Market Simulation – Luzon Grid
Using the Market Management System

- **Customer Zonal Pricing**
- **Market Surplus due to Congestion**

Philippine Electricity Market Corporation
Market Operations Group
August 2005

NOTICE

Table of Contents

Appendices

Executive Summary

In compliance with the Energy Regulatory Commission (ERC) Order dated March 15, 2004, the Philippine Electricity Market Corporation conducted a market simulation for the Luzon grid to quantify the potential subsidies that would be created with the adoption of customer pricing zones and to determine the possible level of surplus due to congestion. This document contains the assumptions, methodologies and the results of the simulations.[1]

This simulation uses the Philippine Wholesale Electricity Spot Market (WESM) Market Management System (MMS) Week-Ahead Projections (WAP) to calculate ex-ante hourly dispatch and nodal pricing. Generator offers considered two offer blocks using assumed variable cost for each type of generating unit updated to 2005 price levels. Reserve offers were provided as a single block offer based on assumed percentage of the energy offer. The simulation also utilized the Luzon grid Market Network Model composed of 118 generator nodes and 96 customer nodes.

Cross-Subsidy

Zonal price is the load weighted average of nodal prices in a pre-defined zone. Since nodal prices may vary from node to node, the different node prices may be higher or lower than the customer zonal price. In a zonal pricing scheme, the customers will pay a uniform rate equal to the zonal price. Therefore, if the nodal price at the node where a customer is connected is lower than that of the uniform zonal price, that customer is deemed to be subsidizing customers connected at nodes with higher nodal prices. Therefore, the amount of cross subsidy is the difference between the settlement amount of a customer computed based on zonal prices and the settlements amount of the same customer based on nodal prices.

In determining the potential subsidy, the simulation considered a representative month with a peak load of about 6,400 MW and customer energy transactions of some P3,880 GWh. This Base Case Scenario considers normal power system condition (i.e. no line or generator outages and no congestion). To provide a comparative analysis, customer zonal price is calculated considering three pricing zone configurations. The first configuration considered Luzon as one pricing zone, the second configuration considered three pricing zones for Luzon and the third pricing configuration considered five pricing zones. The results of the simulation indicate that, in general, Metro Manila and the surrounding areas tend to have higher nodal prices than in the

[1] A market simulation study report has earlier been submitted to the Commission in the Compliance dated November 26, 2004, but the earlier study was made using the Luzon Demonstration Market System in view of the unavailability of the Market Management System at that time.

extreme North and South Luzon areas. This is attributed to the fact that bulk of the Luzon load are consumed in Metro Manila while generating plants are mostly located in North and South Luzon.

Considering the results of the single pricing zone for the Luzon grid, customers with nodal prices lower than the uniform zonal price will pay an additional amount of 29 million pesos per month. Correspondingly, customers with nodal prices higher than the uniform zonal price will be paying 29 million pesos less than if they will pay at their nodal prices per month.

Considering the results of the three pricing zones in Luzon (i.e. north Luzon, Metro Manila and South Luzon), the results indicate that within the North Luzon pricing zone, the subsidy or the additional amount paid by customers with nodal prices lower than the uniform zonal price is about 25 million pesos or 1.7% of the total customer payments. For the Metro Manila pricing zone, the subsidy or the additional amount paid by customers with nodal prices lower than the uniform zonal price is about 30 million pesos or 0.72% of the total customer payments. For the South Luzon pricing zone, the subsidy or the additional amount paid by customers with nodal prices lower than the uniform zonal price is about 7.74 million pesos or 0.55% of the total customer payments in that zone.

In the five- pricing zone configuration, North Luzon zone subsidy is about 2.5 million pesos or 0.48% of total customer payments; Central Luzon zone subsidy is about 3.29 million pesos or 0.35% of total customer payments; Metro Manila subsidy is 30 million pesos or 0.72% of total customer payments; Southern Tagalong zone subsidy is about 4.49 million pesos or 0.35% of total customer payments; and Bicol Region zone subsidy is about 0.28 million pesos 0r 0.21% of total customer payments.

Market Surplus due to Congestion

Considering full nodal pricing, line rental revenues or market surplus is the settlement surplus remaining after all market transactions have been accounted for. That is, there is settlement surplus if the amounts collected from customers are greater than the amounts paid to generators. This remainder is normally attributable to economic rentals arising from binding constraints or congestion in the power system.

It should be noted that latest transmission reinforcement in the Luzon grid has effectively removed any congestion (assuming there are no major multiple line or generator outages) particularly in South Luzon. On-going transmission reinforcements in North Luzon are expected to also reinforce the transmission of power from the North Luzon plants to Metro Manila. Considering the fact

that the Luzon Grid is congestion free, it became necessary to simulate congestion. North Luzon is selected to have congestion since transmission reinforcement projects in this area are still on-going. For the Luzon grid to encounter congestion, to the simulation assumed the outage of one circuit of the Bauang-La Trinidad line. Outage of this line resulted to congestion in the remaining Bauang – La Trinidad line and in the Labarador – Kadampat line. The result of this scenario indicate that the monthly settlement surplus due to congestion would amount to 160 million pesos or about 2.19% of the total customer payments in Luzon grid.

1.0 About this Document

This document presents the methodology and results of the market simulation results conducted by the Market Operations Group, Philippine Electricity Market Corporation (PEMC). This study is made in compliance with the Order of the Energy Regulatory Commission (ERC) dated March 15, 2004 to quantify the potential cross subsidies that would be created with the adoption of customer pricing zones and to determine the likely magnitude of line rental revenues (or market surplus) resulting from congestion.

It is noted that the results of the simulations are indicative only since market outcome or results are greatly affected by the market participants' behaviour as regards to their offer and the physical condition of their assets as well as the physical condition of the power system. This simulation likewise uses inputs and assumptions on which PEMC makes no representation or warranty. The results are not intended to be used for any other purpose other than to comply with the Order of the Commission. As such, PEMC shall have no liability for any statements, opinions, information or matters (expressed or implied) arising out of, contained in or derived from this document.

2.0 Background

A market simulation report for the Luzon Grid has earlier been submitted to the ERC in compliance with the above-mentioned Order. However, this earlier simulation was made using the Luzon Demonstration Market System in view of the unavailability of the Market Management System at that time. This simulation, which still considers only the Luzon Grid, using the Market Management System is prepared in full compliance to the ERC order.

Customer Pricing Zone

In its Order dated March 15, 2004, the ERC directed that a simulation of the electricity market be conducted considering a full nodal regime as well as the prices that would result if customer nodes were grouped into Customer Pricing Zones in order to quantify the potential cross subsidies that would be created by the adoption of the proposed Customer Pricing Zones.

Originally, the WESM Rules provide that generator pricing will be based on nodal prices while customers are priced on zonal prices. Zonal prices are load weighted average nodal prices for a particular customer pricing zone (or group of nodes within a zone). As such, some customers whose nodal prices are lower than the zonal price would in effect pay a higher price while customers with nodal prices higher than the zonal price would pay lower prices. In which case, customers whose nodal prices are lower are deemed to subsidize customers

with high nodal prices. On the other hand, by implementing full nodal pricing for customers, distribution utilities with large franchise areas having multiple nodes would have the potential problem of having different prices for contiguous customers.

In view of this, a simulation using the Market Management System is presented to quantify the potential cross subsidies that would be created if customer zonal pricing is adopted in the Luzon Grid.

Market Surplus

The ERC also directed that the market simulation also determine the likely magnitude of line rental revenues arising from congestion in the power system. The simulation was made using the Market Management System.

Line rental revenues or line rentals are the economic rental arising from the use of a transmission line and is brought about by the differences in the nodal prices. Differences in nodal prices are brought about by the application of Locational Marginal Pricing (LMP). Line rentals are also known as market surpluses, i.e. the Market Operator may collect more revenue from customers than it will pay to generators. However, in extreme power system conditions, a negative surplus or deficit may also be encountered (i.e. the payments to generators may be more than the amount collected from the customers). These differences in payments and collections are the results of losses and congestion in the power system.

The Luzon Grid[2]

The simulation focuses on the Luzon Grid as this is expected to be the first grid in which the electricity market will be implemented. The current generation and transmission configuration of the Luzon grid is presented below to facilitate understanding of the results of the simulation in relation to the Luzon power system.

The transmission voltages in the Luzon grid are generally rated at 230 kilovolt (kV) level, although a 500 kV high voltage Alternating Current transmission backbone extends from Labrador, Pangasinan in the north to Naga (Bicol Region) in the south. The Luzon grid is also connected to the Visayas grid through a ±350 kV high voltage Direct Current (DC) link. The 230 kV transmission lines cover the main island of Luzon from Laoag, Ilocos Norte and Tuguegarao, Cagayan in the north and Legaspi, Albay in the Bicol region.

[2] The information contained in this section is taken from the Transmission Development Program (2004-2013) and 2004 Annual Report of the National Transmission Corporation.

The sub-transmission lines in Luzon rated at 115 kV and below emanates from the bulk substations to serve distribution companies, electric cooperatives and some load-end customers. Some utilities and NPC customers, however, are served at 230 kV voltage level transmission lines.

As of 2004, the Luzon Grid has a dependable generating capacity of about 11,000 megawatt (MW) and an installed generating capacity of about 12,000 MW. The transmission system totals to about 10,000 circuit-kilometers with a total substation capacities of about 20,000 megavolt-amperes (MVA). The peak demand is about 6,300 MW with nearly 60% consumed in the Metro Manila area while the remaining MW is distributed across the rest of the Luzon Grid (i.e., North and South Luzon areas, including Bicol region). About 41% of the customers in Luzon are utilities while the rest are industrial and other customers.

Generation facilities with about 40% of the total generation capacity are located in the northern parts of Luzon, while generation facilities with about 56% of the total generation capacity are located in the southern Luzon area. The rest, about 4% of total generation capacity, are within Metro Manila. Considering this load and supply configuration, power must be transmitted from the north and south part of the Luzon grid to Metro Manila. Hence, it is vital that the power transfer capability of the Luzon grid in transferring power from the north and south Luzon to Metro Manila is sufficient.

Recently completed transmission projects, particularly the Binan-Dasmarinas Line which has been uprated from 2 x 300 MW to 2 x 1200 MW under the Binan-Dasmarinas Upgrading Project, has provided such sufficiency in the transmission corridor from southern Luzon to Metro Manila. Considering a normal power system condition (i.e, no multiple major transmission line and generator outages), this uprating effectively removed congestion in transmitting power to Metro Manila.

Additional transmission projects are also being implemented (e.g., Luzon Transmission Line Upgrading Projects I) that are expected to reinforce and de-congest the transmission of power from North Luzon to Metro Manila.

3.0 Objectives

This study was made to –

3.1 Quantify the potential subsidies that would be created by the adoption of the Customer Pricing Zones in comparison to applying Full Nodal Pricing.

3.2 Provide information as to the likely magnitude of line rental revenues (market surplus) from congestion.

4.0 General Assumptions and Input Data

In determining the level of cross-subsidy and market surplus, demand levels and energy were arbitrarily selected to represent a typical month. To limit the simulation to the Luzon grid, an over-riding constraint of 1 MW is imposed on the Leyte-Luzon HVDC link[3]. This effectively separated the Luzon from the Visayas electricity market. The assumed offers are based on the variable cost for each type of plant with an exchange rate of 56 Pesos to 1 US dollar. In determining plants that may offer for ancillary services, the simulation considered the plants registered for ancillary services in the Trial Operations Program of the WESM.

4.1 Luzon System Demand

The system demand in the market simulation has a typical peak and off-peak value of 6,264 MW and 3,564 MW during days with lower demand profile (i.e. Monday, Saturday, Sunday) and typical peak and off-peak value of about 6,400 MW and 4,400 MW during days with higher demand profile (i.e. Tuesday to Friday) for the simulated month. The month translates to an energy consumption of about 3,880 gigawatt-hours (GWh).

4.2 Load Forecast Methodology

The Similar Day Load Forecast (SDLF) application of the MMS was used to project hourly nodal loads for the forecast period.

4.3 Load Profile and Load Distribution

[3] The Leyte-Luzon High Voltage Direct Current (HVDC) links the transmission system of Luzon with Visayas. It is rated at +/-350 kV with a capacity of 440 MW.

The Luzon grid typically has four sets of Load Profile representing the days of Sunday, Monday, and Tuesday to Friday and Saturday. These typical profiles are used in the Similar Day Load Forecast methodology.

4.4 Transmission and Generator parameters

The electrical characteristic of the transmission system and generators used in the simulation were based on the planning data provided by the System Operator. These include, among others things, maximum and minimum generator capacity, ramp up and ramp down rates, line capacity, line resistance, etc. However, limitations on the generator minimum stable loading were disregarded.

4.5 System Security

System security for the transmission system was simulated by limiting the line capacity to 90% of the rated line capacity.

4.6 Must Run Plant

In this simulation, no plant is considered for reliability must run. This aims to remove any price distortion that maybe introduced by dispatching units for system reliability purposes.

4.7 Reserve Requirement

Three reserve categories were considered in the simulation, namely, regulating reserve, contingency reserve and dispatchable reserve. Interruptible Load Reserve requirement was disregarded. The regulating reserve requirement is pegged at 4% of the hourly load while the Contingency and Dispatchable reserves were pegged at 10% of the hourly load. On the other hand, dispatchable demands are disregarded.

4.8 Generator Offers

Energy offers are structured into two blocks with the first quantity ranging from zero generation to the minimum stable loading and the second quantity ranging from the minimum stable loading to maximum capacity.

Reserve price offers were taken as percentage of the energy price offers. The regulating reserve offer prices were assumed to be 120% of the energy offer price. For contingency and dispatchable reserves, the reserve price offers were assumed to be 80% of the energy offer.

4.9 Market Dispatch Process

The Week-Ahead Market Projections (WAP) workflow is used in the simulation and, therefore, no ex-post imbalance is considered in the determination of settlement amount.

4.10 Market Scenario

A Base Case Scenario incorporating the assumed energy supply and demand levels is considered. The Base Case scenario also assumes that the power system is in normal condition, that is, no major outages scheduled or unscheduled is considered. However, for the determination of market surplus due to congestion, line or generator outages is simulated.

4.11 Customer Zone Pricing Scenario

To simulate and provide comparative analysis, the customer nodes in Luzon are grouped into two sets of customer pricing zones. In the first set, the Luzon grid is divided into three zones, namely North Luzon, Metro Manila, and South Luzon and in the second set, the Luzon grid is divided into five zones, namely, North Luzon, Central Luzon, Metro Manila, Southern Tagalog and Bicol region. In subdividing the Luzon customers into pricing zones, geographical location is considered particularly in subdividing North Luzon into Northern Luzon and Central Luzon and also south Luzon into Southern Tagalog and Bicol Region. Metro Manila, which is generally a single franchise area and bulk of the Luzon grid load is in this particular area, is treated as one customer pricing zone.

For the three customer pricing zones, the North Luzon zone comprises of all customer nodes north of Metro Manila; the Metro Manila zone comprises mostly of Transco bulk power substations supplying Metro Manila and the South Luzon zone is composed of all customer nodes south of Metro Manila up to the Bicol Region.

For the five customer pricing zones, the North Luzon zone comprises of customer nodes towards the north beyond the provinces of Tarlac, Nueva Ecija and Zambales. The central Luzon zone comprises of customer nodes from Tarlac, Nueva Ecija and Zambales up to Bulacan. The Metro Manila zone comprises mostly of Transco bulk power substations supplying Metro Manila. The Southern Tagalog pricing zone is from south of Metro Manila up to Quezon. The Bicol Region Pricing zone covers the entire Bicol region.

A simulation of the Luzon grid as a single pricing zone is also considered to provide general determination on which nodes tend to have higher prices and which nodes tend to have lower prices and the resulting level of the subsidy. That is, the simulation is expected to show which customers nodes are deemed to be subsidizing which customer nodes. This presentation is also applied to both the three and five pricing zone configurations in order to provide general idea of which are the subsidizing and subsidized nodes and the level of subsidy within that particular pricing zone.

In summary, the Customer Pricing Scenarios are:

a. Luzon as a Single Pricing Zone
b. Luzon with 3 Pricing Zones
c. Luzon with 5 Pricing Zones

4.12 Luzon Market Network Model

The Market Network Model (MNM) is a representation of the physical Luzon Grid in the Market Dispatch Optimization Model. The MNM includes all transmission lines and transformers with rated voltages of 500 kV, 230 kV and 115 kV. Loads are represented at the secondary side of the power transformers and mostly connected at 115 kV and 69 kV. Generators are modeled on per unit level up. For Metro Manila, the Market Network Model is limited to the interface point between the Transco system and the Meralco system.

The Luzon MNM is composed of 118 generator nodes and 96 customer nodes and incorporates recently completed transmission reinforcement projects. Typical 230 KV lines have a rated capacity of 300 MW per circuit.

5.0 Simulation Tool – Market Management System

The simulation used the Market Management System (MMS) processes to provide the input requirements and determine the market pricing and schedules. The MMS settlement subsystem was not used, however, for the determination of hourly settlement amount.

6.0 Methodology

6.1 General Simulation Methodology

The following are the general simulation methodology employed in achieving the objectives of the simulation.

6.1.1 Establish the system condition using the input data and assumptions, including, but not limited to:

- Hourly system demand
- Generator and line outages (for congestion scenarios)
- Transmission limits
- Reserve requirements
- Generator's energy and reserve offers based on assumed variable costs.

6.1.2 Perform the market simulation using the MMS.

- Calculate Nodal Prices and Dispatch Schedule.

6.1.3 Determine the zonal prices for each pricing zone.

6.1.4 Compare the nodal prices with zonal prices.

6.1.5 Determine the level of potential subsidy within a pricing zone.

6.1.6 Calculate the settlement and determine market surplus.

6.2 Determination of Cross Subsidy

Zonal price is the load weighted average of nodal prices in a pre-defined zone. Since nodal prices may vary from node to node, the different node prices within the pre-defined zone may be higher or lower than the customer zonal price. In a zonal pricing scheme, the customers will pay a uniform rate equal to the zonal price. Therefore, if the nodal price at the node where a customer is connected is lower than that of the uniform zonal price, that customer is deemed to be subsidizing customers connected at nodes with higher nodal prices. Therefore, the amount of cross subsidy is the difference between the settlement amount of a customer computed based on zonal prices and the settlements amount of the same customer based on nodal prices.

The methodology used in the determination of the potential cross subsidy is shown below and illustrated in Figure 6.2.

6.2.1 Determine the load-weighted average price (i.e., the customer zonal price or CZP) for each zone.

$$CZP = \sum (NP * Qn) \ / \ \text{total load}$$

Where: NP = nodal price
Qn = nodal load

6.2.2 Segregate nodes into nodes with price < CZP and nodes with price > CZP.

6.2.3 Compute Customer Zonal Payment (CZPay) for each zone.

CZPay = CZP x Qn

6.2.4 Compute Customer Nodal Payment (CNPay) for each zone.

CNPay = NP x Qn

6.2.5 Get the difference between the nodal payments and the zonal payments for each zone. Subsidy is the difference between the nodal and zonal payments.

- If CZPay > CNPay: Customer Subsidizes
- If CZPay< CNPay: Customer is being subsidized

6.2.6 Determine the additional amount paid by subsidizing customers (i.e., sum the differences of the Nodal and zonal payments)[4]

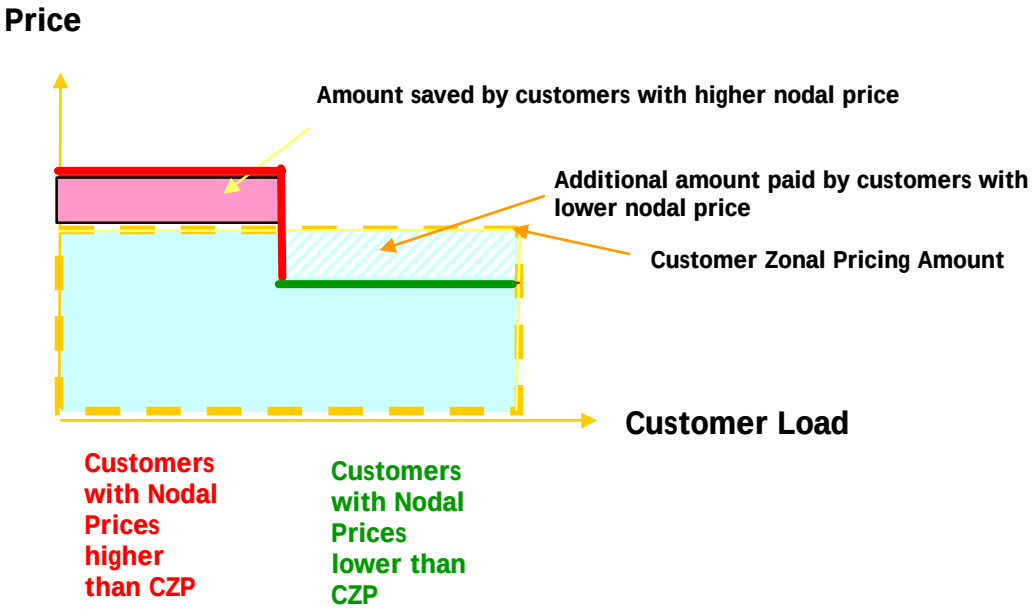
6.2.7 Determine the reduction in the amount to be paid by subsidized customers. (i.e., sum the differences of the Nodal and zonal payments).

6.2.8 Calculate percentage of subsidy to total customer payment.

% Subsidy = (additional amount paid by subsidizing customers/total customer zonal payments) x 100

[4] Total customer payment based on zonal pricing should be equal to total nodal payments based on nodal pricing since zonal prices are load weighted average prices and consequently the amount saved by customers with nodal prices higher than customer zonal price is equal to the additional amount paid by customers whose nodal prices are lower than the customer zonal price.

Figure 6.2. Cross Subsidy Illustration



6.3 Determination of Market Surplus

Line rental revenues or market surplus is the settlement surplus remaining after all market transactions have been accounted for. That is, there is settlement surplus if the amounts collected from customers are greater than the amounts paid to generators. This remainder is normally attributable to economic rentals arising from binding constraints or congestion in the power system.

The following methodology for determining market surplus is applied:

6.3.1 Calculate hourly collection from customers
6.3.2 Calculate hourly payments to generators.
6.3.3 Determine the difference between the amounts collected from customers and the amounts paid to generators.

7.0 Summary of Results for Potential Cross Subsidy

The following Tables and Figures present the summary of the simulation results if a single, three and five pricing zones are considered for the Luzon Grid. The Tables refer to the results for a single month while the figures show the nodal prices and the zonal price for the Peak hour (2 PM) and Off-Peak period (7 AM) for a typical high demand day. The spread of nodal prices and the customer nodes whose nodal prices are lower than zonal prices (subsidizing nodes) and customer whose nodal prices are greater than the zonal prices (subsidized nodes) are shown in Appendices 1 through 3.

7.1 Luzon as a single pricing zone

Table 7.1 Potential Subsidy within the whole Luzon Grid Zone

MONTH	
Energy Consumed by Customers, GWh	**3879.9**
Total Customer Zonal Payments, Million Pesos	**7153.66**
Total Customer Nodal Payments, Million Pesos	**7153.66**
Additional amount Paid by customers with lower nodal price, Million Pesos	**29.362**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**29.362**
% Subsidy	**0.41**

Figure 7.1a Nodal Prices Vs. Zonal Price - Off Peak Hour

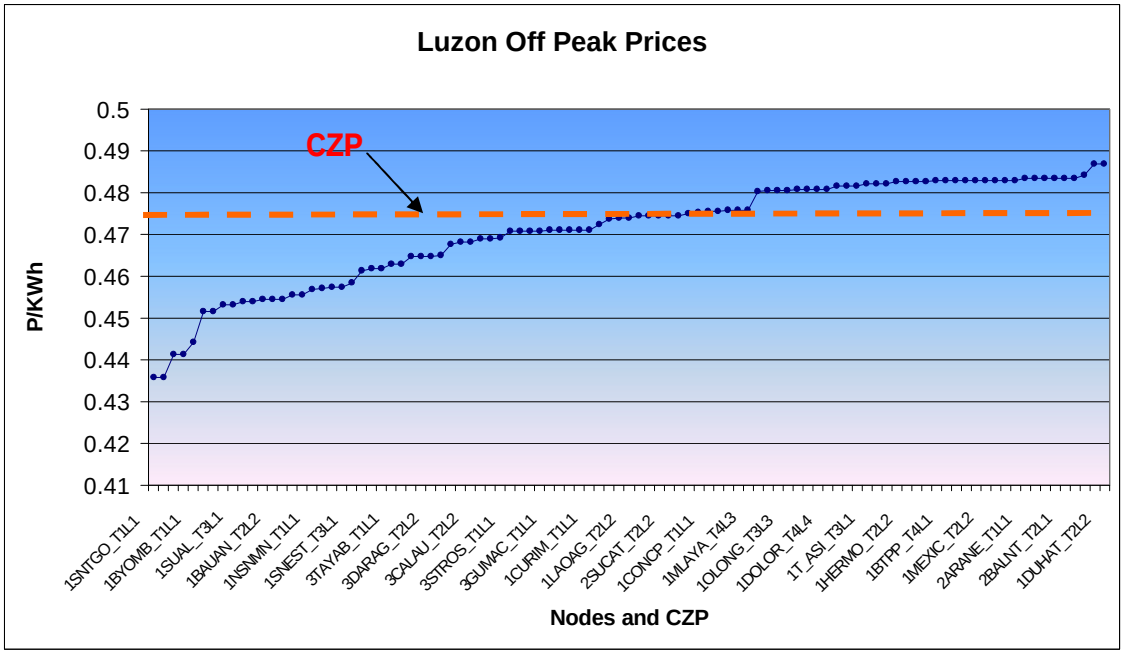
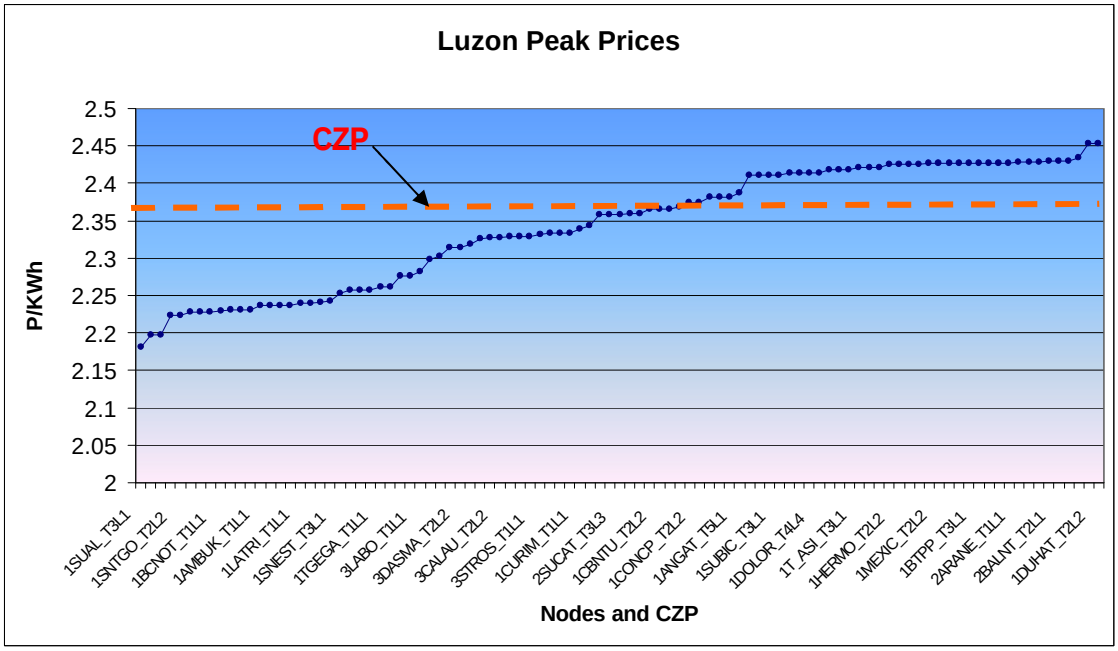


Figure 7.1b Nodal Prices Vs. Zonal Price -Peak Hour



7.2 Luzon with 3 pricing zones

North Luzon Pricing Zone

Table 7.2.1 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**805.22**
Total Customer Zonal Payments, Million Pesos	**1471.35**
Total Customer Nodal Payments, Million Pesos	**1471.35**
Additional amount Paid by customers with lower nodal price, Million Pesos	**25.059**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**25.059**
% Subsidy	**1.7**

Figure 7.2.1a Nodal Prices Vs. Zonal Price - Off Peak Hour

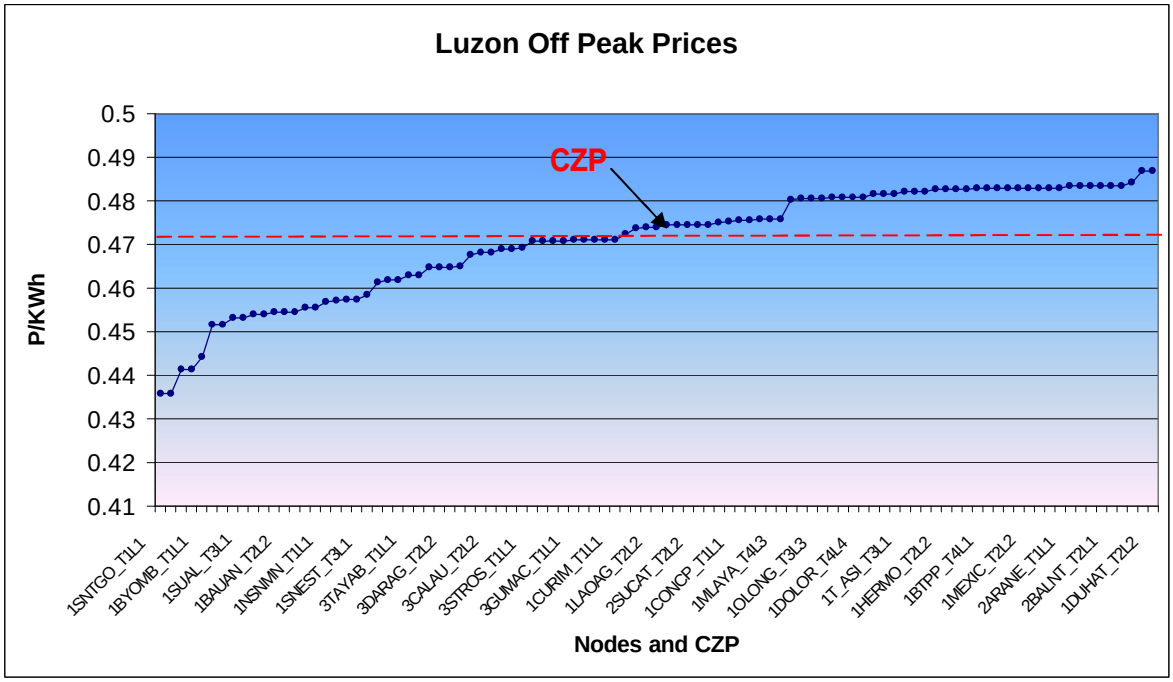
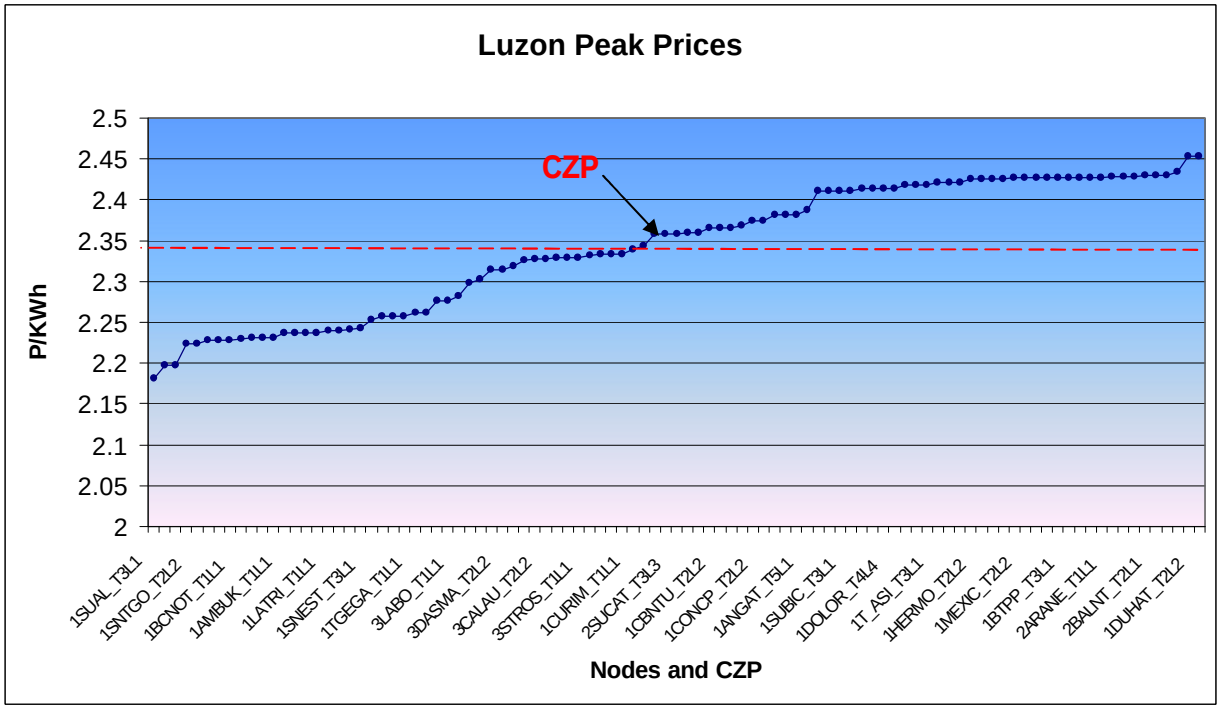


Figure 7.2.1b Nodal Prices Vs. Zonal Price –Peak Hour



Metro Manila Pricing Zone

Table 7.2.2 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**2,294.86**
Total Customer Zonal Payments, Million Pesos	**4,276.89**
Total Customer Nodal Payments, Million Pesos	**4,276.89**
Additional amount Paid by customers with lower nodal price, Million Pesos	**30.70**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**30.70**
% Subsidy	**0.72**

Figure 7.2.2a Nodal Prices Vs. Zonal Price -Off-Peak Hour

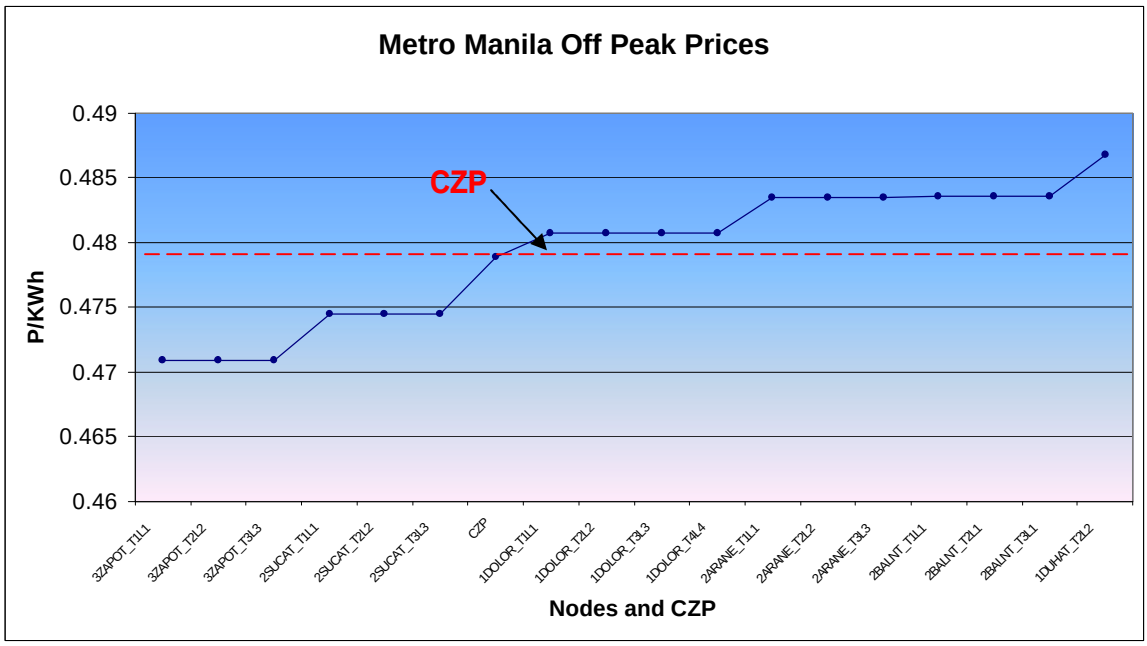
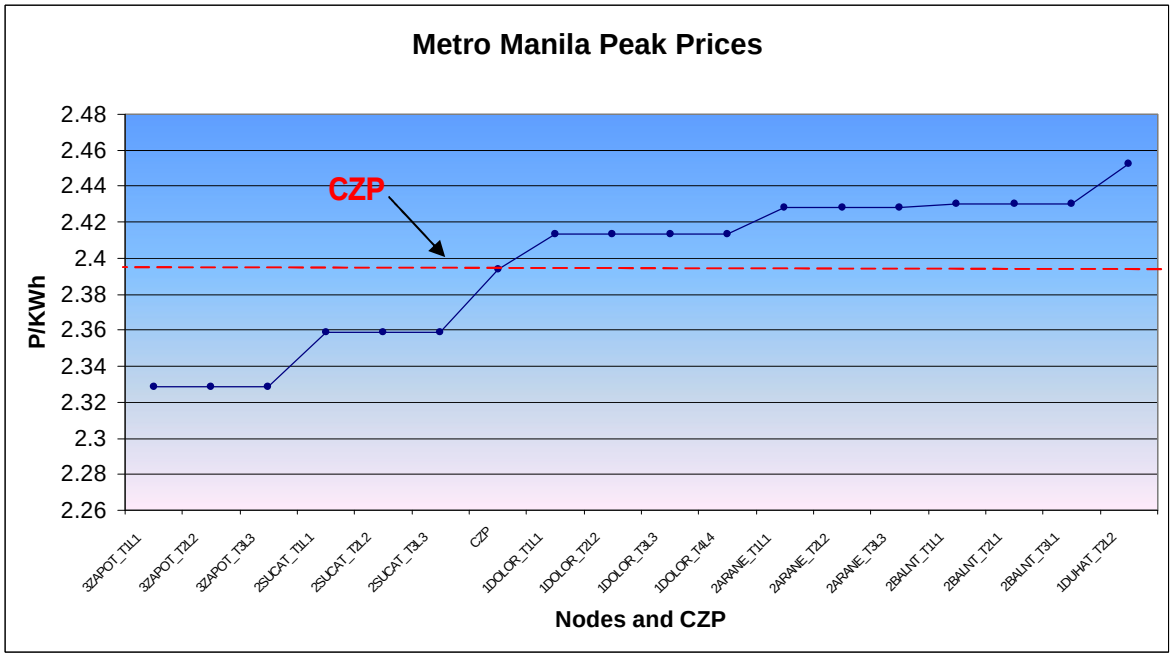


Figure 7.2.2b Nodal Prices Vs. Zonal Price - Peak Hour



South Luzon Pricing Zone

Table 7.2.3 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**779.82**
Total Customer Zonal Payments, Million Pesos	**1405.43**
Total Customer Nodal Payments, Million Pesos	**1405.43**
Additional amount Paid by customers with lower nodal price, Million Pesos	**7.74**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**7.74**
% Subsidy	**0.55**

Figure 7.2.3a Nodal Prices Vs. Zonal Price -Off-Peak Hour

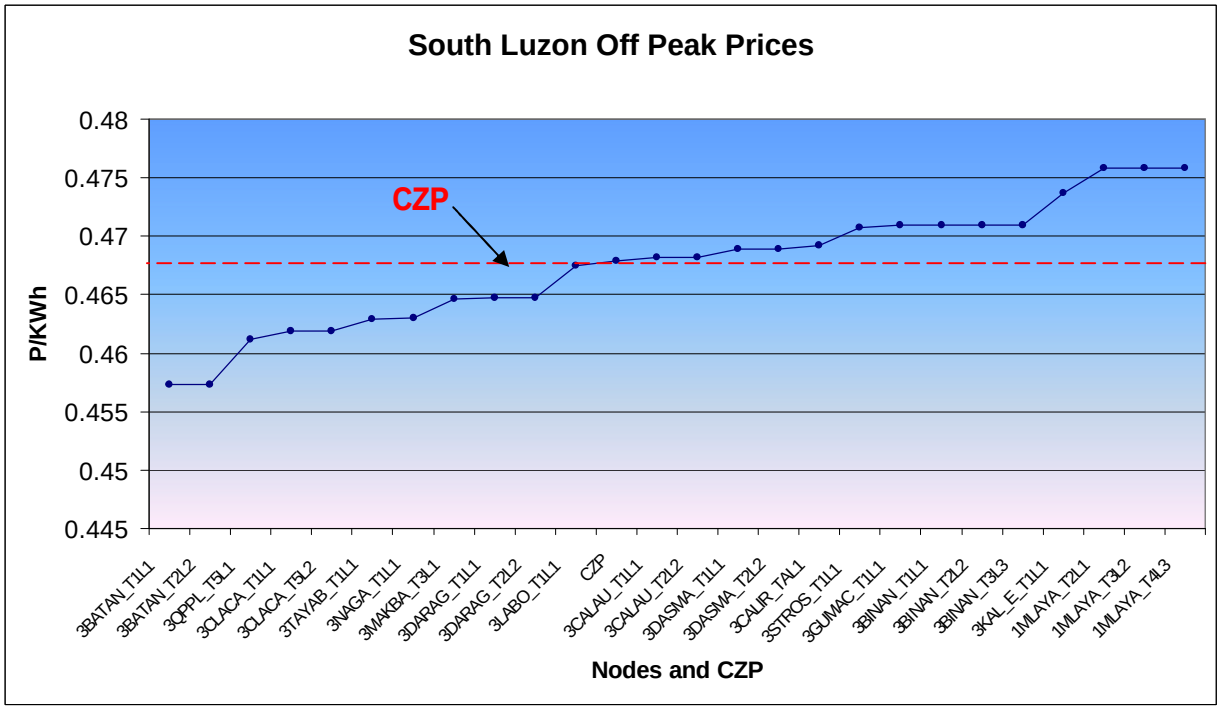
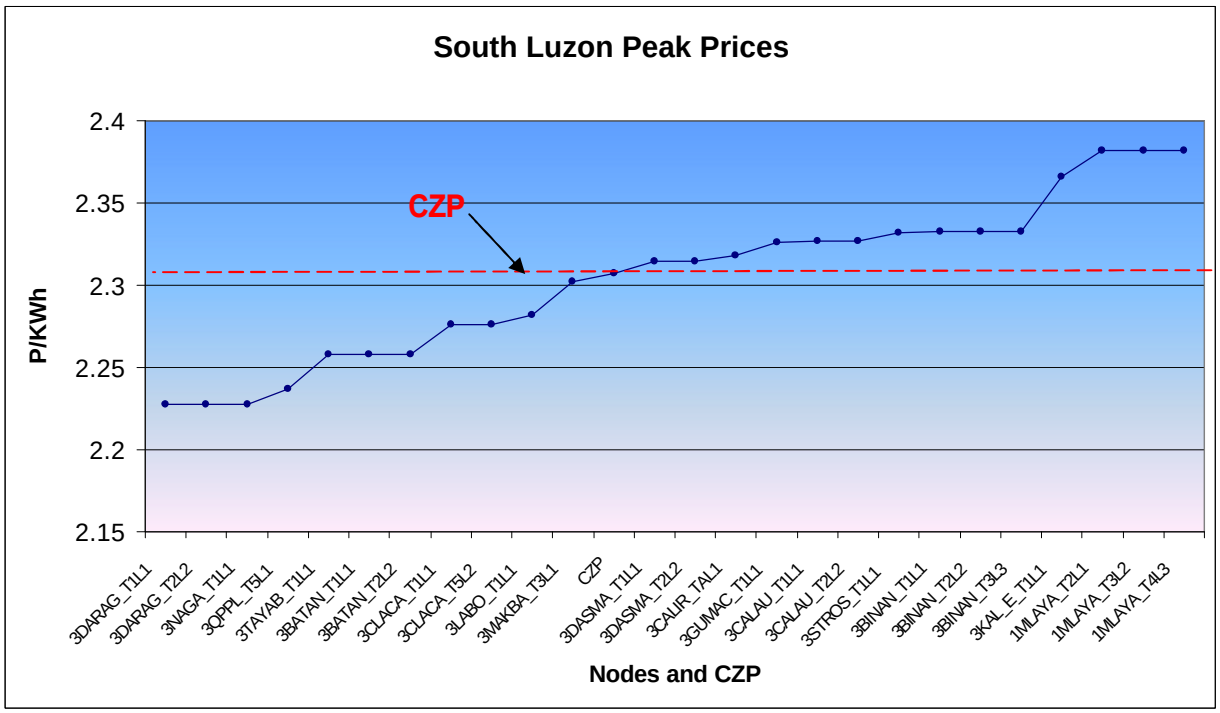


Figure 7.2.3b Nodal Prices Vs. Zonal Price - Peak Hour



7.3 Luzon with 5 pricing zones

North Luzon Pricing Zone

Table 7.3.1 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**304.19**
Total Customer Zonal Payments, Million Pesos	**531.88**
Total Customer Nodal Payments, Million Pesos	**531.88**
Additional amount Paid by customers with lower nodal price, Million Pesos	**2.535**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**2.535**
% Subsidy	**0.48**

Figure 7.3.1a Nodal Prices Vs. Zonal Price -Off-Peak Hour

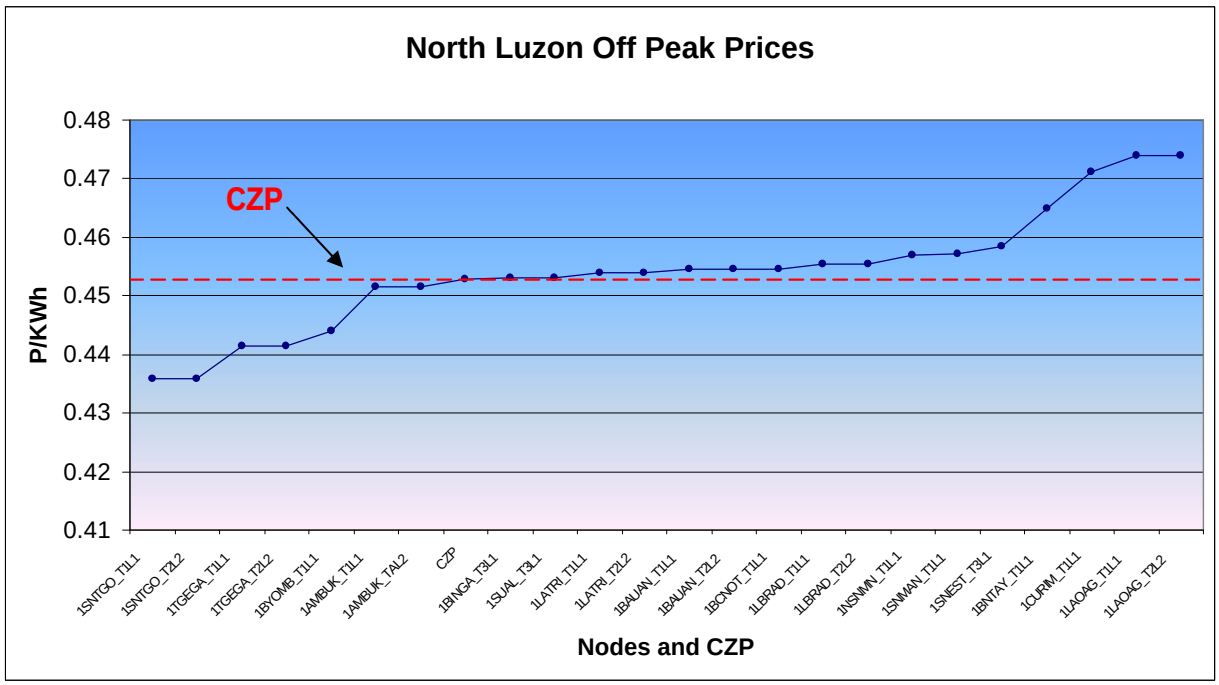
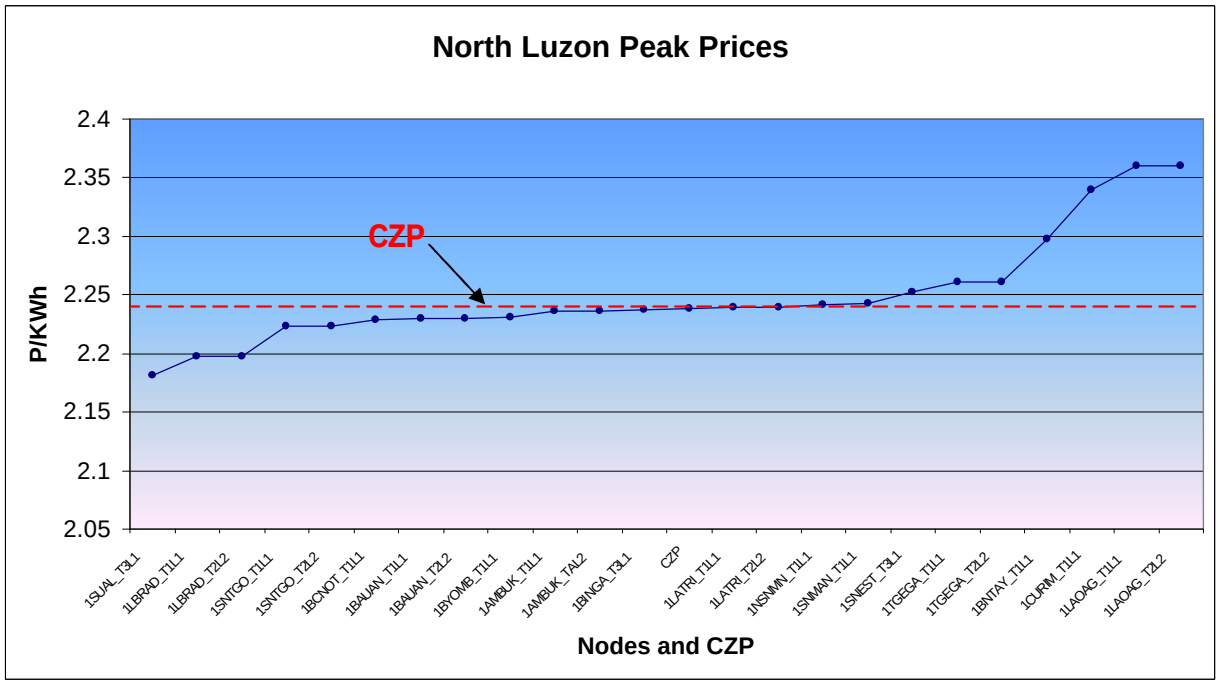


Figure 7.3.1b Nodal Prices Vs. Zonal Price - Peak Hour



Central Luzon Pricing Zone

Table 7.3.2 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**501.03**
Total Customer Zonal Payments, Million Pesos	**939.46**
Total Customer Nodal Payments, Million Pesos	**939.46**
Additional amount Paid by customers with lower nodal price, Million Pesos	**3.29**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**3.29**
% Subsidy	**0.35**

Figure 7.3.2a Nodal Prices Vs. Zonal Price -Off-Peak Hour

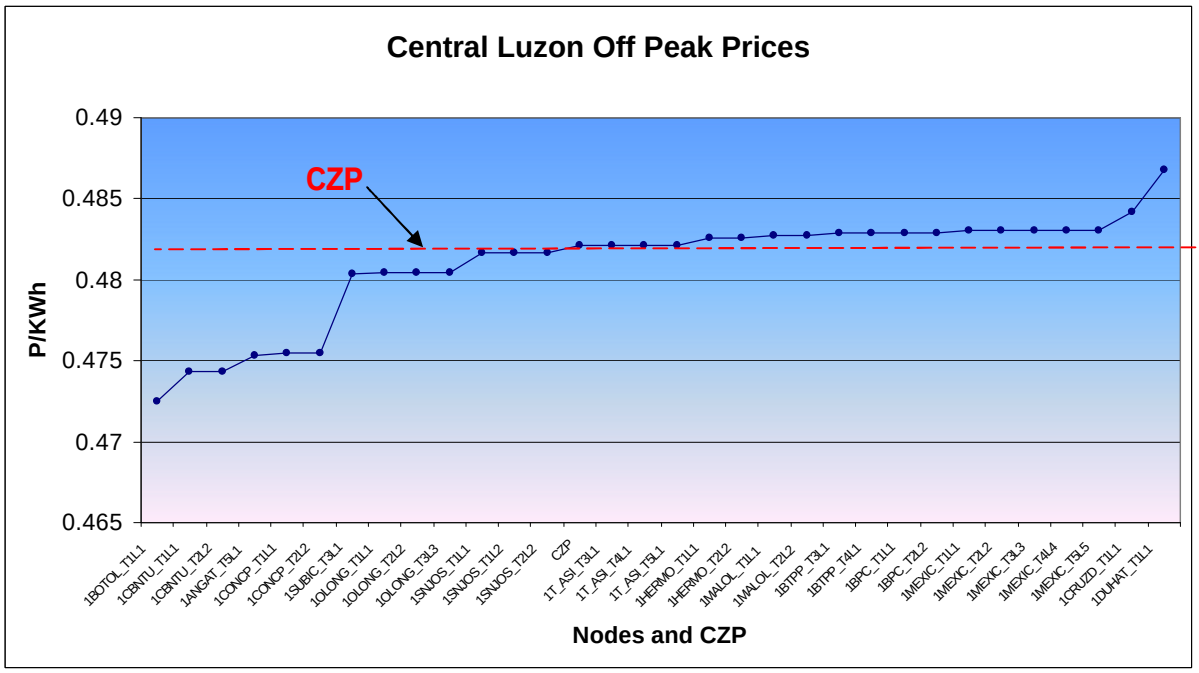
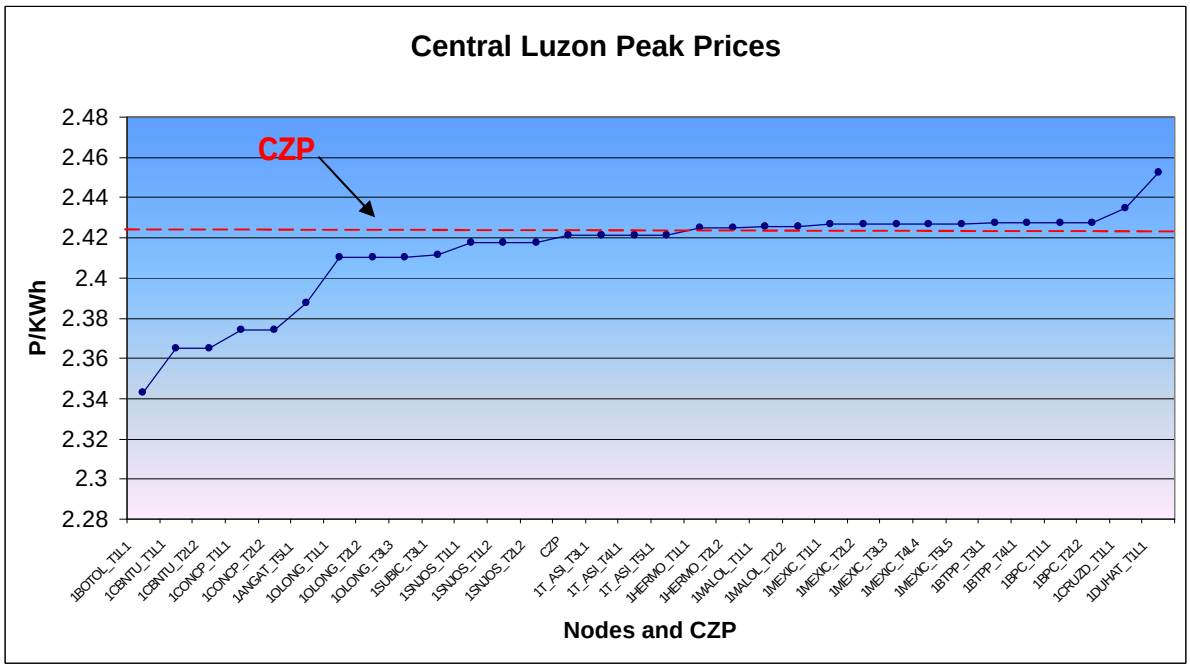


Figure 7.3.2b Nodal Prices Vs. Zonal Price - Peak Hour



Metro Manila Pricing Zone

Table 7.3.3 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**2,294.86**
Total Customer Zonal Payments, Million Pesos	**4,276.89**
Total Customer Nodal Payments, Million Pesos	**4,276.89**
Additional amount Paid by customers with lower nodal price, Million Pesos	**30.70**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**30.70**
% Subsidy	**0.72**

Figure 7.3.3a Nodal Prices Vs. Zonal Price -Off-Peak Hour

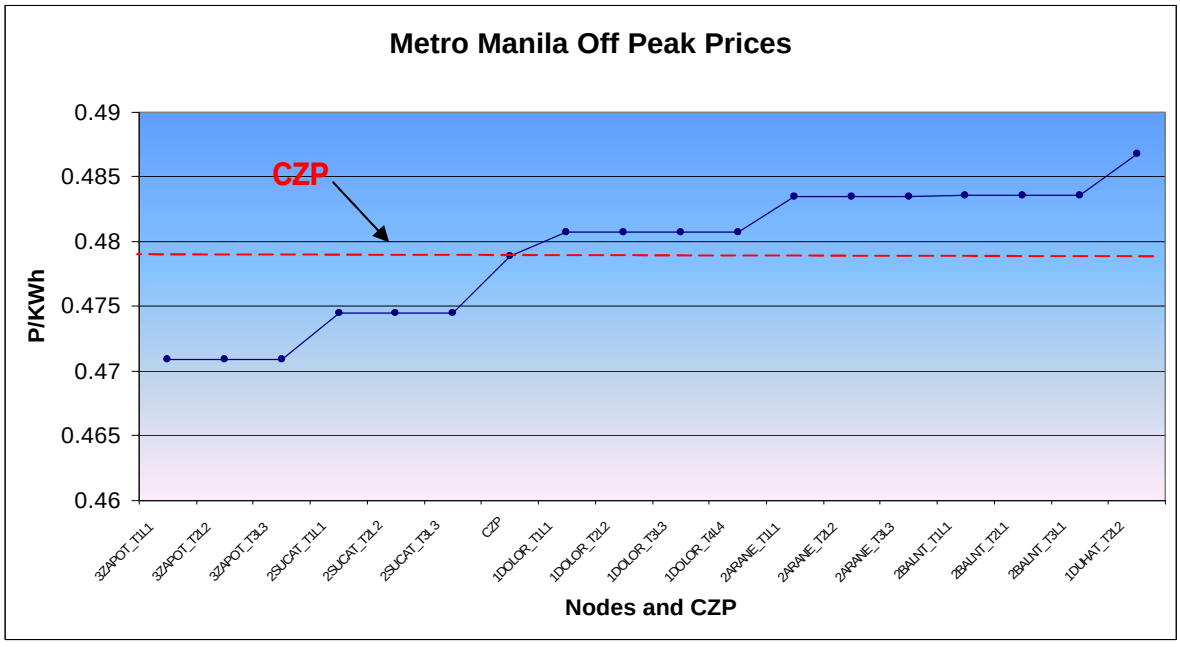
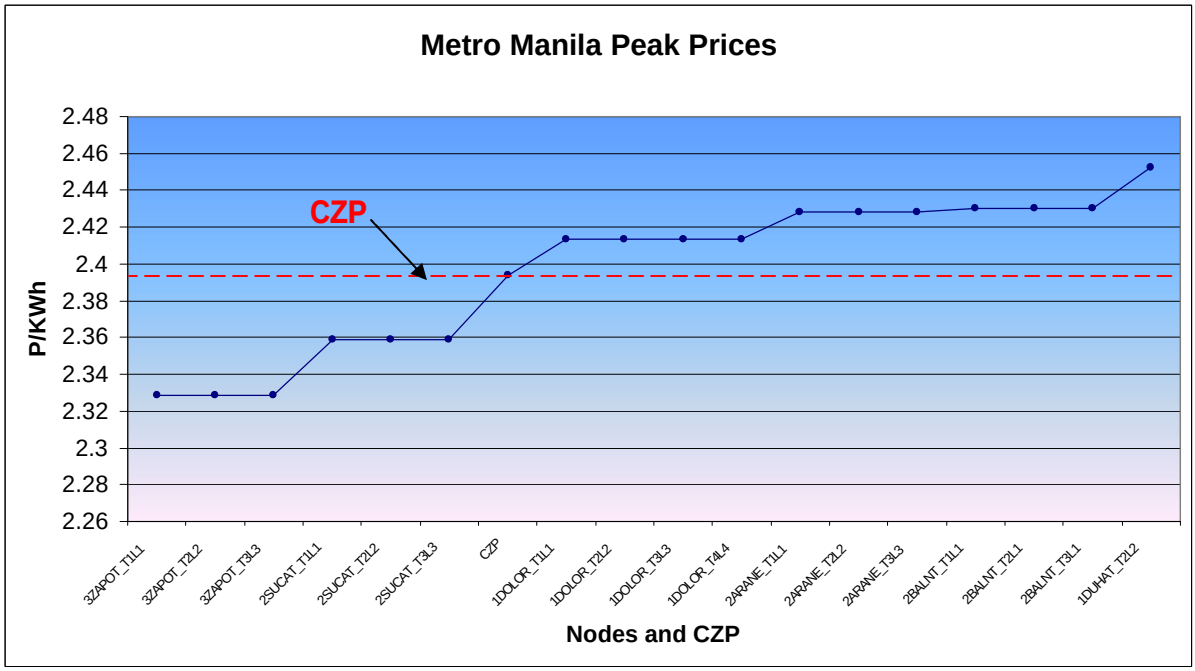


Figure 7.3.3b Nodal Prices Vs. Zonal Price - Peak Hour



Southern Tagalog Pricing Zone

Table 7.3.4 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**702.54**
Total Customer Zonal Payments, Million Pesos	**1,270.38**
Total Customer Nodal Payments, Million Pesos	**1,270.38**
Additional amount Paid by customers with lower nodal price, Million Pesos	**4.49**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**4.49**
% Subsidy	**0.35**

Figure 7.3.4a Nodal Prices Vs. Zonal Price -Off-Peak Hour

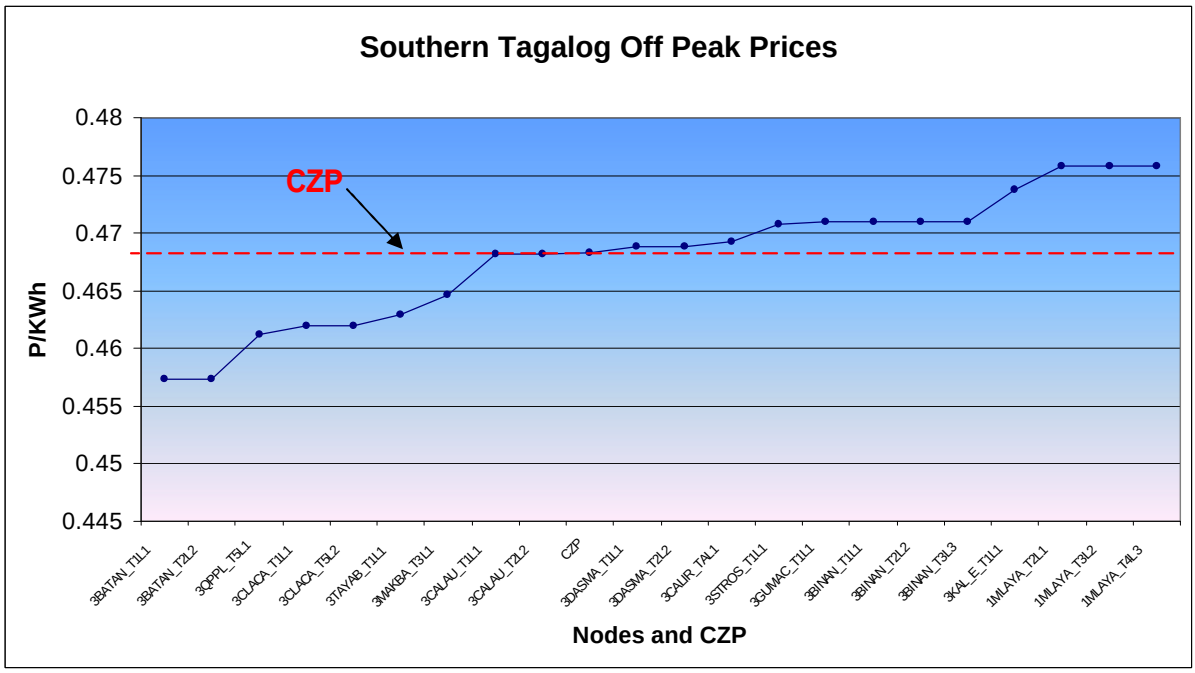
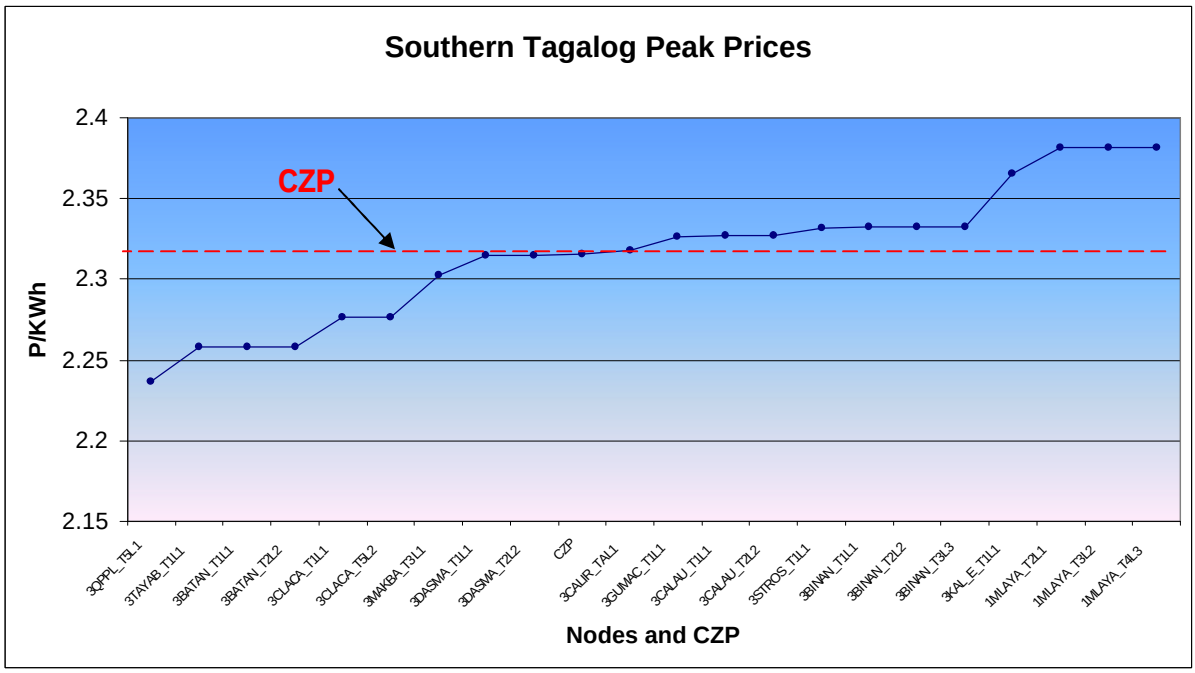


Figure 7.3.4b Nodal Prices Vs. Zonal Price - Peak Hour



Bicol Region Pricing Zone

Table 7.3.5 Potential Subsidy within the Zone

MONTH	
Energy Consumed by Customers, GWh	**77.28**
Total Customer Zonal Payments, Million Pesos	**135.04**
Total Customer Nodal Payments, Million Pesos	**135.04**
Additional amount Paid by customers with lower nodal price, Million Pesos	**0.28**
Amount saved by customers with higher nodal price = Subsidy Amount, Million Pesos	**0.28**
% Subsidy	**0.21**

Figure 7.3.5a Nodal Prices Vs. Zonal Price -Off-Peak Hour

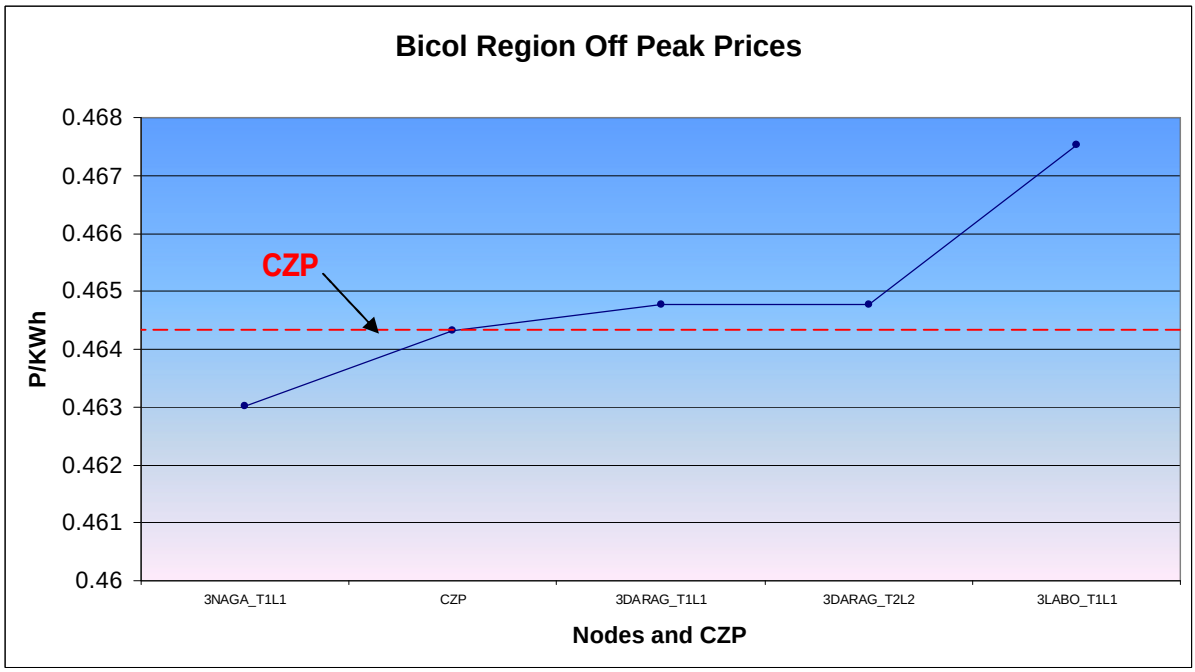
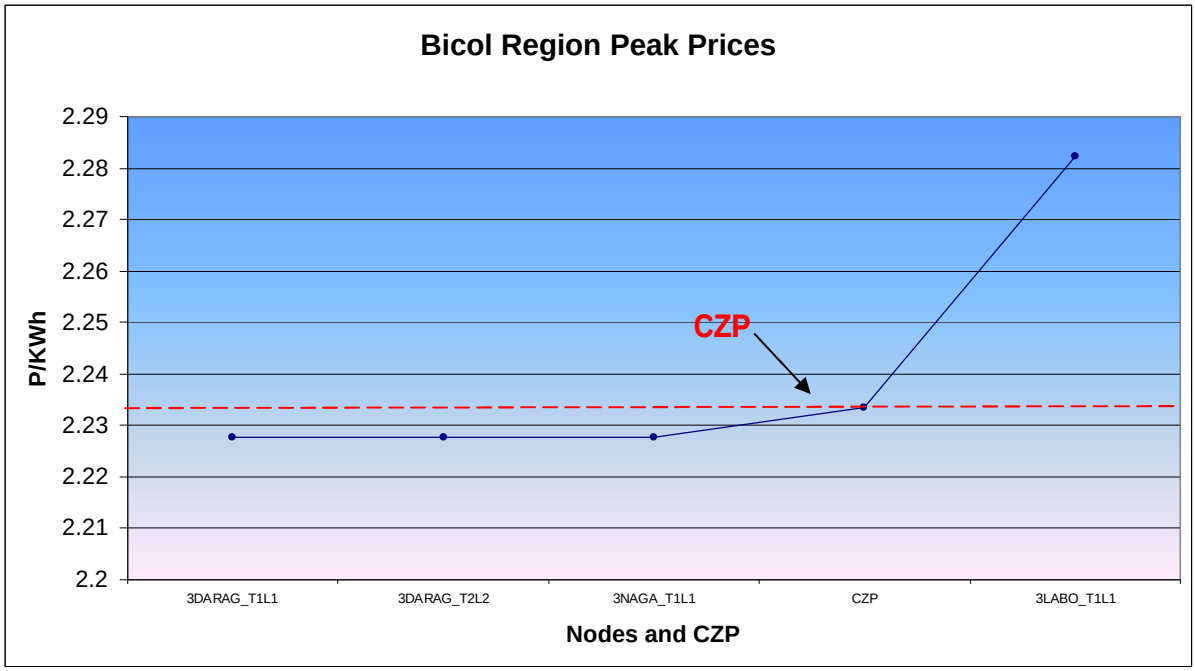


Figure 7.3.5b Nodal Prices Vs. Zonal Price - Peak Hour



8.0 Summary of Results for Settlement Surplus due to Congestion

Since no congestion is encountered due to recent transmission line reinforcements particularly in Southern Luzon, potential bottlenecks or congestion in the Luzon grid are most likely to occur in North Luzon pending completion of some transmission projects in North Luzon (e.g. Luzon Transmission Line Upgrading Project 1 and Binga-San Manuel 230 kV T/L Project). In this case, congestion was simulated in North Luzon by considering outage of the Bauang-La Trinidad 230 kV Line 2 during peak demand intervals. The Bauang-La Trinidad 230 kV Lines provide power to the Baguio City area which has, relatively, the highest load in North Luzon. This line outage provided congestion in Bauang-La Trinidad 230 kV Line 1 and Labrador –Kadampat Line2.

The results of the simulation are shown in the following Table.

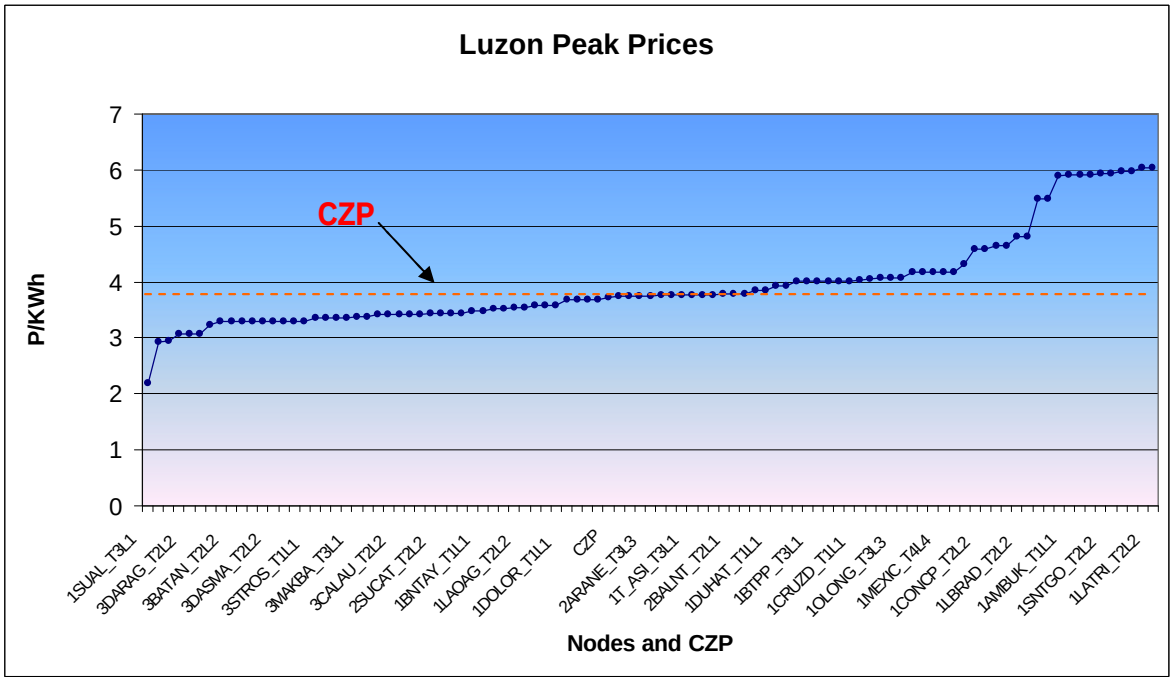
Table 8 - Base Case with Congestion in North Luzon

1 Month	
Total Energy Produced (GWh)	**3967.35**
Total Energy Consumed (GWh)	**3,879.90**
Total Customer Payments, Million Pesos	**7,339.48**

Total Generator Payments, Million Pesos	**7,178.67**
Settlement Surplus, Million Pesos	**160.81**
% of Total Customer Payments	**2.19%**
Annual Surplus, Million Pesos	**1,929.70**

The spread of the nodal prices are shown in the graph below. The load weighted average price (customer zonal prices) are also calculated and are indicated in the graph to show comparison of the nodes with prices lower than the zonal price and nodes with higher prices. During peak period, the price ranges from a minimum of 2.181 pesos per kilowatt-hour to a maximum of about 6 pesos per kilowatt-hour or a difference of about 3.86 pesos per kilowatt-hour. Full details of the nodal prices (and price separation) are indicated in Appendix 4.

Figure 8 - Price Spread in Luzon Grid with Congestion in North Luzon (Peak Hour)



9.0 Analysis of Results

Where Luzon is considered as a single customer pricing zone, the results indicate that Metro Manila and its surrounding areas are subsidized by the customers in North Luzon and South Luzon. That is, the customer nodes in North Luzon and South Luzon up to Bicol area tend to have lower nodal prices than the nodes in and around Metro Manila. This is illustrated in Figure 7.1a and 7.1 b and in Appendix 1. This is attributable to the fact that the generation supply is located in North Luzon and in South Luzon. The additional amount (potential subsidy) that will be paid by customers in north and south Luzon if a single load weighted price is applied in the Luzon grid amounts to about 29 million pesos per month.

If the Luzon Grid is divided into three pricing zones with Metro Manila area as one zone and the customer nodes north and south of Metro Manila is considered as separate pricing zones, the results indicate that the potential subsidies amount to 25 million pesos, 30 million pesos and 7.74 million pesos for the North Luzon, Metro Manila and South Luzon zones, respectively.

Figures 7.2.1a to 7.2.3b shows the spread of the nodal prices as compared with the customer zonal price. A comparison of the nodes which have higher prices than the zonal price and the nodes which have prices lower than the zonal price are detailed in Appendix 2. For the North Luzon zone, the northern-most nodes tend to have lower prices than the nodes closer to Metro Manila. Within the Metro Manila pricing zone, the nodes in the south (e.g. Zapote and Sucat nodes) tend to have lower prices than the nodes in the northern part (e.g. Araneta and Balintawak). For the South Luzon zone, the nodes in the Bicol region tend to have lower prices than the nodes closer to Metro Manila.

For the five customer pricing zones, the same trend as in the three pricing zone is seen. Nodes that are closer to Metro Manila tend to have higher prices than the nodes that are farther from Metro Manila. Figures 7.3.1a to 7.3.5b show the spread of prices and the comparison of nodal prices with the zonal price. The complete details of the nodes with higher or lower prices than the zonal prices are presented in Appendix 3.

For the settlement surplus arising from congestion in the Luzon grid, the amount of surplus is about 161 million pesos per month or about 1.9 billion pesos per year. This is about 2.19% of the total monthly customer payments. The results also indicate that congestion can provide a significant spread in prices if encountered in the power system as indicated in Figure 8.

Appendix 1 – Base Case -Luzon as a Single Pricing Zone (Spread of Prices,P/kWh)

OFF PEAK	CZP = 0.475	
Nodes < CZP	Load,MW	Nodal Price
1SNTGO_T1L1	19.955	0.43587
1SNTGO_T2L2	19.955	0.43587
1TGEGA_T1L1	12.45	0.44135
1TGEGA_T2L2	18.035	0.44135
1BYOMB_T1L1	2.485	0.4441
1AMBUK_T1L1	0.29	0.45158
1AMBUK_TAL2	0.29	0.45158
1BINGA_T3L1	7.85	0.45305
1SUAL_T3L1	16.8	0.45317
1LATRI_T1L1	39.485	0.45393
1LATRI_T2L2	39.485	0.45393
1BAUAN_T1L1	13.285	0.45449
1BAUAN_T2L2	13.285	0.45449
1BCNOT_T1L1	0	0.45454
1LBRAD_T1L1	24.245	0.45543
1LBRAD_T2L2	24.245	0.45543
1NSNMN_T1L1	3.02	0.45697
1SNMAN_T1L1	53.6	0.45707
3BATAN_T1L1	29.495	0.4573
3BATAN_T2L2	29.495	0.4573
1SNEST_T3L1	9.315	0.45841
3QPPL_T5L1	0	0.46122
3CLACA_T1L1	15.465	0.46191
3CLACA_T5L2	15.465	0.46191
3TAYAB_T1L1	31.035	0.46292
3NAGA_T1L1	36.98	0.46301
3MAKBA_T3L1	27.185	0.46466
3DARAG_T1L1	20.62	0.46478
3DARAG_T2L2	20.62	0.46478
1BNTAY_T1L1	9.675	0.46503
3LABO_T1L1	9.365	0.46753

OFF PEAK	CZP = 0.475	
Nodes > CZP	Load,MW	Nodal Price
1ANGAT_T5L1	8.36	0.47529
1CONCP_T1L1	8.04	0.47549
1CONCP_T2L2	8.04	0.47549
1MLAYA_T2L1	0	0.47585
1MLAYA_T3L2	0	0.47585
1MLAYA_T4L3	0	0.47585
1SUBIC_T3L1	6.325	0.48035
1OLONG_T1L1	14.155	0.48048
1OLONG_T2L2	14.155	0.48048
1OLONG_T3L3	14.155	0.48048
1DOLOR_T1L1	127.04	0.48075
1DOLOR_T2L2	108.69	0.48075
1DOLOR_T3L3	182.08	0.48075
1DOLOR_T4L4	113.9	0.48075
1SNJOS_T1L1	2.95	0.48168
1SNJOS_T1L2	2.95	0.48168
1SNJOS_T2L2	2.95	0.48168
1T_ASI_T3L1	1.605	0.48216
1T_ASI_T4L1	1.605	0.48216
1T_ASI_T5L1	1.605	0.48216
1HERMO_T1L1	22.305	0.48259
1HERMO_T2L2	22.305	0.48259
1MALOL_T1L1	28.89	0.48272
1MALOL_T2L2	28.89	0.48272
1BTPP_T3L1	21.11	0.48287
1BTPP_T4L1	21.11	0.48287
1BPC_T1L1	0	0.48287
1BPC_T2L2	0	0.48287
1MEXIC_T1L1	27.045	0.48301
1MEXIC_T2L2	27.045	0.48301
1MEXIC_T3L3	27.045	0.48301

OFF PEAK	CZP = 0.475	
Nodes < CZP	Load,MW	Nodal Price
3CALAU_T1L1	23.825	0.4682
3CALAU_T2L2	23.825	0.4682
3DASMA_T1L1	107.805	0.46886
3DASMA_T2L2	105.135	0.46886
3CALIR_TAL1	13.425	0.46926
3STROS_T1L1	210.755	0.47072
3ZAPOT_T1L1	169.905	0.47089
3ZAPOT_T2L2	177.55	0.47089
3ZAPOT_T3L3	178.3	0.47089
3GUMAC_T1L1	11.74	0.47097
3BINAN_T1L1	52.355	0.47099
3BINAN_T2L2	57.025	0.47099
3BINAN_T3L3	47.57	0.47099
1CURIM_T1L1	1.875	0.47109
1BOTOL_T1L1	6.355	0.47246
3KAL_E_T1L1	1.485	0.47374
1LAOAG_T1L1	8.34	0.47403
1LAOAG_T2L2	8.34	0.47403
1CBNTU_T1L1	26.285	0.47435
1CBNTU_T2L2	26.285	0.47435
2SUCAT_T1L1	153.615	0.47454
2SUCAT_T2L2	153.615	0.47454
2SUCAT_T3L3	163.42	0.47454

OFF PEAK	CZP = 0.475	
Nodes > CZP	Load,MW	Nodal Price
1MEXIC_T4L4	27.045	0.48301
1MEXIC_T5L5	27.045	0.48301
2ARANE_T1L1	159.73	0.48351
2ARANE_T2L2	159.73	0.48351
2ARANE_T3L3	159.73	0.48351
2BALNT_T1L1	173.05	0.48355
2BALNT_T2L1	173.05	0.48355
2BALNT_T3L1	173.05	0.48355
1CRUZD_T1L1	37.2	0.48418
1DUHAT_T1L1	96.145	0.48681
1DUHAT_T2L2	96.145	0.48681

PEAK	CZP = 2.368	
Nodes < CZP	Load,MW	Nodal Price
1SUAL_T3L1	23.54	2.181
1LBRAD_T1L1	33.97	2.19761
1LBRAD_T2L2	33.97	2.19761
1SNTGO_T1L1	27.96	2.22357
1SNTGO_T2L2	27.96	2.22357
3DARAG_T1L1	28.895	2.22756
3DARAG_T2L2	28.895	2.22756
3NAGA_T1L1	51.805	2.22757

PEAK	CZP = 2.368	
Nodes > CZP	Load,MW	Nodal Price
1CONCP_T1L1	11.265	2.37394
1CONCP_T2L2	11.265	2.37394
1MLAYA_T2L1	0	2.38171
1MLAYA_T3L2	0	2.38171
1MLAYA_T4L3	0	2.38171
1ANGAT_T5L1	11.71	2.38764
1OLONG_T1L1	19.835	2.4102
1OLONG_T2L2	19.835	2.4102

PEAK	CZP = 2.368	
Nodes < CZP	Load,MW	Nodal Price
1BCNOT_T1L1	0	2.22892
1BAUAN_T1L1	18.61	2.23029
1BAUAN_T2L2	18.61	2.23029
1BYOMB_T1L1	3.48	2.23052
1AMBUK_T1L1	0.405	2.2363
1AMBUK_TAL2	0.405	2.2363
3QPPL_T5L1	0	2.23694
1BINGA_T3L1	11	2.23742
1LATRI_T1L1	55.32	2.23927
1LATRI_T2L2	55.32	2.23927
1NSNMN_T1L1	4.23	2.24162
1SNMAN_T1L1	75.095	2.24295
1SNEST_T3L1	13.045	2.2527
3TAYAB_T1L1	43.48	2.25789
3BATAN_T1L1	41.325	2.25802
3BATAN_T2L2	41.325	2.25802
1TGEGA_T1L1	17.44	2.26114
1TGEGA_T2L2	25.27	2.26114
3CLACA_T1L1	21.67	2.2763
3CLACA_T5L2	21.67	2.2763
3LABO_T1L1	13.12	2.2822
1BNTAY_T1L1	13.55	2.2982
3MAKBA_T3L1	38.095	2.3023
3DASMA_T1L1	151.045	2.3146
3DASMA_T2L2	147.295	2.3146
3CALIR_TAL1	18.815	2.3182
3GUMAC_T1L1	16.445	2.32621
3CALAU_T1L1	33.385	2.32693
3CALAU_T2L2	33.385	2.32693
3ZAPOT_T1L1	238.055	2.32853
3ZAPOT_T2L2	248.76	2.32853
3ZAPOT_T3L3	249.815	2.32853
3STROS_T1L1	295.285	2.33179
3BINAN_T1L1	73.35	2.33286
3BINAN_T2L2	79.9	2.33286

PEAK	CZP = 2.368	
Nodes > CZP	Load,MW	Nodal Price
1OLONG_T3L3	19.835	2.4102
1SUBIC_T3L1	8.865	2.4112
1DOLOR_T1L1	177.985	2.41337
1DOLOR_T2L2	152.275	2.41337
1DOLOR_T3L3	255.105	2.41337
1DOLOR_T4L4	159.57	2.41337
1SNJOS_T1L1	4.13	2.41783
1SNJOS_T1L2	4.13	2.41783
1SNJOS_T2L2	4.13	2.41783
1T_ASI_T3L1	2.245	2.42109
1T_ASI_T4L1	2.245	2.42109
1T_ASI_T5L1	2.245	2.42109
1HERMO_T1L1	31.25	2.42522
1HERMO_T2L2	31.25	2.42522
1MALOL_T1L1	40.475	2.42531
1MALOL_T2L2	40.475	2.42531
1MEXIC_T1L1	37.89	2.4268
1MEXIC_T2L2	37.89	2.4268
1MEXIC_T3L3	37.89	2.4268
1MEXIC_T4L4	37.89	2.4268
1MEXIC_T5L5	37.89	2.4268
1BTPP_T3L1	29.58	2.42748
1BTPP_T4L1	29.58	2.42748
1BPC_T1L1	0	2.42748
1BPC_T2L2	0	2.42748
2ARANE_T1L1	223.795	2.42851
2ARANE_T2L2	223.795	2.42851
2ARANE_T3L3	223.795	2.42851
2BALNT_T1L1	242.455	2.4303
2BALNT_T2L1	242.455	2.4303
2BALNT_T3L1	242.455	2.4303
1CRUZD_T1L1	52.12	2.43476
1DUHAT_T1L1	134.705	2.4527
1DUHAT_T2L2	134.705	2.4527

PEAK	CZP = 2.368	
Nodes < CZP	Load,MW	Nodal Price
3BINAN_T3L3	66.65	2.33286
1CURIM_T1L1	2.625	2.33979
1BOTOL_T1L1	8.905	2.34299
2SUCAT_T1L1	215.22	2.35889
2SUCAT_T2L2	215.22	2.35889
2SUCAT_T3L3	228.965	2.35889
1LAOAG_T1L1	11.69	2.35992
1LAOAG_T2L2	11.69	2.35992
1CBNTU_T1L1	36.83	2.36493
1CBNTU_T2L2	36.83	2.36493
3KAL_E_T1L1	2.085	2.36572

PEAK	CZP = 2.368	
Nodes > CZP	Load,MW	Nodal Price

Appendix 2 – Base Case -Luzon with 3 Pricing Zones (Spread of Prices,P/kWh)

North Luzon Pricing Zone

OFF PEAK	CZP= 0.4709	
Nodes < CZP	Load , MW	Nodal Price
1SNTGO_T1L1	19.955	0.43587
1SNTGO_T2L2	19.955	0.43587
1TGEGA_T1L1	12.45	0.44135
1TGEGA_T2L2	18.035	0.44135
1BYOMB_T1L1	2.485	0.4441
1AMBUK_T1L1	0.29	0.45158
1AMBUK_TAL2	0.29	0.45158
1BINGA_T3L1	7.85	0.45305
1SUAL_T3L1	16.8	0.45317
1LATRI_T1L1	39.485	0.45393
1LATRI_T2L2	39.485	0.45393
1BAUAN_T1L1	13.285	0.45449
1BAUAN_T2L2	13.285	0.45449
1BCNOT_T1L1	0	0.45454
1LBRAD_T1L1	24.245	0.45543
1LBRAD_T2L2	24.245	0.45543
1NSNMN_T1L1	3.02	0.45697
1SNMAN_T1L1	53.6	0.45707
1SNEST_T3L1	9.315	0.45841
1BNTAY_T1L1	9.675	0.46503

OFF PEAK	CZP= 0.4709	
Nodes > CZP	Load , MW	Nodal Price
1CURIM_T1L1	1.875	0.47109
1BOTOL_T1L1	6.355	0.47246
1LAOAG_T1L1	8.34	0.47403
1LAOAG_T2L2	8.34	0.47403
1CBNTU_T1L1	26.285	0.47435
1CBNTU_T2L2	26.285	0.47435
1ANGAT_T5L1	8.36	0.47529
1CONCP_T1L1	8.04	0.47549
1CONCP_T2L2	8.04	0.47549
1SUBIC_T3L1	6.325	0.48035
1OLONG_T1L1	14.155	0.48048
1OLONG_T2L2	14.155	0.48048
1OLONG_T3L3	14.155	0.48048
1SNJOS_T1L1	2.95	0.48168
1SNJOS_T1L2	2.95	0.48168
1SNJOS_T2L2	2.95	0.48168
1T_ASI_T3L1	1.605	0.48216
1T_ASI_T4L1	1.605	0.48216
1T_ASI_T5L1	1.605	0.48216
1HERMO_T1L1	22.305	0.48259
1HERMO_T2L2	22.305	0.48259
1MALOL_T1L1	28.89	0.48272
1MALOL_T2L2	28.89	0.48272
1BTPP_T3L1	21.11	0.48287
1BTPP_T4L1	21.11	0.48287
1BPC_T1L1	0	0.48287
1BPC_T2L2	0	0.48287
1MEXIC_T1L1	27.045	0.48301
1MEXIC_T2L2	27.045	0.48301
1MEXIC_T3L3	27.045	0.48301
1MEXIC_T4L4	27.045	0.48301

OFF PEAK	CZP= 0.4709	
Nodes < CZP	Load , MW	Nodal Price

OFF PEAK	CZP= 0.4709	
Nodes > CZP	Load , MW	Nodal Price
1MEXIC_T5L5	27.045	0.48301
1CRUZD_T1L1	37.2	0.48418
1DUHAT_T1L1	96.145	0.48681

PEAK	CZP= 2.351365	
Nodes < CZP	Load , MW	Nodal Price
1SUAL_T3L1	23.54	2.181
1LBRAD_T1L1	33.97	2.19761
1LBRAD_T2L2	33.97	2.19761
1SNTGO_T1L1	27.96	2.22357
1SNTGO_T2L2	27.96	2.22357
1BCNOT_T1L1	0	2.22892
1BAUAN_T1L1	18.61	2.23029
1BAUAN_T2L2	18.61	2.23029
1BYOMB_T1L1	3.48	2.23052
1AMBUK_T1L1	0.405	2.2363
1AMBUK_TAL2	0.405	2.2363
1BINGA_T3L1	11	2.23742
1LATRI_T1L1	55.32	2.23927
1LATRI_T2L2	55.32	2.23927
1NSNMN_T1L1	4.23	2.24162
1SNMAN_T1L1	75.095	2.24295
1SNEST_T3L1	13.045	2.2527
1TGEGA_T1L1	17.44	2.26114
1TGEGA_T2L2	25.27	2.26114
1BNTAY_T1L1	13.55	2.2982
1CURIM_T1L1	2.625	2.33979
1BOTOL_T1L1	8.905	2.34299

PEAK	CZP= 2.351365	
Nodes > CZP	Load , MW	Nodal Price
1LAOAG_T1L1	11.69	2.35992
1LAOAG_T2L2	11.69	2.35992
1CBNTU_T1L1	36.83	2.36493
1CBNTU_T2L2	36.83	2.36493
1CONCP_T1L1	11.265	2.37394
1CONCP_T2L2	11.265	2.37394
1ANGAT_T5L1	11.71	2.38764
1OLONG_T1L1	19.835	2.4102
1OLONG_T2L2	19.835	2.4102
1OLONG_T3L3	19.835	2.4102
1SUBIC_T3L1	8.865	2.4112
1SNJOS_T1L1	4.13	2.41783
1SNJOS_T1L2	4.13	2.41783
1SNJOS_T2L2	4.13	2.41783
1T_ASI_T3L1	2.245	2.42109
1T_ASI_T4L1	2.245	2.42109
1T_ASI_T5L1	2.245	2.42109
1HERMO_T1L1	31.25	2.42522
1HERMO_T2L2	31.25	2.42522
1MALOL_T1L1	40.475	2.42531
1MALOL_T2L2	40.475	2.42531
1MEXIC_T1L1	37.89	2.4268
1MEXIC_T2L2	37.89	2.4268
1MEXIC_T3L3	37.89	2.4268
1MEXIC_T4L4	37.89	2.4268
1MEXIC_T5L5	37.89	2.4268
1BTPP_T3L1	29.58	2.42748
1BTPP_T4L1	29.58	2.42748

PEAK	CZP= 2.351365	
Nodes < CZP	Load , MW	Nodal Price

PEAK	CZP= 2.351365	
Nodes > CZP	Load , MW	Nodal Price
1BPC_T1L1	0	2.42748
1BPC_T2L2	0	2.42748
1CRUZD_T1L1	52.12	2.43476
1DUHAT_T1L1	134.705	2.4527

Metro Manila Pricing Zone

OFF PEAK	CZP= 0.479	
Nodes < CZP	Load, MW	Nodal Price
3ZAPOT_T1L1	169.91	0.47089
3ZAPOT_T2L2	177.55	0.47089
3ZAPOT_T3L3	178.3	0.47089
2SUCAT_T1L1	153.62	0.47454
2SUCAT_T2L2	153.62	0.47454
2SUCAT_T3L3	163.42	0.47454

OFF PEAK	CZP= 0.479	
Nodes > CZP	Load, MW	Nodal Price
1DOLOR_T1L1	127.04	0.48075
1DOLOR_T2L2	108.69	0.48075
1DOLOR_T3L3	182.08	0.48075
1DOLOR_T4L4	113.9	0.48075
2ARANE_T1L1	159.73	0.48351
2ARANE_T2L2	159.73	0.48351
2ARANE_T3L3	159.73	0.48351
2BALNT_T1L1	173.05	0.48355
2BALNT_T2L1	173.05	0.48355
2BALNT_T3L1	173.05	0.48355
1DUHAT_T2L2	96.145	0.48681

PEAK	CZP= 2.394	
Nodes < CZP	Load, MW	Nodal Price
3ZAPOT_T1L1	238.055	2.32853
3ZAPOT_T2L2	248.76	2.32853
3ZAPOT_T3L3	249.815	2.32853
2SUCAT_T1L1	215.22	2.35889
2SUCAT_T2L2	215.22	2.35889
2SUCAT_T3L3	228.965	2.35889

PEAK	CZP= 2.394	
Nodes > CZP	Load, MW	Nodal Price
1DOLOR_T1L1	177.985	2.41337
1DOLOR_T2L2	152.275	2.41337
1DOLOR_T3L3	255.105	2.41337
1DOLOR_T4L4	159.57	2.41337
2ARANE_T1L1	223.795	2.42851
2ARANE_T2L2	223.795	2.42851
2ARANE_T3L3	223.795	2.42851
2BALNT_T1L1	242.455	2.4303
2BALNT_T2L1	242.455	2.4303
2BALNT_T3L1	242.455	2.4303
1DUHAT_T2L2	134.705	2.4527

South Luzon Pricing Zone

OFF PEAK	CZP= 0.467894	
Nodes < CZP	Load, MW	Nodal Price
3BATAN_T1L1	29.495	0.4573
3BATAN_T2L2	29.495	0.4573
3QPPL_T5L1	0	0.46122
3CLACA_T1L1	15.465	0.46191
3CLACA_T5L2	15.465	0.46191
3TAYAB_T1L1	31.035	0.46292
3NAGA_T1L1	36.98	0.46301
3MAKBA_T3L1	27.185	0.46466
3DARAG_T1L1	20.62	0.46478
3DARAG_T2L2	20.62	0.46478
3LABO_T1L1	9.365	0.46753

OFF PEAK	CZP= 0.467894	
Nodes > CZP	Load, MW	Nodal Price
3CALAU_T1L1	23.825	0.4682
3CALAU_T2L2	23.825	0.4682
3DASMA_T1L1	107.81	0.46886
3DASMA_T2L2	105.14	0.46886
3CALIR_TAL1	13.425	0.46926
3STROS_T1L1	210.76	0.47072
3GUMAC_T1L1	11.74	0.47097
3BINAN_T1L1	52.355	0.47099
3BINAN_T2L2	57.025	0.47099
3BINAN_T3L3	47.57	0.47099
3KAL_E_T1L1	1.485	0.47374
1MLAYA_T2L1	0	0.47585
1MLAYA_T3L2	0	0.47585
1MLAYA_T4L3	0	0.47585

PEAK	CZP= 2.30742	
Nodes < CZP	Load, MW	Nodal Price
3DARAG_T1L1	28.895	2.22756
3DARAG_T2L2	28.895	2.22756
3NAGA_T1L1	51.805	2.22757
3QPPL_T5L1	0	2.23694
3TAYAB_T1L1	43.48	2.25789
3BATAN_T1L1	41.325	2.25802
3BATAN_T2L2	41.325	2.25802
3CLACA_T1L1	21.67	2.2763
3CLACA_T5L2	21.67	2.2763
3LABO_T1L1	13.12	2.2822
3MAKBA_T3L1	38.095	2.3023

PEAK	CZP= 2.30742	
Nodes > CZP	Load, MW	Nodal Price
3DASMA_T1L1	151.045	2.3146
3DASMA_T2L2	147.295	2.3146
3CALIR_TAL1	18.815	2.3182
3GUMAC_T1L1	16.445	2.32621
3CALAU_T1L1	33.385	2.32693
3CALAU_T2L2	33.385	2.32693
3STROS_T1L1	295.285	2.33179
3BINAN_T1L1	73.35	2.33286
3BINAN_T2L2	79.9	2.33286
3BINAN_T3L3	66.65	2.33286
3KAL_E_T1L1	2.085	2.36572
1MLAYA_T2L1	0	2.38171
1MLAYA_T3L2	0	2.38171
1MLAYA_T4L3	0	2.38171

Appendix 3 – Base Case -Luzon with 5 Pricing Zones (Spread of Prices,P/kWh)

North Luzon Pricing Zone

OFF PEAK	CZP= 0.453	
Nodes < CZP	Load,MW	Nodal Price
1SNTGO_T1L1	19.955	0.43587
1SNTGO_T2L2	19.955	0.43587
1TGEGA_T1L1	12.45	0.44135
1TGEGA_T2L2	18.035	0.44135
1BYOMB_T1L1	2.485	0.4441
1AMBUK_T1L1	0.29	0.45158
1AMBUK_TAL2	0.29	0.45158

OFF PEAK	CZP= 0.453	
Nodes > CZP	Load,MW	Nodal Price
1BINGA_T3L1	7.85	0.45305
1SUAL_T3L1	16.8	0.45317
1LATRI_T1L1	39.485	0.45393
1LATRI_T2L2	39.485	0.45393
1BAUAN_T1L1	13.285	0.45449
1BAUAN_T2L2	13.285	0.45449
1BCNOT_T1L1	0	0.45454
1LBRAD_T1L1	24.245	0.45543
1LBRAD_T2L2	24.245	0.45543
1NSNMN_T1L1	3.02	0.45697
1SNMAN_T1L1	53.6	0.45707
1SNEST_T3L1	9.315	0.45841
1BNTAY_T1L1	9.675	0.46503
1CURIM_T1L1	1.875	0.47109
1LAOAG_T1L1	8.34	0.47403
1LAOAG_T2L2	8.34	0.47403

PEAK	CZP= 2.239	
Nodes < CZP	Load,MW	Nodal Price
1SUAL_T3L1	23.54	2.181
1LBRAD_T1L1	33.97	2.19761
1LBRAD_T2L2	33.97	2.19761
1SNTGO_T1L1	27.96	2.22357
1SNTGO_T2L2	27.96	2.22357
1BCNOT_T1L1	0	2.22892
1BAUAN_T1L1	18.61	2.23029
1BAUAN_T2L2	18.61	2.23029
1BYOMB_T1L1	3.48	2.23052
1AMBUK_T1L1	0.405	2.2363
1AMBUK_TAL2	0.405	2.2363
1BINGA_T3L1	11	2.23742

PEAK	CZP= 2.239	
Nodes > CZP	Load,MW	Nodal Price
1LATRI_T1L1	55.32	2.23927
1LATRI_T2L2	55.32	2.23927
1NSNMN_T1L1	4.23	2.24162
1SNMAN_T1L1	75.095	2.24295
1SNEST_T3L1	13.045	2.2527
1TGEGA_T1L1	17.44	2.26114
1TGEGA_T2L2	25.27	2.26114
1BNTAY_T1L1	13.55	2.2982
1CURIM_T1L1	2.625	2.33979
1LAOAG_T1L1	11.69	2.35992
1LAOAG_T2L2	11.69	2.35992

Central Luzon Pricing Zone

OFF PEAK	CZP= 0.482	
Nodes < CZP	Load,MW	Nodal Price
1BOTOL_T1L1	6.355	0.47246
1CBNTU_T1L1	26.285	0.47435
1CBNTU_T2L2	26.285	0.47435
1ANGAT_T5L1	8.36	0.47529
1CONCP_T1L1	8.04	0.47549
1CONCP_T2L2	8.04	0.47549
1SUBIC_T3L1	6.325	0.48035
1OLONG_T1L1	14.155	0.48048
1OLONG_T2L2	14.155	0.48048
1OLONG_T3L3	14.155	0.48048
1SNJOS_T1L1	2.95	0.48168
1SNJOS_T1L2	2.95	0.48168
1SNJOS_T2L2	2.95	0.48168

OFF PEAK	CZP= 0.482	
Nodes > CZP	Load,MW	Nodal Price
1T_ASI_T3L1	1.605	0.48216
1T_ASI_T4L1	1.605	0.48216
1T_ASI_T5L1	1.605	0.48216
1HERMO_T1L1	22.305	0.48259
1HERMO_T2L2	22.305	0.48259
1MALOL_T1L1	28.89	0.48272
1MALOL_T2L2	28.89	0.48272
1BTPP_T3L1	21.11	0.48287
1BTPP_T4L1	21.11	0.48287
1BPC_T1L1	0	0.48287
1BPC_T2L2	0	0.48287
1MEXIC_T1L1	27.045	0.48301
1MEXIC_T2L2	27.045	0.48301
1MEXIC_T3L3	27.045	0.48301
1MEXIC_T4L4	27.045	0.48301
1MEXIC_T5L5	27.045	0.48301
1CRUZD_T1L1	37.2	0.48418
1DUHAT_T1L1	96.145	0.48681

PEAK	CZP= 2.421	
Node Name	Load,MW	Nodal Price
1BOTOL_T1L1	8.905	2.34299
1CBNTU_T1L1	36.83	2.36493
1CBNTU_T2L2	36.83	2.36493
1CONCP_T1L1	11.265	2.37394
1CONCP_T2L2	11.265	2.37394
1ANGAT_T5L1	11.71	2.38764
1OLONG_T1L1	19.835	2.4102
1OLONG_T2L2	19.835	2.4102
1OLONG_T3L3	19.835	2.4102
1SUBIC_T3L1	8.865	2.4112
1SNJOS_T1L1	4.13	2.41783
1SNJOS_T1L2	4.13	2.41783

PEAK	CZP= 2.421	
Nodes > CZP	Load,MW	Nodal Price
1T_ASI_T3L1	2.245	2.42109
1T_ASI_T4L1	2.245	2.42109
1T_ASI_T5L1	2.245	2.42109
1HERMO_T1L1	31.25	2.42522
1HERMO_T2L2	31.25	2.42522
1MALOL_T1L1	40.475	2.42531
1MALOL_T2L2	40.475	2.42531
1MEXIC_T1L1	37.89	2.4268
1MEXIC_T2L2	37.89	2.4268
1MEXIC_T3L3	37.89	2.4268
1MEXIC_T4L4	37.89	2.4268
1MEXIC_T5L5	37.89	2.4268

OFF PEAK	CZP= 0.482	
Nodes < CZP	Load,MW	Nodal Price
1SNJOS_T2L2	4.13	2.41783

OFF PEAK	CZP= 0.482	
Nodes > CZP	Load,MW	Nodal Price
1BTPP_T3L1	29.58	2.42748
1BTPP_T4L1	29.58	2.42748
1BPC_T1L1	0	2.42748
1BPC_T2L2	0	2.42748
1CRUZD_T1L1	52.12	2.43476
1DUHAT_T1L1	134.705	2.4527

Metro Manila Pricing Zone

OFF PEAK	CZP= 0.479	
Nodes < CZP	Load, MW	Nodal Price
3ZAPOT_T1L1	169.91	0.47089
3ZAPOT_T2L2	177.55	0.47089
3ZAPOT_T3L3	178.3	0.47089
2SUCAT_T1L1	153.62	0.47454
2SUCAT_T2L2	153.62	0.47454
2SUCAT_T3L3	163.42	0.47454

OFF PEAK	CZP= 0.479	
Nodes > CZP	Load, MW	Nodal Price
1DOLOR_T1L1	127.04	0.48075
1DOLOR_T2L2	108.69	0.48075
1DOLOR_T3L3	182.08	0.48075
1DOLOR_T4L4	113.9	0.48075
2ARANE_T1L1	159.73	0.48351
2ARANE_T2L2	159.73	0.48351
2ARANE_T3L3	159.73	0.48351
2BALNT_T1L1	173.05	0.48355
2BALNT_T2L1	173.05	0.48355
2BALNT_T3L1	173.05	0.48355
1DUHAT_T2L2	96.145	0.48681

PEAK	CZP= 2.394	
Nodes < CZP	Load, MW	Nodal Price
3ZAPOT_T1L1	238.055	2.32853
3ZAPOT_T2L2	248.76	2.32853
3ZAPOT_T3L3	249.815	2.32853
2SUCAT_T1L1	215.22	2.35889
2SUCAT_T2L2	215.22	2.35889
2SUCAT_T3L3	228.965	2.35889

PEAK	CZP= 2.394	
Nodes > CZP	Load, MW	Nodal Price
1DOLOR_T1L1	177.985	2.41337
1DOLOR_T2L2	152.275	2.41337
1DOLOR_T3L3	255.105	2.41337
1DOLOR_T4L4	159.57	2.41337
2ARANE_T1L1	223.795	2.42851
2ARANE_T2L2	223.795	2.42851
2ARANE_T3L3	223.795	2.42851
2BALNT_T1L1	242.455	2.4303
2BALNT_T2L1	242.455	2.4303

OFF PEAK	CZP= 0.479	
Nodes < CZP	Load, MW	Nodal Price

OFF PEAK	CZP= 0.479	
Nodes > CZP	Load, MW	Nodal Price
2BALNT_T3L1	242.455	2.4303
1DUHAT_T2L2	134.705	2.4527

Southern Tagalog Pricing Zone

OFF PEAK	CZP= 0.468	
Nodes < CZP	Load,MW	Nodal Price
3BATAN_T1L1	29.495	0.4573
3BATAN_T2L2	29.495	0.4573
3QPPL_T5L1	0	0.46122
3CLACA_T1L1	15.465	0.46191
3CLACA_T5L2	15.465	0.46191
3TAYAB_T1L1	31.035	0.46292
3MAKBA_T3L1	27.185	0.46466

OFF PEAK	CZP= 0.468	
Nodes > CZP	Load,MW	Nodal Price
3CALAU_T1L1	23.825	0.4682
3CALAU_T2L2	23.825	0.4682
3DASMA_T1L1	107.81	0.46886
3DASMA_T2L2	105.14	0.46886
3CALIR_TAL1	13.425	0.46926
3STROS_T1L1	210.76	0.47072
3GUMAC_T1L1	11.74	0.47097
3BINAN_T1L1	52.355	0.47099
3BINAN_T2L2	57.025	0.47099
3BINAN_T3L3	47.57	0.47099
3KAL_E_T1L1	1.485	0.47374
1MLAYA_T2L1	0	0.47585
1MLAYA_T3L2	0	0.47585
1MLAYA_T4L3	0	0.47585

PEAK	CZP= 2.315	
Nodes < CZP	Load,MW	Nodal Price
3QPPL_T5L1	0	2.23694
3TAYAB_T1L1	43.48	2.25789
3BATAN_T1L1	41.325	2.25802
3BATAN_T2L2	41.325	2.25802
3CLACA_T1L1	21.67	2.2763
3CLACA_T5L2	21.67	2.2763
3MAKBA_T3L1	38.095	2.3023
3DASMA_T1L1	151.045	2.3146
3DASMA_T2L2	147.295	2.3146

PEAK	CZP= 2.315	
Nodes > CZP	Load,MW	Nodal Price
3CALIR_TAL1	18.815	2.3182
3GUMAC_T1L1	16.445	2.32621
3CALAU_T1L1	33.385	2.32693
3CALAU_T2L2	33.385	2.32693
3STROS_T1L1	295.285	2.33179
3BINAN_T1L1	73.35	2.33286
3BINAN_T2L2	79.9	2.33286
3BINAN_T3L3	66.65	2.33286
3KAL_E_T1L1	2.085	2.36572
1MLAYA_T2L1	0	2.38171

OFF PEAK	CZP= 0.468	
Nodes < CZP	Load,MW	Nodal Price

OFF PEAK	CZP= 0.468	
Nodes > CZP	Load,MW	Nodal Price
1MLAYA_T3L2	0	2.38171
1MLAYA_T4L3	0	2.38171

Bicol Region Pricing Zone

OFF PEAK	CZP= 0.464	
Nodes < CZP	Load,MW	Nodal Price
3NAGA_T1L1	36.98	0.46301

OFF PEAK	CZP= 0.464	
Nodes > CZP	Load,MW	Nodal Price
3DARAG_T1L1	20.62	0.46478
3DARAG_T2L2	20.62	0.46478
3LABO_T1L1	9.365	0.46753

PEAK	CZP= 2.23	
Nodes < CZP	Load,MW	Nodal Price
3DARAG_T1L1	28.895	2.22756
3DARAG_T2L2	28.895	2.22756
3NAGA_T1L1	51.805	2.22757

PEAK	CZP= 2.23	
Nodes > CZP	Load,MW	Nodal Price
3LABO_T1L1	13.12	2.2822

Appendix 4 - Price Spread in Congestion Scenario

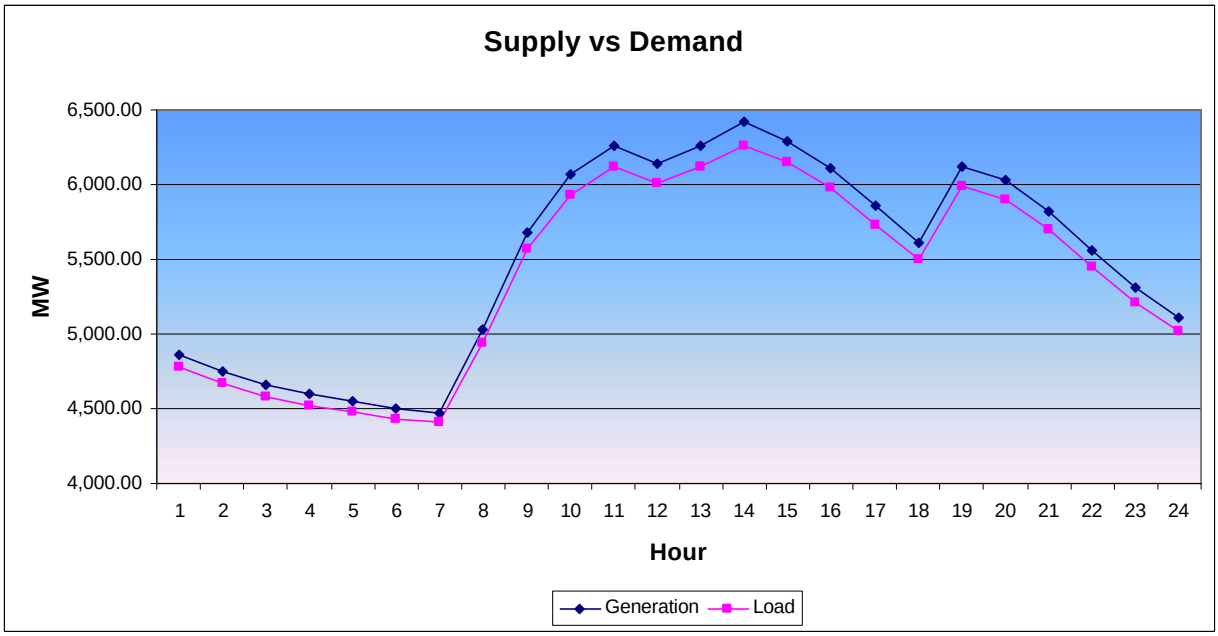
Node Name	Load,MW	Nodal Price
1SUAL_T3L1	23.54	2.181
3QPPL_T5L1	0	2.93597
3TAYAB_T1L1	43.48	2.95691
3DARAG_T1L1	28.895	3.06468
3DARAG_T2L2	28.895	3.06468
3NAGA_T1L1	51.805	3.07041
3LABO_T1L1	13.12	3.2337
3BATAN_T1L1	41.325	3.28729
3BATAN_T2L2	41.325	3.28729
3CLACA_T1L1	21.67	3.28822
3CLACA_T5L2	21.67	3.28822
3DASMA_T1L1	151.045	3.28866
3DASMA_T2L2	147.295	3.28866
3ZAPOT_T1L1	238.055	3.3026
3ZAPOT_T2L2	248.76	3.3026
3ZAPOT_T3L3	249.815	3.3026
3STROS_T1L1	295.285	3.36173
3BINAN_T1L1	73.35	3.36586
3BINAN_T2L2	79.9	3.36586
3BINAN_T3L3	66.65	3.36586
3MAKBA_T3L1	38.095	3.3691
3GUMAC_T1L1	16.445	3.3768
1BCNOT_T1L1	0	3.41965
3CALAU_T1L1	33.385	3.4207
3CALAU_T2L2	33.385	3.4207
1BAUAN_T1L1	18.61	3.42103
1BAUAN_T2L2	18.61	3.42103
2SUCAT_T1L1	215.22	3.43582
2SUCAT_T2L2	215.22	3.43582
2SUCAT_T3L3	228.965	3.43582
1SNEST_T3L1	13.045	3.44345
3CALIR_TAL1	18.815	3.47206
1BNTAY_T1L1	13.55	3.48898
3KAL_E_T1L1	2.085	3.51958

Node Name	Load,MW	Nodal Price
1ANGAT_T5L1	11.71	3.73861
2ARANE_T1L1	223.795	3.74647
2ARANE_T2L2	223.795	3.74647
2ARANE_T3L3	223.795	3.74647
1SNJOS_T1L1	4.13	3.7688
1SNJOS_T1L2	4.13	3.7688
1SNJOS_T2L2	4.13	3.7688
1T_ASI_T3L1	2.245	3.77206
1T_ASI_T4L1	2.245	3.77206
1T_ASI_T5L1	2.245	3.77206
2BALNT_T1L1	242.455	3.79487
2BALNT_T2L1	242.455	3.79487
2BALNT_T3L1	242.455	3.79487
1MALOL_T1L1	40.475	3.85563
1MALOL_T2L2	40.475	3.85563
1DUHAT_T1L1	134.705	3.92917
1DUHAT_T2L2	134.705	3.92917
1HERMO_T1L1	31.25	4.01333
1HERMO_T2L2	31.25	4.01333
1BTPP_T3L1	29.58	4.0156
1BTPP_T4L1	29.58	4.0156
1BPC_T1L1	0	4.0156
1BPC_T2L2	0	4.0156
1CRUZD_T1L1	52.12	4.02225
1SUBIC_T3L1	8.865	4.04508
1OLONG_T1L1	19.835	4.06798
1OLONG_T2L2	19.835	4.06798
1OLONG_T3L3	19.835	4.06798
1MEXIC_T1L1	37.89	4.16586
1MEXIC_T2L2	37.89	4.16586
1MEXIC_T3L3	37.89	4.16586
1MEXIC_T4L4	37.89	4.16586
1MEXIC_T5L5	37.89	4.16586
1BOTOL_T1L1	8.905	4.31536

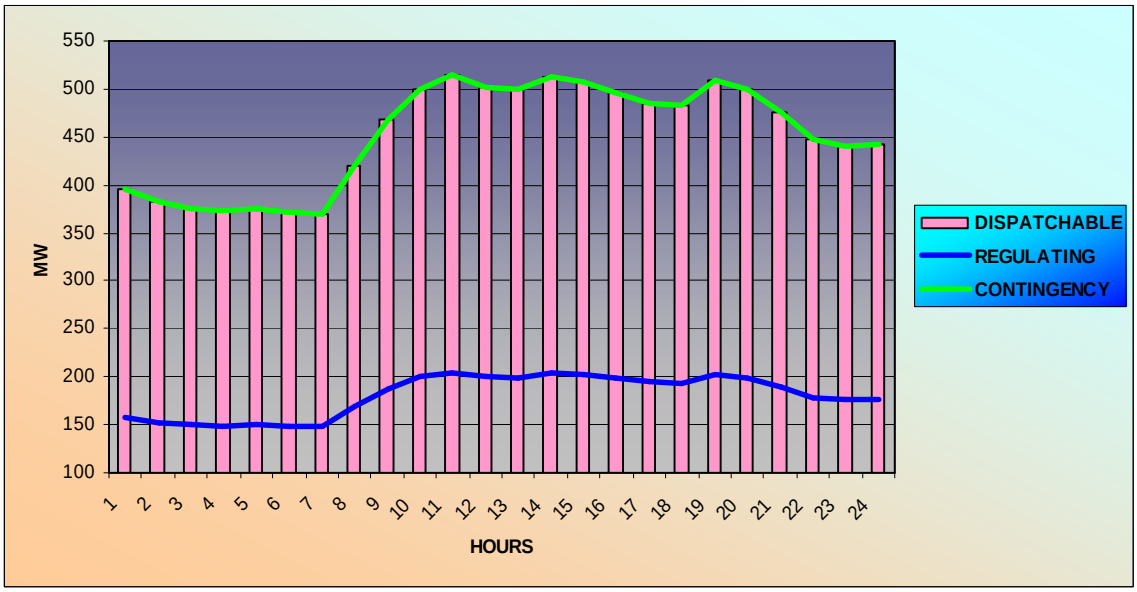
Node Name	Load,MW	Nodal Price
1CURIM_T1L1	2.625	3.53058
1LAOAG_T1L1	11.69	3.55072
1LAOAG_T2L2	11.69	3.55072
1MLAYA_T2L1	0	3.58647
1MLAYA_T3L2	0	3.58647
1MLAYA_T4L3	0	3.58647
1DOLOR_T1L1	177.985	3.69042
1DOLOR_T2L2	152.275	3.69042
1DOLOR_T3L3	255.105	3.69042
1DOLOR_T4L4	159.57	3.69042

Node Name	Load,MW	Nodal Price
1CONCP_T1L1	11.265	4.59183
1CONCP_T2L2	11.265	4.59183
1CBNTU_T1L1	36.83	4.65236
1CBNTU_T2L2	36.83	4.65236
1LBRAD_T1L1	33.97	4.80425
1LBRAD_T2L2	33.97	4.80425
1NSNMN_T1L1	4.23	5.47942
1SNMAN_T1L1	75.095	5.48445
1BINGA_T3L1	11	5.90173
1AMBUK_T1L1	0.405	5.90561
1AMBUK_TAL2	0.405	5.90561
1BYOMB_T1L1	3.48	5.92499
1SNTGO_T1L1	27.96	5.94505
1SNTGO_T2L2	27.96	5.94505
1TGEGA_T1L1	17.44	5.98263
1TGEGA_T2L2	25.27	5.98263
1LATRI_T1L1	55.32	6.04532
1LATRI_T2L2	55.32	6.04532

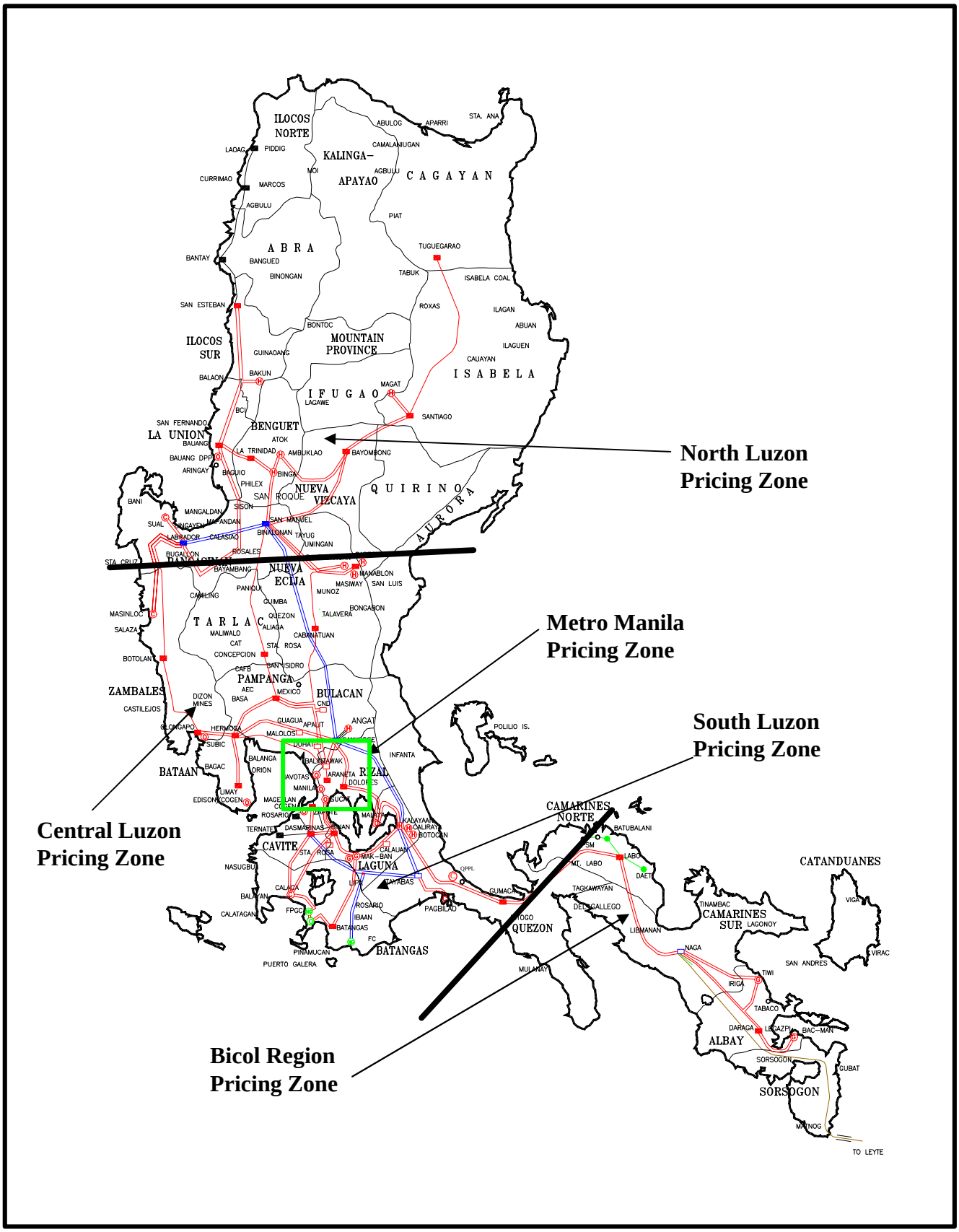
Appendix 5 - Typical High Demand and Supply Curve



Appendix 6- Typical Daily Reserve Curve



Appendix 7 – Luzon Grid Map



Appendix 8 – Load Nodes Per Zone

Zone	Load Node Name
North Luzon	1AMBUK_T1L1
North Luzon	1AMBUK_TAL2
North Luzon	1BAUAN_T1L1
North Luzon	1BAUAN_T2L2
North Luzon	1BCNOT_T1L1
North Luzon	1BINGA_T3L1
North Luzon	1BNTAY_T1L1
North Luzon	1BYOMB_T1L1
North Luzon	1CURIM_T1L1
North Luzon	1LAOAG_T1L1
North Luzon	1LAOAG_T2L2
North Luzon	1LATRI_T1L1
North Luzon	1LATRI_T2L2
North Luzon	1LBRAD_T1L1
North Luzon	1LBRAD_T2L2
North Luzon	1NSNMN_T1L1
North Luzon	1SNEST_T3L1
North Luzon	1SNMAN_T1L1
North Luzon	1SNTGO_T1L1
North Luzon	1SNTGO_T2L2
North Luzon	1SUAL_T3L1
North Luzon	1TGEGA_T1L1
North Luzon	1TGEGA_T2L2
Central Luzon	1ANGAT_T5L1
Central Luzon	1BOTOL_T1L1
Central Luzon	1BPC_T1L1
Central Luzon	1BPC_T2L2
Central Luzon	1BTPP_T3L1
Central Luzon	1BTPP_T4L1
Central Luzon	1CBNTU_T1L1
Central Luzon	1CBNTU_T2L2
Central Luzon	1CONCP_T1L1
Central Luzon	1CONCP_T2L2
Central Luzon	1CRUZD_T1L1
Central Luzon	1DUHAT_T1L1
Central Luzon	1HERMO_T1L1
Central Luzon	1HERMO_T2L2
Central Luzon	1MALOL_T1L1
Central Luzon	1MALOL_T2L2
Central Luzon	1MEXIC_T1L1
Central Luzon	1MEXIC_T2L2
Central Luzon	1MEXIC_T3L3
Central Luzon	1MEXIC_T4L4

Zone	Load Node Name
Central Luzon	1SNJOS_T1L2
Central Luzon	1SNJOS_T2L2
Central Luzon	1SUBIC_T3L1
Central Luzon	1T_ASI_T3L1
Central Luzon	1T_ASI_T4L1
Central Luzon	1T_ASI_T5L1
Metro Manila	1DOLOR_T1L1
Metro Manila	1DOLOR_T2L2
Metro Manila	1DOLOR_T3L3
Metro Manila	1DOLOR_T4L4
Metro Manila	1DUHAT_T2L2
Metro Manila	2ARANE_T1L1
Metro Manila	2ARANE_T2L2
Metro Manila	2ARANE_T3L3
Metro Manila	2BALNT_T1L1
Metro Manila	2BALNT_T2L1
Metro Manila	2BALNT_T3L1
Metro Manila	2SUCAT_T1L1
Metro Manila	2SUCAT_T2L2
Metro Manila	2SUCAT_T3L3
Metro Manila	3ZAPOT_T1L1
Metro Manila	3ZAPOT_T2L2
Metro Manila	3ZAPOT_T3L3
Metro Manila	1MLAYA_T2L1
Metro Manila	1MLAYA_T3L2
Southern Tagalog	1MLAYA_T4L3
Southern Tagalog	3BATAN_T1L1
Southern Tagalog	3BATAN_T2L2
Southern Tagalog	3BINAN_T1L1
Southern Tagalog	3BINAN_T2L2
Southern Tagalog	3BINAN_T3L3
Southern Tagalog	3CALAU_T1L1
Southern Tagalog	3CALAU_T2L2
Southern Tagalog	3CALIR_TAL1
Southern Tagalog	3CLACA_T1L1
Southern Tagalog	3CLACA_T5L2
Southern Tagalog	3DASMA_T1L1
Southern Tagalog	3DASMA_T2L2
Southern Tagalog	3GUMAC_T1L1
Southern Tagalog	3KAL_E_T1L1
Southern Tagalog	3MAKBA_T3L1
Southern Tagalog	3QPPL_T5L1
Southern Tagalog	3STROS_T1L1

Zone	Load Node Name		Zone	Load Node Name
Central Luzon	1MEXIC_T5L5		Southern Tagalog	3TAYAB_T1L1
Central Luzon	1OLONG_T1L1		Bicol Region	3DARAG_T1L1
Central Luzon	1OLONG_T2L2		Bicol Region	3DARAG_T2L2
Central Luzon	1OLONG_T3L3		Bicol Region	3LABO_T1L1
Central Luzon	1SNJOS_T1L1		Bicol Region	3NAGA_T1L1

Appendix 9 – Generator Resources per Zone

Resource Name	Zone	Fuel Type
BAKUN	North Luzon	Hydro
BINGA	North Luzon	Hydro
BPPC	North Luzon	Diesel
MAGAT	North Luzon	Hydro
SAN ROQUE	North Luzon	Hydro
SUAL	North Luzon	Coal
ANGAT	Central Luzon	Hydro
CASECNAN	Central Luzon	Hydro
LIMAY	Central Luzon	Diesel
MASIWAY	Central Luzon	Hydro
MASINLOC	Central Luzon	Coal
PANTABANGAN	Central Luzon	Hydro
SUBIC ENRON	Central Luzon	Diesel
TRANS ASIA	Central Luzon	Diesel
HOPEWELL	Metro Manila	Diesel
BOTOCAN	Southern Tagalog	Hydro
CALACA	Southern Tagalog	Coal
CALIRAYA	Southern Tagalog	Hydro
ILIJAN	Southern Tagalog	Nat Gas
KALAYAAN	Southern Tagalog	Hydro
MALAYA	Southern Tagalog	Diesel
MAKBAN	Southern Tagalog	Geo
MCI	Southern Tagalog	Diesel
ORMAT	Southern Tagalog	Geo
PAGBILAO	Southern Tagalog	Coal
QPPL	Southern Tagalog	Coal
STA RITA	Southern Tagalog	Nat Gas
BACMAN	Bicol Region	Geo
BOTONG	Bicol Region	Hydro
CAWAYAN	Bicol Region	Hydro
TIWI	Bicol Region	Geo

Appendix 10 - Summary Nodes and Load Distribution

Zones	Nodes		% Load Distribution
	Gen	Load	
North Luzon	18	23	7.89%
Central Luzon	37	31	17.38%
Metro Manila	4	17	55.63%
Southern Tagalog	49	21	16.94%
Bicol Region	10	4	2.16%
Total	118	96	100.00%

Appendix 11 – Typical Load Profiles used in Similar Day Load Forecasting for Luzon

Figure 1 Monday Profile

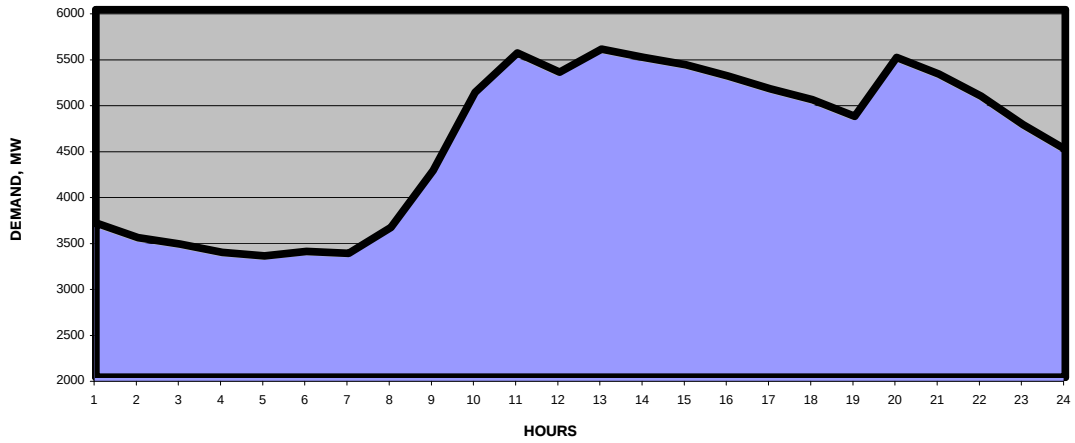


Figure 2 Tuesday- Friday Profile

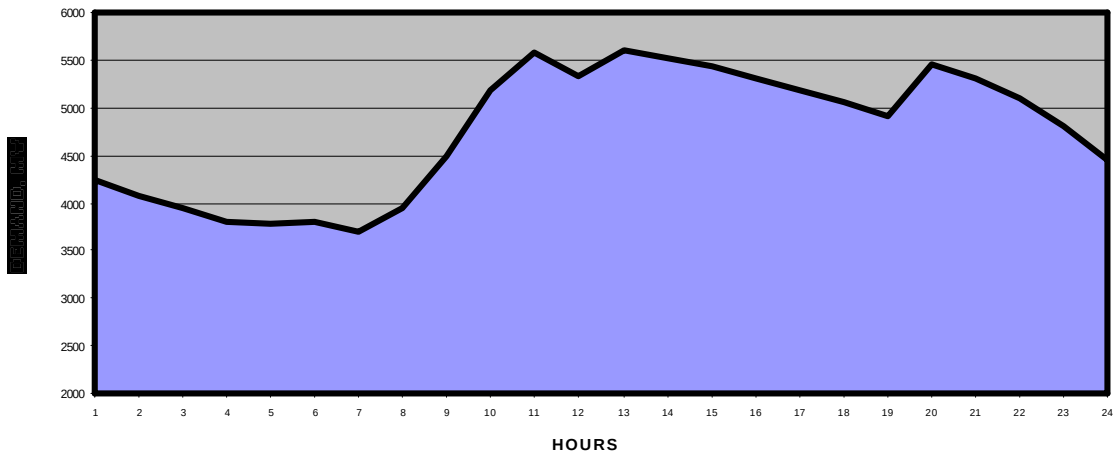


Figure 3 Saturday Profile

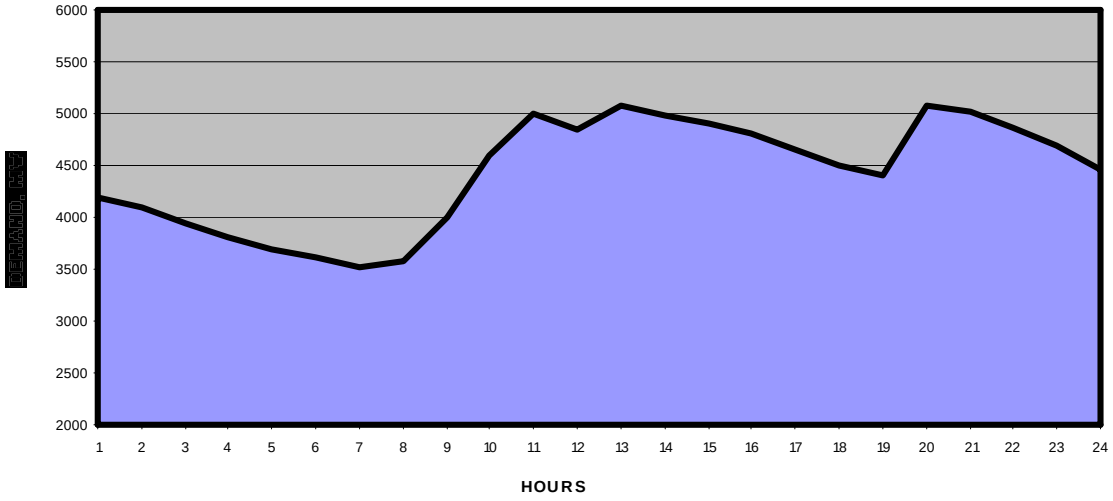


Figure 4 Sunday Profile