power price response to changes in demand and supply (see Section 4.3.3) in CGE models. As shown in Exhibit 16 the relative price response fluctuates markedly for the years analysed.

[79] The other significant assumption made input-output modelling –constant input prices– is made here as well (with the exception of electricity of course). However, the increase of manufacturing output is rather small (< 1.5%) that this is considered not overly severe. In addition, the Philippine economy is rather open and imports would help to constrain prices increases (in fact, imports constitute a sizeable portion of inputs).

[80] A new table is being compiled by the Philippine Statistics Authority but it will not be available until 2016.

[81] The table used is an aggregated version compiled by the Global Trade Analysis Program (GTAP) v8.

main two reasons to use the aggregated input output table are that (i) detailed employment data are only available for a 22 sectors (Section 4.5.3); and (ii) because the 2013 sector GDP data, needed for updating the 2006 table to 2013, is available for 36 economic sectors. Notwithstanding the loss of some detail, the resulting table still allows the routing of manufacturing output changes (Section 4.4.2).

The so-called RAS[82] procedure is applied to update the 2006 table to 2013. Based on new GDP contribution figures for the 36 sectors, column and row coefficients are alternatingly and iteratively updated until the table reflects the new figures and is balanced again. It is important to note that the table leaves the 'technology coefficients' essentially unchanged. This means that it nudges the table to reflect the new totals but it does not considerably change the implicit production structure of the sectors.

The same RAS procedure is also used to analyse the effects of increased manufacturing output on non-manufacturing sectors. Exhibit 19 shows how a new table is constructed that reflects changes in manufacturing and utilities output only. Although it is still assumed that sectors maintain their individual production structures, these structures change in one important aspect namely that the electricity costs for all sectors fall (i.e. the values in the utilities row which indicate the spending of individual sector on utilities). If electricity use does not change, these lower electricity costs translate into higher profits and (corporate) taxes for all electricity consuming sectors at the cost of lower profits and taxes in the utilities sector (i.e. economy-wide value added remains practically unchanged). However, output of the manufacturing subsectors increase as is shown in Table 6. This leads to the following changes in the original Philippine input output table:

1. Decrease electricity spending of all sectors by ΔP;
2. Add change of electricity cost to profits and taxes (respectively 70% and 30%[83] for all sectors and decrease profits and taxes[84] of the electricity sector);
3. Increase all elements in the manufacturing columns by the change of manufacturing output ΔY (see Table 6);
4. Increase all elements in the manufacturing rows by ΔY and lower the imports row by the same amount, reflecting that the increased manufacturing output substitutes for imports.[85]

Driven by these changes the RAS procedure will, after a number of iterations, yield a balanced SAM[86] in which all the sectors produce the necessary additional intermediary

[82] The RAS method is a bi-proportional matrix balancing techniques (the letters reflect the symbols in a matrix multiplication rather than an acronym). A detailed description can be found in Miller, R.E. and Blair, P.D., *Input-Output Analysis – Features and Extension*, pp 784, 2009.
[83] The corporate tax rate in the Philippines is 30%.
[84] Since the same physical amount of electricity is produced the cost structure of the electricity sector does not change and lower revenues come at the cost of profits and corporate taxes.
[85] The reduction of imports serves to minimise differences between row and column total which would force the RAS method to make unrealistic numerical changes. Economically it can reasonably be expected that lower electricity costs render local manufacturing firms more competitive vis-a-vis imports.
[86] Although economic interpretations of the RAS methodology have been given (the alternating rounds of adjustments essentially being changes of intra-sector production efficiency and inter-sector substitution), the method is a mathematical procedure to solve a system of more variables than fully-known equations. In practice this means that many solutions are possible. By starting the iterations one time with the new row totals and one time with the new column totals, two different solutions are arrived upon. Because of the linear nature of the procedure, the average of these two solutions is a solution as well. This average solution is considered to be a better prediction of how cheaper electricity and higher manufacturing output drive changes elsewhere in the economy. The reason for this is that the sum of squared differences of the diagonal terms between the original and the updated average table is smaller than for two alternatives. The diagonal terms represent the auto consumption of sectors and can (heuristically) be expected to change least in the non-manufacturing and non-

output needed by the manufacturing sectors. The economy wide increase of output and value added corresponding with the lower electricity-price induced increase of manufacturing output is thus quantified.

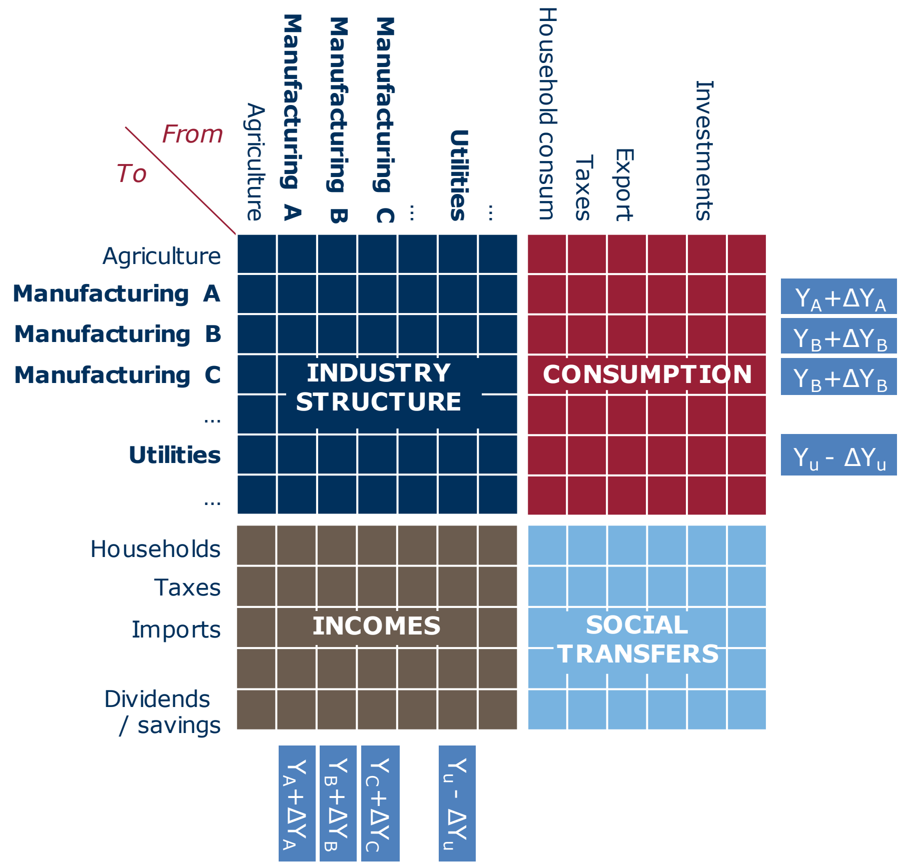

Exhibit 19: RAS methodology to rebalance the Social Accounting Matrix for changes in manufacturing and utilities output.

It is important to note that the typical application of input-output modelling, and indeed the original formulation by Leontief, is demand driven: Changes in final demand cause changes in supply and through that changes in value added. The chain of events here is different: an electricity-price induced change in manufacturing output causes changes in changes in demand of the non-manufacturing sectors which drive changes in value added. This formulation is more akin to the so-called Ghosh input-output model except that in that model the event chain starts with a change in value added that drives a change in output which then forces a change of demand. The Leontief and Ghosh formulations are two sides of the same coin, each suffering from their own limitations[87]. Given the small output changes imposed the here used formulation (in between Leontief and Ghosh) in combination with the third rule above, which essentially prescribes the unchanged production structure (and thus value added) for the manufacturing sectors, is adequate.

electricity sectors (e.g. one would expect the change of demand for agricultural products within the agricultural sector to change relatively little).

[87] For a more in depth discussion: Manresa, A. and Sancho, F., *Leontief versus Ghosh: two faces of the same coin*, REAP2012-18, Xarxa de Referencia en economia Aplicada, 2012.

4.5.2 IFI-attributable value added

The electricity tariff and manufacturing output changes indicated in Table 6 have been routed through the input output table as described in Section 4.5.1. The resulting changes of GDP and incomes are summarised in Table 7. Depending on the change of electricity tariffs, the IFI-attributable GDP impact ranges between 0.21% and 0.32% of GDP, or USD 616 - 932 million. It should be noted that this increase in GDP is a one-off effect; the economy increases in size after which trend growth resumes from that level. As expected, the change of manufacturing GDP is the largest. The electricity sector GDP decreases sharply because the loss of revenues translates straight into lower profits, bar the slight increase of electricity use as a result of lower prices. The relatively large response of the agriculture sector is caused by the increase of food manufacturing output, 30% of which is the value agricultural products. Household incomes increase slightly more than profits and taxes. Of the total GDP increase, 51.2% are incomes for households, 37.4% are profits & savings for companies and self-employed and taxes make up the remaining 11.3%.

Table 7: IFI-attributable change of GDP and incomes.

	2013	2014	2015	2016
Δ GDP:	0.21%	0.30%	0.32%	0.23%
Δ Agriculture:	*0.38%*	*0.54%*	*0.58%*	*0.40%*
Δ Industry:	*0.28%*	*0.40%*	*0.43%*	*0.30%*
Δ Manufacturing:	*1.10%*	*1.57%*	*1.67%*	*1.17%*
Δ Electricity:	*-5.31%*	*-7.53%*	*-8.04%*	*-5.61%*
Δ Other:	*0.07%*	*0.10%*	*0.11%*	*0.08%*
Δ Services:	*0.15%*	*0.21%*	*0.22%*	*0.15%*
Δ Household income:	0.23%	0.32%	0.34%	0.24%
Δ Profits & Savings:	0.20%	0.28%	0.30%	0.21%
Δ Taxes:	0.21%	0.29%	0.31%	0.22%

Note: Table corresponds with the changes of electricity tariff and manufacturing output as given in Table 6.

As was mentioned in Section 4.4.2, the price elasticity of electricity consumption is not known exactly and is assumed in the range -0.50 — -1.00. The effect of this parameter on the outcomes for 2014 in Table 7 is shown in Table 8. Of course the GDP and income variables increase more when the price elasticity increases. A second effect is that this stronger increase of GDP enhances the strength of the negative feedback from GDP growth to electricity consumption, shown in Exhibit 11. This feedback means that an increase of GDP causes the demand for electricity to go up by 0.69 times the GDP increase (see Section 2.2). This increase of electricity demand of course increases the electricity tariffs, thereby reducing the increase of manufacturing output. This in return reduces the GDP increase. Using the model iteratively, the resulting partial equilibrium electricity price is determined. Table 8 also shows the impact of the GDP feedback for 2014: the IFI-attributable electricity tariff reduction is some 4% to 12% smaller due to the GDP feedback and, in return, the GDP increase is somewhat smaller too. For 2013, where the electricity tariff reduction is less, the feedback is less than that.

Table 8: Influence of price elasticity and GDP feedback on 2014 results in Table 7.

	With GDP Feedback			Without GDP Feedback		
Price elasticity:	-0.50	-0.75	-1.00	-0.50	-0.75	-1.00
Δ Electricity tariff:	-5.75%	-5.59%	-5.31%	-6.02%	-6.02%	-6.02%
Δ GDP:	0.19%	0.30%	0.40%	0.20%	0.33%	0.46%
Δ Agriculture:	*0.38%*	*0.54%*	*0.68%*	*0.39%*	*0.58%*	*0.77%*
Δ Industry:	*0.11%*	*0.40%*	*0.66%*	*0.12%*	*0.43%*	*0.75%*
Δ Manufacturing:	*1.17%*	*1.57%*	*1.90%*	*1.22%*	*1.69%*	*2.15%*
Δ Electricity:	*-7.80%*	*-7.53%*	*-7.11%*	*-8.17%*	*-8.11%*	*-8.06%*
Δ Other:	*0.09%*	*0.10%*	*0.11%*	*0.10%*	*0.11%*	*0.12%*
Δ Services:	*0.19%*	*0.21%*	*0.21%*	*0.20%*	*0.22%*	*0.24%*
Δ Household income:	0.22%	0.32%	0.41%	0.23%	0.35%	0.46%
Δ Profits & Savings:	0.16%	0.28%	0.39%	0.16%	0.30%	0.44%
Δ Taxes:	0.15%	0.29%	0.42%	0.15%	0.31%	0.48%

4.5.3 Philippine employment intensity

In 2013 the total labour force comprised 36.286 million people for which the distribution is known for 2 agriculture subsectors, 5 industry subsectors (including manufacturing) and 15 services subsectors[88]. Using the latest economic output figures (which were also used in the updating of the input-output table) the employment intensity[89] for all these sectors can be determined. Given the central role of manufacturing in this study, the information of the 2009 World Bank Enterprise Study was used to determine the employment intensity for the manufacturing subsectors given in Table 6. The output-weighted average employment intensity of the manufacturing subsectors determined in this way deviates less than 1.5% from the official statistics for the entire manufacturing sector.[90]

4.5.4 IFI-attributable employment

Using the employment intensities together with the IFI-attributable economic output derived from the input-output analysis yields the IFI-attributable jobs, as summarised in Table 9.

Table 9: IFI-attributable jobs for the years 2013-2016 and minimum and maximum percentages of the total workforce.

	2013	2014	2015	2016	Min	Max
Δ Employment:	72,234	102,523	109,452	76,407	0.20%	0.30%
Δ Agriculture:	*37,738*	*53,565*	*57,185*	*39,919*	*0.34%*	*0.52%*
Δ Industry:	*26,555*	*37,692*	*40,240*	*28,089*	*0.46%*	*0.70%*
Δ Manufacturing:	*26,224*	*37,223*	*39,739*	*27,739*	*0.85%*	*1.29%*
Δ Electricity:	*-*	*-*	*-*	*-*	*0.00%*	*0.00%*
Δ Other:	*331*	*469*	*501*	*350*	*0.01%*	*0.02%*
Δ Services:	*7,940*	*11,267*	*12,028*	*8,399*	*0.04%*	*0.06%*

88 Philippine Statistics Authority, *The 2014 employment situation*, Labstat updates 19(1), 2014.
89 Number of people employed per million PHP of economic output.
90 The output weighted average employment intensity determined using the Enterprise Survey is 0.372 persons per million PHP output as compared with 0.367 using the PSA data.

Roughly in between 72 and 110 thousand jobs can be attributed to the IFI investments in power generation, which is equivalent to 0.20% - 0.30% of the total labour force, which is comparable to the relative GDP contribution in Table 7. As can be seen in the table, about half of the created jobs are in Agriculture, which is due to the before-mentioned size of the food industry and its significant procurement from the agricultural sector as well as the high employment intensity of agriculture (it is 3.8 time higher than the national average employment intensity). Unsurprisingly the relative increase of employment is largest for the manufacturing sector, although lower than the GDP contribution (see Table 7) because the manufacturing sector is less labour intensive than the overall economy. Reflecting its size and responsiveness to the electricity price (see Table 6), the food & beverage sector is responsible for 63% of the increase of manufacturing jobs. The change in employment in the electricity sector is set to zero because the lower revenues (for the same physical output) are entirely absorbed in the sector's profits and tax payments, while leaving household income unchanged.[91]

4.5.5 Key indicators of investments in power generation

For ease of comparison with other studies and countries, the results derived in this section are expressed as key ratios in Table 10. Caution must be observed though when using these indicators as they represent the impacts of different power generation technologies. These differences reflect the varying position of power plants in the power supply cure (Exhibit 12) and will be discussed in more detail in the two micro studies.

Table 10: Key metrics of economic impacts of power generation.

	1 MW capacity increase			1% capacity increase			USD 1 m IFI investment		
Key indicators	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**
Generation charge (m USD)	- 1.21	- 2.01	- 2.62	- 358	- 275	- 166	- 0.45	- 0.74	- 0.96
GDP (m USD)	1.49	1.86	2.25	203	254	308	0.55	0.68	0.83
Jobs created (#)	181	226	274	24,711	30,842	37,444	67	83	101
Generation charge (%)				-2.45%	-3.06%	-3.71%			
GDP (%)				0.073%	0.091%	0.111%			
Jobs created (%)				0.068%	0.085%	0.103%			

Note: an exchange rate of 45 PHP/USD has been assumed. A 1% capacity increase is measured against the current total dependable capacity in the Philippines. Relative increase of GDP and jobs per absolute capacity addition or investment amount are not given because they cannot be compared with other studies or countries.

[91] The power generators will need to deliver the same (or slightly more) amount of electricity and by assuming an unchanged production structure this implies that employment does not change.

5. Impact of two specific IFI investments in power generation

The results in Section 4 showed the impact of the entire portfolio of IFI power generation investments. In this section the impact of IFI investments in two specific power plants will be investigated in more detail albeit using the same analysis framework (Exhibit 11). The two power plants are Masinloc, a coal plant in which IFC and ADB have invested, and Magat, a large hydro plant in which IFC and Norfund have invested (see Table 4).

The electricity price and economic impact of these power plants is analysed by turning the IFI-attributable capacity of each plant on or off in the supply-demand model outlined in Section 4. Although this provides a good indication of the marginal effect of each plant, they cannot be summed together because of the non-linearity of the model. The joint marginal effect for these two plants is up to 5% smaller or larger than the sum of the marginal effects of the individual plants, depending on the year.

After discussing the results for Masinloc and Magat individually in Section 5.3 some key metrics are compared to shed some light on the different roles of coal and hydro power.

5.1 Masinloc coal-fired thermal power plant

5.1.1 Overview and IFI investments

Masinloc is a municipality in the province of Zambales, situated on the coast of Luzon about 250 kilometres northwest in of Manila. The Masinloc power plant comprises two 315 MW generation units and associated port facilities for importing, unloading, and handling coal. The plant was commissioned in 1998.

Masinloc was among the largest thermal power stations within PSALM's portfolio and the first major facility to be put on sale. In 2004, the first attempt to sell Masinloc ended in failure when the YNN Pacific Corporation was unable to finance its winning bid of $562 million. YNN Pacific's inability to finance the purchase was due in large part to the absence of any existing electricity sales contracts between Masinloc and its customers. The sales risk was worsened by the absence of a functioning power supply market and by perceived uncertainties in regulation. Following the start-up of the wholesale electricity market in June 2006, the Masinloc power plant and 12 existing electricity sales contracts covering 264 MW (44%) of its capacity, were put out to tender in July 2007 as a package. There were six bidders, and Masinloc Power Partners Company Ltd. (MPPCL) won the tender with a bid of USD 930m. MPPCL is a limited liability partnership for the purpose of acquiring and operating Masinloc and possibly other generating facilities. The company's ultimate parent is AES Corporation[92], incorporated in Delaware and listed on the New York Stock Exchange. Based on discussions with senior management we conclude that the presence of IFIs was critical for the completion of the deal and that without it AES, at that time the only global player in the market, might not have entered the Philippine power generation sector.

When the plant was handed over in April 2008, generation capacity had decreased to 440 MW due to lack of preventive and corrective maintenance and the plant operated at 25% of design capacity due to lack of management and skilled operators. In order to restore the plant to its design (as well as to finance working capital needs and transaction costs) capacity an estimated USD 170m was included in the deal on top of the acquisition price, for a total deal value of USD 1,100m. The IFC, mandated to arrange the project's finance,

[92] Before bidding on Masinloc, AES made an offer for Magat.

provided USD 22m equity capital (for an 8% equity stake[93]), USD 13m quasi equity and USD 240m debt capital. The ADB provided USD 200m debt capital at the same conditions as debt capital provided by IFC.

Since the privatisation, plant capacity has been restored to 630 MW, power production has more than doubled and thermal efficiency has increased by about 15%. The fraction of power sold bilaterally has increased and little power is currently sold through the spot market. As indicated in Table 4, the capacity that can be attributed to the IFI investments is 129 MW, of which 51 MW attributable to equity capital and 78 MW to debt capital and. Broken down per IFI, 94 MW are attributed to the IFC and 35 MW to the ADB.

5.1.2 Price, economic and employment impact

The marginal impact of the Masinloc's IFI-attributable capacity on the generation charge (and thus electricity tariff), GDP and employment is determined in the same way as discussed in Section 4. The results are summarised in Table 11.

Table 11: Impact of IFI investment in the Masinloc power plant on electricity price and costs, GDP and employment.

	2013	2014	2015	2016
Δ Generation charge	-2.69%	-3.86%	-4.13%	-2.71%
Δ Electricity tariff	-1.48%	-2.12%	-2.27%	-1.49%
Δ Annual electricity costs (USD m)	- 182	- 305	- 398	- 315
Δ GDP	0.08%	0.12%	0.13%	0.09%
Δ Employment	28,364	41,279	44,364	28,672

The results show that the marginal effect of the 129 MW Masinloc capacity attributed to IFI reduces the electricity tariff for residential, commercial and industrial users by some 1.4% - 2.3%. This increases GDP by some 0.10% and creates about 35,000 jobs.

It is important to note that these results would have been substantially smaller in case the years 2008 and 2009 would have been analysed. The reason for this is that the electricity demand profile in the Philippines at that time did not allow base-load coal plants like Masinloc to run 24/7[94] (see Section 2.2). Because coal plants have high fixed costs and low variable costs (respectively some 67% and 33% of total costs) this hampered profitability. Although during monthly or daily demand peaks the plant would have brought down the generation charge, its marginal effect on the load-weighted electricity price (LWAP) would have been rather small. In situations like these, adequate peaking capacity, with low fixed costs and high variable costs, would have been a more cost efficient way or achieving the same economic impacts. Eventually, the losses that Masinloc made in 2008 and 2009 were recouped very quickly in 2010 when the Malampaya gas field outage caused prices to increase rapidly. During the period 2009-2013 electricity demand increased such that the utilisation rates of coal power plants have gone up by some 20 percent points, which has improved their profitability.

[93] In October 2014 AES sold a 45% equity stake in Masinloc Power Plant and Development Projects in the Philippines to EGCO Group (Thailand) for USD 453m. This values IFC's 8% stake at USD 80m, 3.66x cost.
[94] Geothermal and natural gas (because of the take-or-pay contract) come before coal in the merit order in the Philippines.

5.2 Magat hydro-electric power plant

5.2.1 Overview and IFI investments

The Magat hydro power plant is located on Magat River, a major tributary of Cagayan River in North Luzon, at the boundary of Alfonso Lista in the province of Ifugao and Ramon in the province of Isabella. Construction of the Magat dam started in 1975 and was completed in 1982. With a height of 114m, Magat is one of the largest dams in the Philippines and has two primary purposes: first as a source of irrigation water and second as a provider of hydroelectric power. The plant consists of 4 turbines of 90 MW for a total of 360 MW[95]. The construction of the dam was co-financed by the World Bank.

The Magat plant was the second major power plant to be privatised in 2006 (see Table 1). SN Aboitiz Power-Magat (SNAP-Magat) won the bidding with a price of USD 530 million. SNAP-Magat is a joint venture between SN Power, currently 60% owned by Statkraft and 40% by Norfund (both from Norway), and Aboitiz Power, a Philippine company. Allowing for transaction costs and some refurbishment, the total deal value was USD 542 million. IFC financed the deal with USD 105 million debt and Norfund, through its 40%[96] ownership of SN Power, holds a 20% equity stake.

Included in the takeover plan was the so-called half-life refurbishment, which was completed in 2014. The refurbishment, water loss reduction and improved operational performance are estimated to have increased the plants dependable capacity by some 60 MW. As indicated in Table 4, the capacity that can be attributed to the IFI investments is 84 MW, of which 72 MW attributable to (Norfund) equity capital and 12 MW to (IFC) debt capital. Based on discussion with senior management we conclude that the deal would have commenced without the presence of IFIs, but that it would have left Aboitiz Power capital constrained which would have delayed the further expansion of the company into the power generation sector.

5.2.2 Price, economic and employment impact

The marginal impact of the Masinloc's IFI-attributable capacity on the generation charge (and thus electricity tariff), GDP and employment is determined in the same way as discussed in Section 4. The results are summarised in Table 12.

Table 12: Impact of IFI investment in the Magat power plant on electricity price and costs, GDP and employment.

	2013	2014	2015	2016
Δ Generation charge	-1.12%	-1.95%	-1.99%	-1.44%
Δ Electricity tariff	-0.62%	-1.07%	-1.09%	-0.79%
Δ Annual electricity costs (USD m)	- 76	- 154	- 192	- 167
Δ GDP	0.04%	0.06%	0.06%	0.05%
Δ Employment	12,005	21,218	21,786	15,399

The results show that the marginal effect of the 84 MW Masinloc capacity attributed to IFI reduces the electricity tariff for residential, commercial and industrial users by some 0.6% - 1.1%. This increases GDP by some 0.05% and creates about 17,000 jobs.

[95] An expansion with another 180 MW unit is being considered.
[96] At the time of the Magat deal Norfund owned 50% of SN Power.

Although across the world hydropower is often used as base-load capacity (by virtue of its low SRMC), Magat is being run as a mid-merit or peaking plant. The reason for that is that despite its relatively low position of the supply curve (in terms of LRMC but especially in terms of SRMC, see Exhibit 12), the opportunity cost of losing hydrostatic head are large because additional "fuel" cannot be obtained. Hydro plants are thus price driven, unlike coal plants which are utilisation rate driven. The presence of an electricity spot market in the Philippines therefore better enables power plants to maximise price and thereby achieve the most efficient dispatch of hydropower. In 2014, a third of Magat's revenues came from ancillary services, which is essentially the provision of reserve capacity.[97] Hydro plants are particularly well suited to provide ancillary services because of their dynamic flexibility. Ancillary services improve the value generated per volume of water and therefore enhance the efficiency of overall power dispatch.

5.3 Key metrics for investment in power generation plants

In order to compare the different impact of coal and hydro power, Table 13 summarises the results presented in Table 11 and Table 12 in some key metrics for Masinloc and Magat. The metrics capture the price, economic and employment effects per additional MW generation capacity, per million dollar (equity) investment and per million dollar IFI (equity and debt) investment.

Table 13: Key metrics related to Masinloc and Magat.

	Masinloc			Magat		
Technology	Coal			Large hydro		
Investment (USD m / MW)	1.75			1.51		
LRMC (PHP / kWh)	3.95			4.42		
Outage (scheduled and seasonal)	13%			33%		
	Min	Mean	Max	Min	Mean	Max
Gen. cost savings (USD m / MW)	1.42	2.33	3.10	0.91	1.76	2.29
Δ GDP (USD m / MW)	1.82	2.28	2.84	1.18	1.73	2.15
Δ Employment (jobs / MW)	220	277	345	144	210	261
Gen. cost savings (USD m / USD 1m investment)	0.81	1.34	1.77	0.60	1.17	1.52
Δ GDP (USD / USD investment)	1.04	1.31	1.63	0.79	1.15	1.43
Δ Employment (jobs / USD 1m investment)	126	159	198	95	140	173
Gen. cost savings (USD m / USD 1m IFI investment)	0.38	0.63	0.84	0.45	0.88	1.15
Δ GDP (USD / USD IFI investment)	0.49	0.62	0.77	0.59	0.87	1.07
Δ Employment (jobs / USD 1m IFI investment)	60	75	93	72	105	130

Based on the deal value in Table 4, which includes acquisition and refurbishment cost, Magat was acquired somewhat cheaper than Masinloc, although one must keep in mind that the actual availability (and predictability) of hydro power is lower due to seasonality. Masinloc has the lower LRMC, as can be expected from a coal plant. As stated before, hydro plants aim to maximise the revenues per volume of water within constraints set by the available water in the reservoir and the required use of water for irrigation. Although LRMC henceforth does not drive actual bidding behaviour, it reflects the fact that hydro plants dispatch power when prices are higher. The outage factor indicated in the table are

[97] Examples of ancillary services are load following or frequency regulating services which help maintain the grid's stability or the provision of contingency reserve to take over power supply when another power plant fails.

statistical averages for the two technologies, where the hydro outages actually varies per month based on historical data.

The generation cost savings and the change of GDP and employment depend on the actual demand, just like the macro results in Section 4. When expressed per MW generation capacity the impacts of Magat are some 25% - 40% lower than Masinloc. This reflects both the higher LRMC as well as the lower availability. But in Section 5.1.2 it was already mentioned that the situation would have been very different in 2008 and 2009 when Masinloc was unable to reach sufficient capacity utilisation. Reflecting its very low SRMC, a plant like Magat would have been able to satisfy peak demand. Because of the cheaper acquisition cost of Magat the price, GDP and employment impact per invested dollar are only some 15% - 30% lower than of Masinloc. Because the Magat deal carried a relatively large IFI equity and smaller IFI debt component, the impacts per dollar IFI investment of Magat are larger than the ones of Masinloc.

Although the analysis above is not by any means exhaustive it demonstrates the trade-off between maximisation of economic and employment impact and investment return. Development impact per MW is maximised by providing more base-load power. Investment return however depends on capital intensity and asset utilisation. In the Philippines it currently seems that base-load capacity achieves good capacity utilisation. Given that electricity demand grows with 4.8% a year (Section 4.2) and allowing for an average 10% outage and excluding retirement of old expensive capacity that means that a maximum of some 400 MW base-load capacity (geothermal or coal) can be added per year in the Luzon and Visayas grid without compromising capacity utilisation and investment return. Investments in mid-merit capacity (which is in short supply; see Exhibit 12) can yield a substantial economic and employment impact (comparable to Magat) with potentially a decent return on investment. Constraints for this type of investment to happen might be the primary and secondary price caps that regulator ERC has introduced[45]. Mid-merit and peaking plants need to recover their capital cost in the limited time they can operate and price caps limit the possibility to do so.

In terms of the price, GDP and employment impact per invested dollar, the impact of mid-merit capacity can be comparable to base load capacity. Open and combined cycle gas turbine technology investment costs per MW are about a third of that of a modern coal plant (or a hydro plant for that matter). That means that even when the impact per MW is only a third per MW of that of Masinloc, the impact per invested dollar would be the same. Using the estimated LRMC of a new generation plant, an indication of its capacity utilisation (and thus profitability) can be gauged from the price duration curves in Exhibit 17.

6. Conclusions and implications

Based on the results discussed in this report the following conclusions can be drawn:

1. Investments in power generation can create economic growth and employment through different pathways. Here the impact has been analysed for an economy where electricity demand can (normally) be met and where electricity prices reflect market conditions. The results cannot be directly generalised to economies where power demand far outstrips supply;
2. The impact of investments in power generation on electricity price can be larger than one would expect based purely on capacity considerations. This is because power prices depend on the ratio between generation capacity and actual electricity demand and thus in a non-linear way on the shape of the power supply curve. In this study, the 2.9% capacity addition which is attributable to IFIs causes a 7.2% – 10.8% decrease of generation charges and a 3.9% - 6.0% decrease of pre-tax end user electricity tariffs. Neglecting the different impacts of various power generation technologies and their merit order in the supply curve, this means that a 1% increment of generation capacity can lead to a 2.6% – 3.9% decrease of generation charges and 1.4% - 2.1% lower end-user electricity tariffs;
3. When tracing the price impact through the economy the impact of the 2.9% additional power generation capacity on economic growth in the Philippines is in the range of 0.21% – 0.32% of GDP. Taking into account the various power technologies, this means that a capacity addition of 1% causes a GDP increase of 0.09% on average (within a range of 0.07% – 0.11%);
4. The total IFI (equity and debt) investment of USD 1,135 million in power generation has resulted in a range of 72,000 – 110,000 jobs. This means roughly 83 jobs have been created per USD 1 million invested;
5. Apart from the quantitative attribution of impacts to IFIs, the fact that they were among the first ones to finance the privatisation of the sector means that IFIs have had a catalysing role in making the Philippine power sector more market-based and private-sector lead;
6. Despite its limited use of electricity, the agriculture sector benefits from lower electricity prices. This is due to the fact that the sector is strongly linked to the food & beverage sectors which will increase their output when electricity becomes cheaper;
7. Given the fact that generation charges can be explained by juxtaposing the long-run marginal cost (LRMC) of power plants with actual demand implies that prices in the Philippines reflect market conditions to a large extent. Although electricity prices are much higher than elsewhere in the Asia region, this implies that future unfavourable price impacts due to exogenous policy shocks (e.g. the abolition of energy subsidies) are less likely in the Philippines than in many other countries;
8. It is nevertheless crucial that new generation capacity will be added at a rate at least equal to (but preferably faster than) the growth of demand. With off-peak demand and capital intensive base-load generation currently well balanced,[98] such capacity would ideally fill the lack of mid-merit capacity, which is less capital intensive. Over the past years the Philippine financial sector has developed a greater appetite for the power

[98] This is unlike six years ago when demand was insufficient to allow capital intensive base-load generators to recover their investments. Nevertheless, with demand increasing at roughly 4.8% annually new base load generation is needed as well.

sector; as such it ought to continue to play and important role in financing these particular capacity additions.

The implications for IFIs are:

1. Although the results in this report do not specifically assess the merits of the liberalisation of the electricity sector, IFI financing does in effect catalyse the privatisation of subsequent generation assets, as shown for the Masinloc and Magat case studies. It is important to note that market uncertainty deters investors and financiers from potentially financing power assets. Once the hurdles of proper regulation and functioning institutions have been addressed, this certainty helps to attract needed investment. For purpose of this study, the start of the WESM spot market helped mitigate market uncertainty and the presence of IFIs provided comfort for local financiers. As such, IFIs should seek to repeat the catalyst role played in the Philippines in other countries that will liberalise their markets;
2. IFIs should optimise the per dollar impact of investments in power generation. The development impact of different power generation technologies will depend on prevailing demand and supply conditions. Capital intensive base-load capacity may have a lower per dollar development impact than less capital intensive peak capacity (e.g. gas turbines) when it cannot be run 24/7. Similarly, hydro and wind power may not substantially improve power dispatch when reliable base-load capacity is lacking. In countries with market-based price mechanisms like the Philippines this may be easier than in countries where supply is grossly insufficient, but the type of analysis presented in detail in this report can be performed at a higher level of aggregation and still deliver actionable results;
3. To the extent that IFIs not do so already, they can include a wider range of pathways through which investments in power generation may help poverty alleviation. Investments in power generation do not necessarily lead to improved (rural) electricity access for the poor when transmission and especially distribution networks lack size, capacity and/or reliability. Notwithstanding this fact, the economic benefits of lower electricity prices can reach the rural poor though economic linkages through sectors such as agriculture and associated food supply chains.