| MINUTES OF THE RULES CHANGE COMMITTEE<br>142nd REGULAR MEETING (No. 2018-06) | |
|---|---|
| **Meeting Date & Time:** | 02 July 2018, 9:00 AM to 3:00 PM |
| **Meeting Venue:** | 19/F Conference Room, Robinsons Equitable Tower, Ortigas Center, Pasig City |

**Attendance List**

| In-Attendance | Not In-Attendance |
|---|---|
| **Rules Change Committee**<br><br>***Principal Members:***<br><br>Maila Lourdes G. de Castro, Chairperson – Independent<br>Francisco Leodegario R. Castro, Jr. – Independent<br>Concepcion I. Tanglao – Independent<br>Allan C. Nerves – Independent<br>Abner B. Tolentino – Generation (PSALM)<br>Jose Ildebrando B. Ambrosio – Generation (Northwind)<br>Ciprinilo C. Meneses – Distribution (MERALCO)<br>Jose P. Santos – Distribution (INEC)<br>Ludovico D. Lim – Distribution (ANTECO)<br>Lorreto H. Rivera – Supply (TPEC)<br>Ambrocio R. Rosales – System Operator (NGCP)<br>Isidro E. Cacho – Market Operator (PEMC) | |

**Other attendees:**

**PEMC – Market Assessment Group (MAG)**

Elaine D. Gonzales
Geraldine A. Rodriguez
Bienvenido C. Mendoza
Divine Gayle C. Cruz
Aldjon Kenneth M. Yap

**DOE Observers**

Ferdinand B. Binondo
Ryan Jaspher Villadiego
Francis Oliver P. Bandong

There being a quorum, Chairperson Maila Lourdes G. de Castro called the meeting to order at 9:31 AM.

## 1. Adoption of the Proposed Agenda

The RCC adopted the revised provisional agenda as proposed by the Secretariat.

## 2. Review of the Minutes of the Previous Meeting

| Agreements/Action Plans |
| --- |
| The RCC approved the minutes of the 141st RCC Meeting held on 01 June 2018, as submitted. |

## 3. New Business

### 3.1. PEMC-MAG's Review of the DOE's Concerns on Cross-Grid Power Supply Agreements

During its previous meeting, the RCC requested the PEMC – Market Assessment Group (PEMC-MAG) to initially review the points and concerns raised by the DOE regarding Cross-Grid Power Supply Agreements (PSAs). Mr. Aldjon Kenneth M. Yap presented before the body PEMC-MAG's review, as follows[1]:

1) *Review current Line Rental formula computation if it reflects actual System Line and Loss Congestion charges and provide reasons why some line rental amounts are being credited instead of being debited*

   Mr. Yap stated that WESM Rules Clause 3.13.12 provides line rental trading amount (LRTA) to be calculated as the difference between the nodal prices of the customers and

[1] See Annex A for the presentation slides.


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the generators. Depending on the nodal prices, the LRTA may at some instance, be credited instead of being debited to the customers.

$$TTA_L = EAETA_L + LRTA_L + EPETA_L$$

$$TTA_L = (EAQ_L - BCQ_L)(EAP_L) + (BCQ_L)(EAP_L - EAP_G) + (MQ_L - EAQ_L)(EPP_L)$$

**Where:**

$TTA_L$ - total trading amount of load (customer) L
$EAETA_L$ - ex-ante energy trading amount corresponding to spot quantity of load (customer) L
$LRTA_L$ - line rental trading amount corresponding to BCQ declared for load (customer) L
$EPETA_L$ - ex-post energy trading amount of load (customer) L
$EAQ_L$ - ex-ante quantity of load (customer) L
$BCQ_L$ - bilateral contract quantity declared for load (customer) L
$MQ_L$ - metered quantity of load (customer) L
$EAP_L$ - ex-ante price of load (customer) L
$EAP_G$ - ex-ante price of generator G
$EPP_L$ - ex-post price of load (customer) L

Based on the formula, if the ex-ante price of the generator is higher than that of the customer, then negative LRTA is expected and that amount will be paid to the customer. If the ex-ante price of the generator is lower than that of the customer, then the resulting LRTA will be paid by the customer.

On the inquiry if line loss and congestion charges are reflected in the computation of LRTA, Mr. Yap explained that actual line loss and congestion charges are reflected in the LRTA computation during normal pricing conditions (as reflected in the formula above). But in cases where there is pricing error at ex-ante and price substitution at ex-post, or there is market suspension or intervention, actual line loss and congestion charges are not reflected in the line rental calculation since market prices are generated based on either previous prices in the market or other applicable methodologies (e.g., administered price), as the case may be.

Mr. Yap continued that in case of price substitution during ex-ante, no line rental trading amount can be calculated since the price for that specific interval will only be pro-rated to the metered quantity of each customer during the trading interval, which means that no difference can be calculated between the nodes of customers and the generators.

In cases of cross-region bilateral contract quantity declaration (across Luzon and Visayas), Mr. Yap showed that line loss and congestion cannot be reflected in the LRTA if Luzon and Visayas have different pricing conditions.

2) *Identify existing cross-grid Power Supply Agreements*

Mr. Yap presented that based on BCQ declarations in the WESM, there are 4 Luzon Distribution Utilities (DUs) and 13 Visayas DUs which have cross-grid power supply agreements.

3) *What is the material effect of cross-grid bilateral contract between the load and generator?*

Mr. Yap continued by presenting the result of PEMC-MAG's simulation to determine the effect of zonal price differences on LRTA. He explained that PEMC-MAG calculated the difference in prices of generators and DUs from different zones using the actual data from January 2017 to May 2018. The nodal prices used were the monthly average nodal prices for each zone (North Luzon, South Luzon, Leyte-Samar, Cebu, Negros and Panay). 1 MWH of BCQ was used for the simulation for a North Luzon customer with supply coming from other zones, and similarly for a Leyte-Samar customer with supply coming from other zones. The result of the simulation showed an approximate monthly LRTA per 1 MWH of cross-grid BCQ for each zone.

Based on the simulation, it was observed that significant nodal price differences between Luzon and Visayas occur when the limit of high-voltage direct current (HVDC) cable is maximized, restricting the flow of power from Visayas to Luzon and results to price separation between Luzon and Visayas. Consequently, the LRTA for Luzon customers would be significantly high, while Visayas customers would be settled at extreme negative prices. Mr. Bienvenido C. Mendoza, Jr. (PEMC-MAG) further clarified that the simulation is based on the premise that bilateral contracts are merely settled "on paper", so even if HVDC is not operational and there is no actual physical flow across Visayas to Luzon and vice-versa, cross-grid bilateral contracting can still be settled in the market.

In summary:

- Without High-Voltage Direct Current (HVDC) Cable constraints, there would be minimal differences in the line rental trading amounts (LRTA) among customers with or without cross-grid bilateral contracts.

- With HVDC cable constraints, the LRTAs for customers with cross-grid PSAs are affected as follows:

| Flow of HVDC | Effects in LRTA |
|---|---|
| Luzon to Visayas | minimal effect due to minimal times that this flow occurs in the system |
| Visayas to Luzon | For Luzon Customers: **High LRTA** |
| | For Visayas Customers: **Negative LRTA** |

Mr. Yap added PEMC-MAG's assessment that bilateral contracting with line rental, whether cross-grid or not, ensures a stable price for customers' electricity requirement since they are shielded from the volatility of spot market prices.

Following the presentation, Ms. Lorreto H. Rivera (TeaM Energy) commented that whoever pays the line rental, whatever amount it may be as it is market-driven, depends on the terms of the contract between the generator and the customer. A DU for instance can easily compute for line rental using historical, or sometimes even projected data, which it could take into consideration before entering into a contract. A generator or customer should therefore not be restricted in entering into power supply contracts regardless whether they are cross-grid or not, since both parties would have already negotiated who and by how much one party pays for the line rental amounts.

4) *What is the line rental rate/charges imposed to the 167 MW Coal-fired Power Plant in Iloilo City, Panay?*

Mr. Yap informed the RCC that the information is confidential and PEMC-MAG will simply provide the data directly to the DOE.

5) *How does the line rental amount affect the paying consumers?*

Mr. Yap explained that the details of the PSAs are needed to accurately evaluate the effect of line rental to the end-users.

6) *Is there a need to examine ERC's methodology in the approval of cross-grid PSAs?*

PEMC-MAG opined that RCC may not be the proper body to examine the ERC's methodology.

7) *What must be the advantage to bid at negative cap (-10,000 Php/MW) for a typical generation company trader?*

If the offered quantity is covered by contracts, Mr. Yap stated that this bidding strategy is done to ensure dispatch of the power plant, especially when covered by contracts.

8) *Is there a need for WESM Rules Change?*

Upon further assessment, PEMC-MAG deemed that there may be no need to amend the current provisions on line rental calculations in the WESM Rules. However, a review on the price substitution mechanism application may be undertaken as a mitigating measure for large line rental amounts. Also, the problems in the notable differences of prices between two grids may be addressed by upgrading the HVDC interconnection.

There being no other matters left for discussion, the RCC requested the Secretariat to draft an RCC report for submission to the PEM Board and the DOE, for the Committee's review in the next meeting. In addition, a related presentation will be prepared for the PEM Board.

| **Agreements/Action Plans** |
|---|
| a) The RCC will submit a report to the PEM Board and the DOE based on PEMC-MAG's review and assessment.<br>b) The RCC will subsequently present its report to the PEM Board. |

### 3.2. Presentation on Negative Line Rental Amount, Cross-grid Energy Flows and Other WESM Peculiarities in Aid of Revision and/or Creation of WESM Rules

In view of the concerns raised by the DOE during the previous RCC meeting, Mr. Ciprinilo C. Meneses (MERALCO) requested the inclusion in the agenda of MERALCO's presentation on *Negative Line Rental Amount, Cross-grid Energy Flows and Other WESM Peculiarities in Aid of Revision and/or Creation of WESM Rules*[2] for the Committee's appreciation of the fundamental concepts and basis for calculating the line rental trading amounts in the WESM.

Before proceeding with his presentation, Mr. Meneses clarified that MERALCO has long been taking into account line rental amounts as one of the criteria in the selection of Power Supply Agreement it enters, particularly in determining which supplier offers the least cost. He added that MERALCO calculates line rental amounts through PEMC's provision of nodal prices for each node in Luzon and Visayas. Mr. Meneses stated that line rental amount should be

[2] See Annex B for the full presentation.

included as a variable in accurately comparing supply between WESM and through bilateral contracts as the latter always have accompanying line rental amounts. In MERALCO's case, he informed that it imposes a cap on line rental charges that it will shoulder and any excess will be absorbed by the generator, hence MERALCO customers are shielded from high line rental charges. All of these is to say that the DUs have already managed the effects of line rental charges.

*A. Introduction and Review of Basic Principles*

As a review of the basic concept of line rental, Mr. Meneses offered a more appropriate definition of "line rental" as: *"the cost of electricity that was used in transmitting a certain volume of electricity (the bilateral contract quantity or BCQ) from a particular generator node to a particular customer node."* This means that a customer will not receive the full volume of energy produced by a generator due to transmission losses. Without the generator buying from the WESM, a generator can either declare as BCQ for its customer the difference between energy generated and the transmission loss, or generate additional energy on top of the required quantity to account for the transmission loss. As a rule, line losses increase, the farther energy moves along the transmission line.

Mr. Meneses explained that line rental is necessary because it serves as an instrument to balance energy generated and sold, taking into account the location of a customer in the grid relative to the location of the generator supplying the energy.

However, in a multi-generator system, Mr. Meneses explained that transmission losses can no longer be attributable to a single generator-customer pair, thus line rental cannot be easily calculable. This is because a customer does not necessarily receive its energy requirement from its generator counter-part given the fact that electrons flow from generator to load centers irrespective of whoever the parties are to a bilateral contract. This is where generator and customer nodal prices come in, wherein each nodal price is determined by the price of the marginal generator and line losses. The difference between a particular customer nodal price and a particular generator nodal price is equivalent to the rate of line rental. In general, the closer a customer is located relative to the marginal generator, the lower the line rental cost is.

*B. Do Negative Line Rentals Make Sense?*

As for the occurrence of negative line rental, Mr. Meneses expounded that this is a result of the contractual flow of power moving in reverse relative to power flow coming from the marginal generator. From an engineering analysis, power flowing from opposite directions cancels out the line current thereby decreasing line loss as well. Negative line rental reduces the transmission line loss of the entire system. Essentially, negative line rental occurs when the customer in a bilateral contract happens to be nodally closer to the marginal generator

rather than from its generator counter-part. Mr. Meneses added that negative line rental naturally occurs since theoretically in every interval, the location of the marginal generator changes.

Mr. Meneses proceeded to show examples where positive and negative line rental amounts always match the cost of energy accounting for both line losses, and bilateral contract quantities plus line losses. He then stated his observation that "line rental may yet be the best method for costing line losses, as other options are just as problematic…"

*C. How Line Rental is Used by DUs for Initial Evaluation of Generator Offers*

As for how the DUs use line rental, Mr. Meneses reiterated that DUs use it as "an important criterion for evaluating PSA proposals from prospective power suppliers, thereby helping DUs meet their mandate of ensuring least-cost of power to its customers." For instance, although a prospective renewable energy supplier does not have VAT as a component of its all-in rates at delivery, it may still lose out from a prospective conventional power plant if the former's average line rental is high due to its plant's location.

*D. How the WESM Makes Cross-Grid Energy "Flows" Possible*

Mr. Meneses proceeded to explain that the WESM serves as a "virtual energy reservoir into which generators can inject energy, and from which customer can draw energy, while maintaining supply-demand balances in both [Luzon and Visayas] grids". This makes it possible for a Visayas generator to declare BCQ for a Luzon customer even if the HVDC line is out and no physical flow of power occurs between the grids. He also stated that "cross-grid energy flows benefit consumers because they can avail of bilaterally-contracted energy that is cheaper than energy sourced from the spot market."

*E. What Forces Generators to Offer Negative Prices?*

Mr. Meneses stated that due to the proliferation of renewable energy (RE) generators which are prioritized for dispatch, generators with conventional plants now have a small window of energy demand for which they must compete to be dispatched and fulfill. He also explained that conventional generators cannot fully maximize their plants' generation capacity because of the insufficient transmission capacity in an island grid and of the HVDC where power flows toward other island grids. Because of these constraints, "non-RE plants must compete for constrained dispatch by offering the lowest possible offer price, -P10/kwh, to increase probability of dispatch." Mr. Meneses raised that if all of them offered at negative price resulting to a negative clearing price, all the financial flows will still be balanced courtesy of line rental but the line rental amount to be borne by certain customers would be very high. This is

especially true for the line rental between a generator in the area where the negative prices cleared and its bilaterally-contracted customer. In the situation presented, Mr. Meneses stated that line rental is not the problem, but it is the establishment of too many RE plants in an island that exceeds the export capacity of transmission facilities.

Following the presentation and with the permission of Mr. Meneses, the RCC agreed to attach the said presentation to the RCC report that will officially be submitted to the DOE and the PEM Board.

| **Agreements/Action Plans** |
| --- |
| The RCC report to be submitted to the PEM Board and the DOE will include MERALCO's presentation. |

## 4. Other Matters

### 4.1. Extension of Commenting Period for the Proposed Amendments to the WESM Penalty Manual

The Secretariat informed the body that the commenting period for the proposed amendments to the WESM Penalty Manual was extended until 18 July 2018 from the original deadline of 06 July 2018 to coincide with the deadline of submission of comments to the additional proposed amendments to the WESM Rules, Market Surveillance Manual and the proposed new Enforcement and Compliance Manual which have provisions related to those in the Penalty Manual.

The RCC noted the information.

### 4.2. Elected PEM Board of Directors

The Secretariat informed the RCC that a new set of PEM Board of Directors was elected on 25 June 2018 during the Annual PEMC Membership Meeting. Likewise, the PEM Board convened on 27 June 2018 to elect the PEM Board Chairperson, PEM Board Treasurer, PEMC President and the Chief Governance Officer. The names of the new PEM Board Directors are in the list below:

| NAME | SECTOR | POSITION |
|---|---|---|
| Aboboto, Noel V. | Supply | Chairman & Director |
| Ala, Oscar E. | Independent | President & Director |
| Go, Elenita D. | Generation | Treasurer & Director |
| Tan, Rauf A. | Independent | Chief Governance Officer & Director |
| Arranza, Jesus | Independent | Director |
| Wallace, Peter | Independent | Director |
| Roxas, Juan Eugenio | Generation | Director |
| Rubio, Emmanuel | Generation | Director |
| Santos, Victor Emmanuel | Generation | Director |
| Agdigos, Felino Herbert | Distribution | Director |
| Cagampan, Rolando | Distribution | Director |
| Laniba, Allan | Distribution | Director |
| Pagobo, Gilbert | Distribution | Director |
| Concepcion, Ronald Dylan | Transmission/ System Operator | Director |
| Juan, Francis Saturnino | Market Operator | Director |

Mr. Isidro C. Cacho, Jr., on the other hand, informed the RCC of the names of the appointed board of directors for the Independent Electricity Market Operator of the Philippines, as follows:

| NAME | POSITION |
|---|---|
| Villanueva, Ralph A. | Chairman & Director |
| Juan, Francis Saturnino | President & Director |
| Nethercott, Richard J. | Treasurer & Director |
| Bigornia, Jose Mari T. | Chief Operating Officer & Director |
| Tang, Carroll U. | Corporate Secretary & Director |
| Porto, Vicente M. | Director |
| Mangulabnan, Jose Rodelio V. | Director |

The RCC noted the Secretariat's update.

### 4.3. Proposals Promulgated by the DOE

The Secretariat informed the RCC that the Proposed Amendments to the WESM Rules and Dispute Resolution Manual regarding Arbitration and Mediation Procedures, which were previously approved by the RCC on two separate occasions in 2016 and 2017, have already been promulgated by the DOE through Department Circular No. 2018-05-0016 - *Adopting Further Amendments to the Wholesale Electricity Spot Market (WESM) Rules and Market Manual on Dispute Resolution* dated 18 May 2018.

The RCC noted the Secretariat's update.

## 5. Next Meeting

The RCC agreed to hold subsequent meetings on the following schedules:

- **03 August 2018**
- **07 September 2018**
- **05 October 2018**

## 6. Adjournment

There being no other matters for discussion, the meeting was adjourned at 1:36 PM.

| Prepared By: | Reviewed By: | Noted By: |
|---|---|---|
| **Divine Gayle C. Cruz** | **Geraldine A. Rodriguez** | **Elaine D. Gonzales** |
| ***Analyst*** *– Market Governance Administration Unit* | ***Assistant Manager*** *– Market Governance Administration Unit* | ***Manager*** *– Market Data and Analysis Division* |
| ***Market Assessment Group*** | ***Market Assessment Group*** | ***Market Assessment Group*** |

Philippine Electricity Market Corporation

RCC-MIN-18-06_142
06 July 2018

| | |
|---|---|
| Approved by:<br>RULES CHANGE COMMITTEE<br>**Maila Lourdes G. de Castro**<br>Chairperson<br>Independent | |
| Members: | |
| **Concepcion I. Tanglao**<br>Independent | **Francisco L.R. Castro, Jr.**<br>Independent |
| **Allan C. Nerves**<br>Independent | **Isidro E. Cacho, Jr.**<br>Market Operator<br>Philippine Electricity Market Corporation (PEMC) |
| **Ambrocio R. Rosales**<br>Transmission Sector<br>National Grid Corporation of the Philippines (NGCP) | **Abner B. Tolentino**<br>Generation Sector<br>Power Sector Assets and Liabilities Management Corporation (PSALM) |
| **Jose Ildebrando B. Ambrosio**<br>Generator Sector<br>NorthWind Power Development Corp. (NorthWind) | **Ciprinilo C. Meneses**<br>Distribution Sector (PDU)<br>Manila Electric Company (MERALCO) |
| **Jose P. Santos**<br>Distribution Sector (EC)<br>Ilocos Norte Electric Cooperative, Inc. (INEC) | **Ludovico D. Lim**<br>Distribution Sector (EC)<br>Antique Electric Cooperative, Inc. (ANTECO) |
| **Lorreto H. Rivera**<br>Supply Sector<br>TeaM (Philippines) Energy Corporation (TPEC) | |

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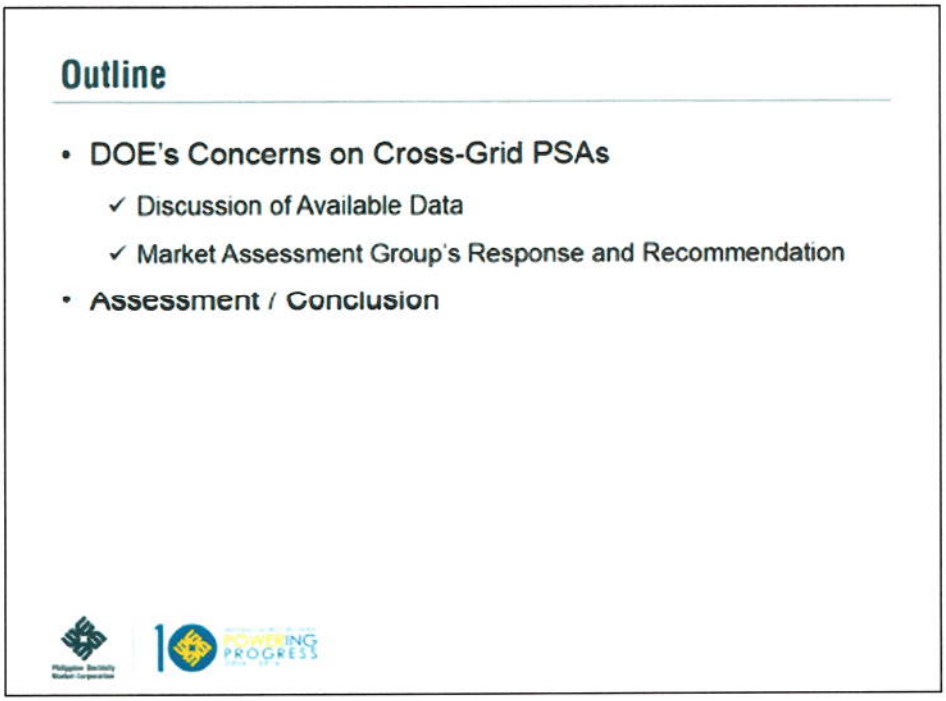
**ANNEX A**

**PEMC-MAG's Presentation Regarding DOE's Concerns on Cross-Grid PSAs**

## DOE's Concerns on Cross-Grid PSAs

- **Review Current Line Rental Formula Computation if it reflects Actual System Line and Loss Congestion Charges and Provide reasons why some line rental amounts are being credited instead of being debited**
- **Identify Existing Cross-Grid PSAs**
- **What is the material effect of cross-grid bilateral contract between the load and generator?**

## How is Line Rental Trading Amount Calculated?

**Normal (Ex-ante) - Based on Ex-ante Prices**

$$TTA_L = EAETA_L + LRTA_L + EPETA_L$$

$$TTA_L = (EAQ_L - BCQ_L)(EAP_L) + (BCQ_L)(EAP_L - EAP_G) + (MQ_L - EAQ_L)(EPP_L)$$

**Where:**

- $TTA_L$ - total trading amount of load (customer) L
- $EAETA_L$ - ex-ante energy trading amount corresponding to spot quantity of load (customer) L
- $LRTA_L$ - line rental trading amount corresponding to BCQ declared for load (customer) L
- $EPETA_L$ - ex-post energy trading amount of load (customer) L
- $EAQ_L$ - ex-ante quantity of load (customer) L
- $BCQ_L$ - bilateral contract quantity declared for load (customer) L
- $MQ_L$ - metered quantity of load (customer) L
- $EAP_L$ - ex-ante price of load (customer) L
- $EAP_G$ - ex-ante price of generator G
- $EPP_L$ - ex-post price of load (customer) L

## How is Line Rental Trading Amount Calculated?

### PEN (Ex-ante), Normal/MRR (Ex-post) - Based on Ex-post/MRR Prices

$$TTA_L = (EAQ_L - BCQ_L)(EAP_L) + (BCQ_L)(EAP_L - EAP_G) + (MQ_L - EAQ_L)(EPP_L)$$

Let $EAQ_L = MQ_L$, $EAP_L = EPP_L$, $EAP_G = EPP_G$

$$TTA_L = (MQ_L - BCQ_L)(EPP_L) + (BCQ_L)(EPP_L - EPP_G)$$

**Where:**

- $TTA_L$ - total trading amount of load (customer) L
- $BCQ_L$ - bilateral contract quantity declared for load (customer) L
- $MQ_L$ - metered quantity of load (customer) L
- $EPP_L$ - ex-post or market re-run price of load (customer) L
- $EPP_G$ - ex-post or market re-run price of generator G


## How is Line Rental Trading Amount Calculated?

### PEN (Ex-ante), PSM (Ex-post) - Based on Substituted Ex-post Prices

$$TTA_L = (EAQ_L - BCQ_L)(EAP_L) + (BCQ_L)(EAP_L - EAP_G) + (MQ_L - EAQ_L)(EPP_L)$$

Let $EAQ_L = MQ_L$, $EAP_L = EPP_{Lsub}$, $EAP_G = EPP_{Gsub}$

$$TTA_L = (MQ_L - BCQ_L)(EPP_{Lsub}) + (BCQ_L)(EPP_{Lsub} - EPP_{Gsub})$$

**Where:**

- $TTA_L$ - total trading amount of load (customer) L
- $BCQ_L$ - bilateral contract quantity declared for load (customer) L
- $MQ_L$ - metered quantity of load (customer) L
- $EPP_{Lsub}$ - substituted ex-post price (load reference price) of load (customer) L
- $EPP_{Lsub}$ - substituted ex-post price (constrained-on and unconstrained) of generator G

## How is Line Rental Trading Amount Calculated?

### PSM (Ex-ante), Normal (Ex-post) - No Line Rental

$$TTA_L = \left|\sum EAETA_G\right|\left|\frac{MQ_L}{\sum MQ_L}\right| + \left|\sum (BCQ_G \times EAP_{Gsub})\right|\left|\frac{MQ_L}{\sum MQ_L} - \frac{BCQ_L}{\sum BCQ_L}\right| + (MQ_L - EAQ_L)(EPP_L)$$

**Where:**

- $TTA_L$ - total trading amount of load (customer) L
- $EAETA_G$ - ex-ante energy trading amount corresponding to spot quantity of generator G
- $EAQ_L$ - ex-ante quantity of load (customer) L
- $BCQ_L$ - bilateral contract quantity declared for load (customer) L
- $BCQ_G$ - bilateral contract quantity declared for generator G
- $MQ_L$ - metered quantity of load (customer) L
- $EAP_{Gsub}$ - substituted ex-ante price (constrained-on and unconstrained) of generator G
- $EPP_L$ - ex-post price of load (customer) L

## How is Line Rental Trading Amount Calculated?

### Market Intervention/Suspension - Based on Administered Prices

$$TTA_L = (EAQ_L - BCQ_L)(EAP_L) + (BCQ_L)(EAP_L - EAP_G) + (MQ_L - EAQ_L)(EPP_L)$$

Let $EAQ_L = MQ_L$, $EAP_L = AP_L$, $EAP_G = AP_G$

$$TTA_L = (MQ_L - BCQ_L)(AP_L) + (BCQ_L)(AP_L - AP_G)$$

$$AP_L = \frac{\sum (MQ_G \times AP_G)}{\sum MQ_L}$$

**Where:**

- $TTA_L$ - total trading amount of load (customer) L
- $BCQ_L$ - bilateral contract quantity declared for load (customer) L
- $MQ_L$ - metered quantity of load (customer) L
- $MQ_G$ - metered quantity of generator G
- $AP_L$ - administered price for load (customer) L
- $AP_G$ - administered price of generator G

## Line Rental Reflects Line Loss and Congestion?

### Same Pricing Condition in Luzon and Visayas

**Intra-region and cross-region BCQ declaration**

| Pricing Condition in Both Regions | | Prices Used for Line Rental | Line Rental Reflects Line Loss and Congestion Cost? |
|---|---|---|---|
| Ex-ante | Ex-post | | |
| OK | Any condition* | Ex-ante prices | Yes |
| PEN | OK | Ex-post prices | Yes |
| | PEN | Re-run prices | Yes |
| | PSM | PSM-substituted prices during Ex-post | No |
| PSM | Any condition* | | No line rental |
| Intervention/ Suspension | | Administered prices | No |

**Note:** * pricing condition may not be the same both regions

## Line Rental Reflects Line Loss and Congestion?

### Different Pricing Condition in Luzon and Visayas

**Intra-region BCQ declaration**

| Pricing Condition in One Region | | Prices Used for Line Rental | Line Rental Reflects Line Loss and Congestion Cost? |
|---|---|---|---|
| Ex-ante | Ex-post | | |
| OK | Any condition | Ex-ante prices | Yes |
| PEN | OK | Ex-post prices | Yes |
| | PEN | Re-run prices | Yes |
| | PSM | PSM-substituted prices during Ex-post | No |
| PSM | Any condition | | No line rental |
| Intervention/ Suspension | | Administered prices | No |

# Line Rental Reflects Line Loss and Congestion?

## Different Pricing Condition in Luzon and Visayas

### Cross-region BCQ declaration

| Pricing Condition in Each Region | | Prices Used for Line Rental (Intra-region BCQ) | Line Rental Reflects Line Loss and Congestion Cost? |
|---|---|---|---|
| Ex-ante | Ex-post | | |
| Luz (PEN), Vis (PEN) | Luz (OK), Vis (PEN) | Luz (Ex-post), Vis (Re-run) | No |
| | Luz (OK), Vis (PSM) | Luz (Ex-post), Vis (PSM Ex-post) | No |
| | Luz (PSM), Vis (PEN) | Luz (PSM Ex-post), Vis (Re-run) | No |
| Luz (OK), Vis (PEN) | Luz (Any), Vis (OK) | Luz (Ex-ante), Vis (Ex-post) | No |
| | Luz (Any), Vis (PEN) | Luz (Ex-ante), Vis (Re-run) | No |
| | Luz (Any), Vis (PSM) | Luz (Ex-ante), Vis (PSM Ex-post) | No |
| Luz (OK), Vis (PSM) | Luz (Any), Vis (Any) | Luz (Ex-ante), Vis (PSM Ex-ante) | No |
| Luz (OK), Vis (AP) | Luz (Any) | Luz (Ex-ante), Vis (AP) | No |
| Luz (PEN), Vis (AP) | Luz (OK) | Luz (Ex-post), Vis (AP) | No |
| | Luz (PEN) | Luz (Re-run), Vis (AP) | No |
| | Luz (PSM) | Luz (PSM Ex-post), Vis (AP) | No |

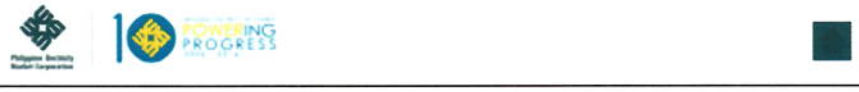
# Line Rental Reflects Line Loss and Congestion?

## Same Pricing Condition in Luzon and Visayas

| Pricing Condition | | Prices Used for Line Rental | 2017 | | | | | | | | | | | | 2018 | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ex-ante | Ex-post | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | |
| OK | Any condition | Ex-ante | 443 | 458 | 311 | 538 | 495 | 513 | 167 | 420 | 505 | 470 | 571 | 494 | 504 | 519 | 582 | 498 | 512 | 7,698 |
| PEN | OK | Ex-post | 5 | 8 | 2 | | 4 | 10 | 1 | 1 | 2 | 11 | 1 | 8 | 10 | 1 | 1 | 28 | 5 | 102 |
| | PEN | Re-run | 5 | 11 | | | 10 | 9 | 6 | | 1 | 10 | 19 | 11 | 1 | | 2 | 5 | 8 | 98 |
| | PSM | PSM Ex-post | 1 | 8 | 2 | 4 | 5 | 5 | 10 | | 1 | 16 | 5 | | 2 | 3 | 2 | 8 | 5 | 75 |
| PSM | Any condition | | 45 | 128 | 152 | 224 | 168 | 201 | 70 | | 152 | 201 | 152 | 182 | 97 | 217 | 265 | 189 | 161 | 2,540 |
| AP | | AP | | | | | | | | | 5 | | | 7 | | | | 2 | | 14 |
| | | | 495 | 613 | 467 | 566 | 682 | 736 | 254 | 421 | 644 | 708 | 730 | 702 | 714 | 740 | 652 | 730 | 691 | 10,525 |

## Line Rental Reflects Line Loss and Congestion?

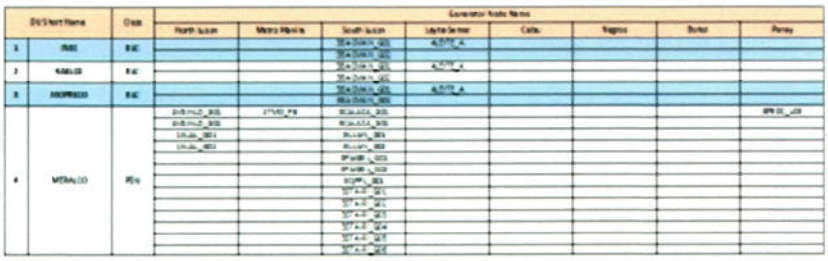
### Different Pricing Condition in Luzon and Visayas





## Luzon DUs with Cross-region Bilateral Contract

### As of May 2018 Billing



# Visayas DUs with Cross-region Bilateral Contract

## As of May 2018 Billing

| | DU Short Name | Class | Generator Node Name | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | North Luzon | Metro Manila | South Luzon | Leyte-Samar | Cebu | Negros | Bohol | Panay |
| 1 | | EC | | | | | | | | |
| 2 | | EC | | | | | | | | |
| 3 | | EC | | | | | | | | |
| 4 | | EC | | | | | | | | |
| 5 | | EC | | | | | | | | |
| 6 | | EC | | | | | | | | |
| 7 | | EC | | | | | | | | |
| 8 | | EC | | | | | | | | |
| 9 | | EC | | | | | | | | |
| 10 | | EC | | | | | | | | |
| 11 | | EC | | | | | | | | |
| 12 | | PDC | | | | | | | | |
| 13 | | PDC | | | | | | | | |

# Impact of Cross-grid Bilateral Contract

## Simulated Line Rental Based on Zonal Price Differences

### 1 MWH BCQ of N. Luzon customer with generator in other zones

| Month | Trading Intervals | Line Rental Amount (PhP) | | | | | | Frequency of Constraints | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Generator Zones | | | | | | Leyte-Luzon | | | Leyte-Cebu | Cebu-Negros | Negros-Panay |
| | | North Luzon | South Luzon | Leyte-Samar | Cebu | Negros | Panay | Not Available | Maximized | | | | |
| | | | | | | | | | Luzon | Visayas | | | |
| Jan 2017 | 445 | 9,115 | 1,430 | 728,596 | 726,004 | 723,781 | 720,407 | 27 | 341 | | 1 | 20 | |
| Feb 2017 | 458 | 16,511 | 1,871 | 446,587 | 428,488 | 549,099 | 549,312 | | 287 | | | 55 | 7 |
| Mar 2017 | 311 | 7,909 | 16,001 | 466,290 | 446,648 | 521,180 | 518,535 | 1 | 260 | | | 32 | |
| Apr 2017 | 538 | 8,470 | 22,361 | 251,830 | 247,078 | 324,615 | 317,938 | | 185 | | | 48 | 1 |
| May 2017 | 466 | 11,026 | 48,641 | 101,890 | 38,735 | 46,113 | (5,503) | 8 | 12 | | 12 | 36 | 4 |
| Jun 2017 | 513 | 9,410 | 51,719 | 33,456 | 2,341 | 135,024 | 179,051 | 2 | 2 | | 4 | 68 | 29 |
| Jul 2017 | 187 | 2,830 | 14,673 | 11,999 | (9,737) | 35,604 | 35,472 | | | | 4 | 22 | 2 |
| Aug 2017 | 420 | 11,847 | 23,474 | 473,161 | 451,001 | 645,026 | 634,568 | 420 | | | | 51 | 8 |
| Sep 2017 | 508 | 13,240 | 42,420 | 128,174 | 112,155 | 283,637 | 361,106 | 227 | 1 | 4 | | 51 | 13 |
| Oct 2017 | 470 | 15,258 | 43,226 | 14,860 | (12,728) | 114,147 | 206,669 | | 1 | | | 36 | 27 |
| Nov 2017 | 571 | 20,273 | 69,994 | 38,083 | 48,388 | 94,166 | 61,593 | | 4 | 5 | | 17 | |
| Dec 2017 | 494 | 19,654 | 34,910 | 37,240 | 9,702 | 76,121 | 61,921 | | | 14 | 1 | 18 | 1 |
| Jan 2018 | 604 | 24,994 | 44,488 | 7,800 | (9,108) | 68,576 | 26,932 | | | 41 | | 29 | |
| Feb 2018 | 519 | 16,135 | 38,415 | (10,945) | (18,212) | 180,981 | 184,748 | | 8 | | 1 | 81 | 18 |
| Mar 2018 | 382 | 12,026 | 45,676 | (22,443) | (16,344) | 206,780 | 268,115 | | 11 | | | 66 | 16 |
| Apr 2018 | 498 | 16,572 | 47,080 | 57,415 | (5,387) | 103,901 | 64,474 | | 14 | | 6 | 19 | |
| May 2018 | 512 | 13,655 | 47,388 | 47,916 | 62,299 | 28,325 | 14,752 | | 1 | | 18 | 5 | 4 |
| Total | 7,698 | 224,705 | 593,775 | 2,841,513 | 2,525,413 | 4,135,057 | 4,203,493 | | | | | | |

Notes:

- Hourly line rental calculated as the difference between North Luzon customer average price and generator average price
- The table covers trading intervals with normal ex-ante market result for Luzon and Visayas

# Impact of Cross-grid Bilateral Contract

## Simulated Line Rental Based on Zonal Price Differences

### 1 MWH BCQ of Leyte-Samar customer with generator in other zones

| Month | Trading Intervals | Line Rental Amount (PhP) | | | | | | Frequency of Constraints | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Generator Zones | | | | | | Leyte-Luzon | | | Leyte-Cebu | Cebu-Negros | Negros-Panay |
| | | North Luzon | South Luzon | Leyte-Samar | Cebu | Negros | Panay | Not Available | Maximized | | | | |
| | | | | | | | | | Luzon | Visayas | | | |
| Jan 2017 | 445 | (726,805) | (724,489) | 2,478 | 88 | (2,138) | (5,553) | 27 | 341 | | 1 | 20 | |
| Feb 2017 | 458 | (411,900) | (424,540) | 17,976 | 75 | 120,688 | 120,901 | | 287 | | | 55 | 7 |
| Mar 2017 | 111 | (449,880) | (441,799) | 8,501 | 8,859 | 63,390 | 60,746 | 1 | 260 | | | 32 | |
| Apr 2017 | 538 | (250,952) | (215,041) | 14,428 | 9,676 | 87,213 | 79,936 | | 165 | | | 48 | 1 |
| May 2017 | 495 | (60,871) | (23,255) | 29,904 | (55,183) | (25,783) | (73,997) | 8 | 12 | | 12 | 30 | 4 |
| Jun 2017 | 513 | 9,686 | 52,004 | 33,741 | 2,426 | 135,309 | 179,336 | 2 | 2 | | 4 | 68 | 29 |
| Jul 2017 | 167 | 550 | 12,993 | 9,720 | (12,016) | 55,525 | 53,193 | | | | 4 | 22 | 2 |
| Aug 2017 | 420 | (438,975) | (427,548) | 22,558 | 288 | 194,203 | 183,745 | 420 | | | | 51 | 8 |
| Sep 2017 | 508 | (78,828) | (89,649) | 36,106 | 20,087 | 191,569 | 269,037 | 227 | 1 | 4 | | 51 | 13 |
| Oct 2017 | 470 | 32,577 | 62,544 | 54,178 | 6,590 | 133,485 | 225,887 | | 1 | | | 36 | 27 |
| Nov 2017 | 571 | (29,551) | 20,589 | 58,458 | (1,216) | 44,562 | 113,888 | | 4 | 5 | | 17 | |
| Dec 2017 | 494 | 851 | 16,106 | 18,457 | (9,632) | 57,318 | 43,117 | | | 14 | 1 | 18 | 1 |
| Jan 2018 | 604 | 35,333 | 54,827 | 18,139 | 1,251 | 76,915 | 57,271 | | | 41 | | 29 | |
| Feb 2018 | 519 | 56,560 | 76,840 | 29,483 | 24,215 | 221,386 | 225,175 | | 8 | | 1 | 81 | 18 |
| Mar 2018 | 382 | 60,898 | 94,548 | 26,429 | 32,528 | 255,652 | 316,988 | | 11 | | | 66 | 16 |
| Apr 2018 | 498 | 10,242 | 40,960 | 51,288 | (9,407) | 97,771 | 58,544 | | 14 | | 6 | 19 | |
| May 2018 | 512 | (1,528) | 32,205 | 32,735 | 47,116 | 13,142 | (431) | | 1 | | 18 | 5 | 4 |
| Total | 7,698 | (2,232,369) | (1,843,299) | 434,444 | 88,343 | 1,697,988 | 1,766,422 | | | | | | |

**Notes:**

- Hourly line rental calculated as the difference between Leyte-Samar customer average price and generator average price
- The table covers trading intervals with normal ex-ante market result for Luzon and Visayas

# Assessment on Cross-Grid Bilateral Contracts

- **Without High-Voltage Direct Current (HVDC) Cable constraints, there would be minimal differences in the line rental trading amounts (LRTA) among customers with or without cross-grid bilateral contracts**

- **With HVDC cable constraints, the LRTAs for customers with cross-grid PSAs are affected as follows:**

| Flow of HVDC | Effects in LRTA |
|---|---|
| Luzon to Visayas | **minimal effect due to minimal times that this flow occurs in the system** |
| Visayas to Luzon | For Luzon Customers: **High LRTA** |
| | For Visayas Customers: **Negative LRTA** |



dgcc

## Assessment on Cross-Grid Bilateral Contracts

- **Customers benefit from engaging in bilateral contracts by ensuring a stable price for its electricity requirement**

**High Market Price**

| | No BCQ | With BCQ | Benefit |
|---|---|---|---|
| EAQ | 10 | 10 | |
| BCQ | 0 | 5 | |
| EAP (L) | 10,000 | 10,000 | |
| EAP (G) | 9,900 | 9,900 | |
| EAETA | 100,000 | 50,000 | (50,000) |
| LRTA | 0 | 500 | 500 |
| **TTA** | **100,000** | **50,500** | **(49,500)** |

| | |
|---|---|
| BCQ | 5 |
| Price | 5,000 |
| Amount | 25,000 |

**Low Market Price**

| | No BCQ | With BCQ | Benefit |
|---|---|---|---|
| EAQ | 10 | 10 | |
| BCQ | 0 | 5 | |
| EAP (L) | 5,000 | 5,000 | |
| EAP (G) | 4,900 | 4,900 | |
| EAETA | 50,000 | 25,000 | (25,000) |
| LRTA | 0 | 500 | 500 |
| **TTA** | **50,000** | **25,500** | **(24,500)** |

| | |
|---|---|
| BCQ | 5 |
| Price | 5,000 |
| Amount | 25,000 |

## DOE's Concerns on Cross-Grid PSAs

- **What is the line rental rate/charges imposed to the 167 MW Coal-fired Power Plant in Iloilo City, Panay?**
  - ✓ The data is confidential, MAG will provide the same directly to the DOE
- **How does the line rental amount affect the paying consumers?**
  - ✓ Details of the PSAs are needed to evaluate the effects of line rental amount to the end-users
- **There is a need to examine ERC's methodology in the approval of cross-grid PSAs**
  - ✓ RCC may not be the proper body to examine the ERC's methodology

## DOE's Concerns on Cross-Grid PSAs

- **What must be the advantage to bid at negative cap (-10,000 Php/MW) for a typical generation company trader?**
  - ✓ If covered by contracts, the advantage in bidding at negative offer prices is to ensure dispatch of the power plant.
- **Is there a need for WESM Rules Change?**
  - ✓ There may no need to amend the current provisions on line rental calculation in the WESM Rules.
  - ✓ Significant nodal price difference between regions may be addressed by upgrading the HVDC interconnection. Meanwhile, DUs should be fully informed of the effects of cross-grid bilateral contracting in the calculation of LRTA.
  - ✓ Review of Price Substitution Mechanism application

Philippine Electricity Market Corporation

## END OF PRESENTATION

9th and 18th Floors Robinsons Equitable Tower
ADB Avenue, Ortigas Center, Pasig City
(+632) 631.8734
(+632) 634.0985
www.wesm.ph

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**Annex B**

**MERALCO Presentation**

1

# Negative Line Rental and Other WESM Mysteries Explained

by Ciprinilo C. Meneses

July 6, 2018

2

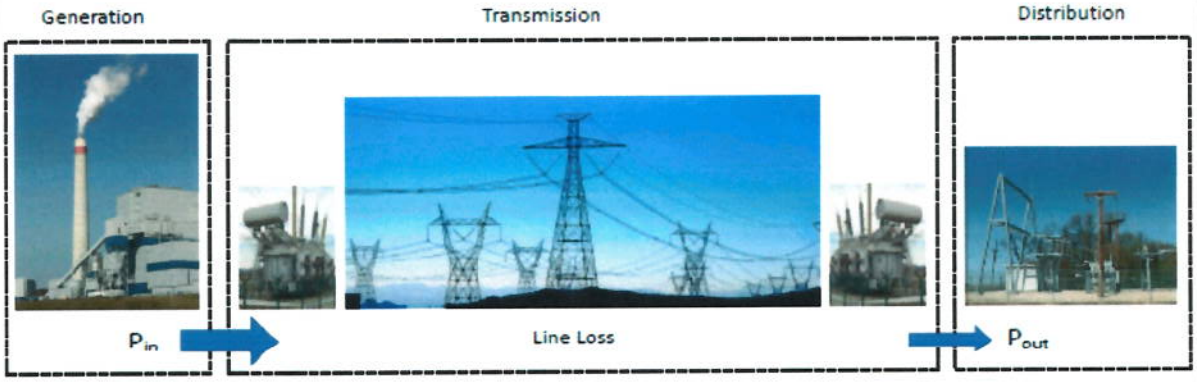
## 1. Introduction and Review of Basic Principles

## A. Terminology

**"Line Rental"** - a misnomer because transmission lines are not for rent, and the fee for the use of transmission lines is not called a rental, either. More importantly, the hourly "line rental" that WESM charges is distinct and separate from the monthly transmission charges that customers pay to NGCP.

A more appropriate definition would be "the cost of electricity that was used in transmitting a certain volume of electricity (the "Bilateral Contract Quantity" or BCQ) from a particular generator node to a particular customer node."

## B. Basic Concepts - The Power Train




$P_{in} = \text{Line Loss} + P_{out}$

$$\%\ \text{Line Loss} = \frac{\text{Line Loss}}{P_{in}} = a \times (P_{in})^b$$

$P_{out} = P_{in} - \text{Line Loss}$

where a and b are constants determined by the circuit's length, the wire's material and diameter, and the line voltage.
To simplify calculations in the succeeding slides, the % line loss will be assumed to be constant for all values of Pin.

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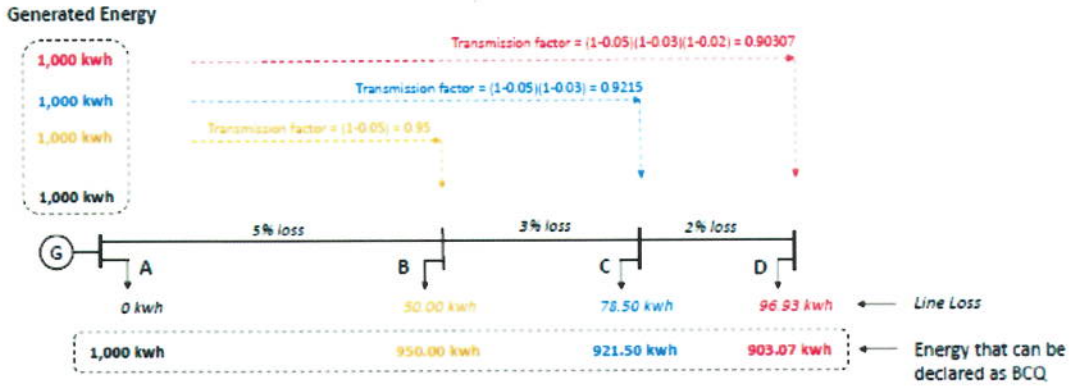
## B. Basic Concepts - Generation vs BCQ, moving downstream




Observation: Without the generator buying from the WESM, the energy that can be declared as BCQ by a generator for its customer is reduced by **transmission losses**

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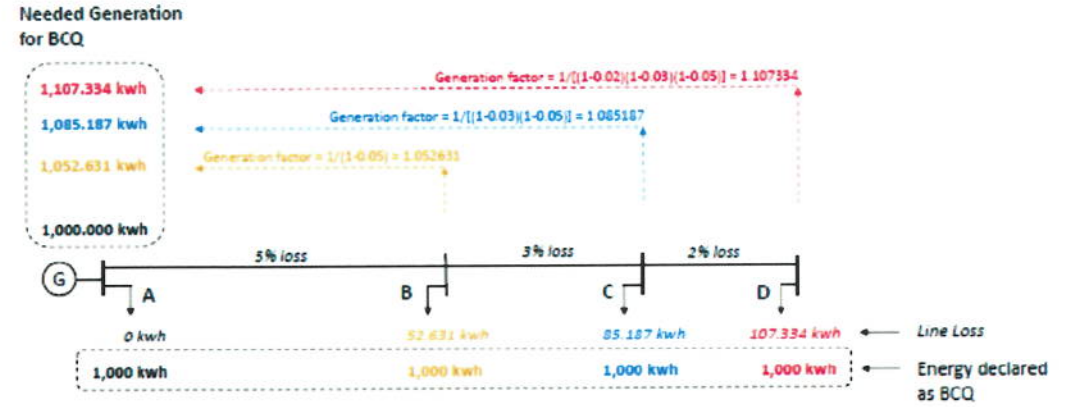
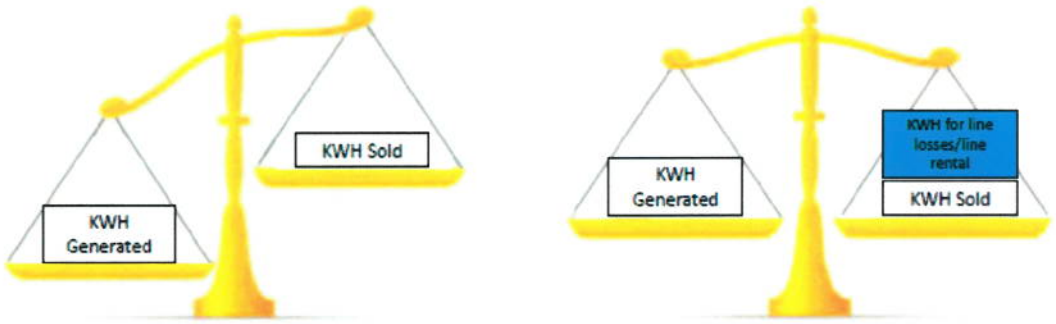
## B. Basic Concepts - Generation vs BCQ, moving upstream




Observation: Without the generator buying from the WESM, a generator will need to generate additional energy on top of the BCQ declaration for **transmission losses**

## 2. Why Line Rental is Necessary

### To Balance Energy Accounting



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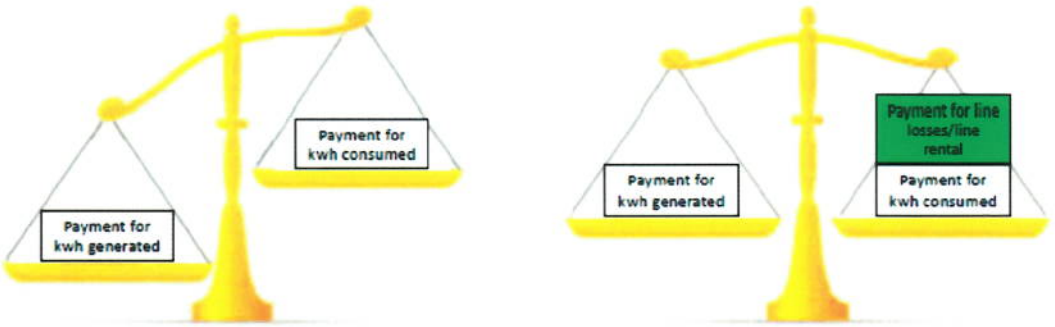
## To Balance Monetary Accounting

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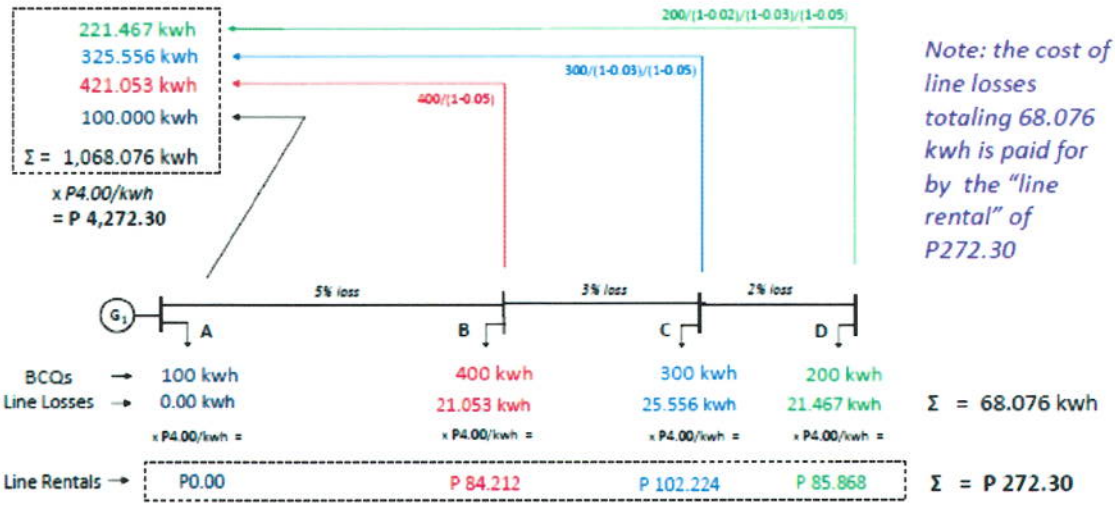
## How Line Rental Balances Kwhs and Costs - Illustrative Example (1 of 3)




*Note: the cost of line losses totaling 68.076 kwh is paid for by the "line rental" of P272.30*

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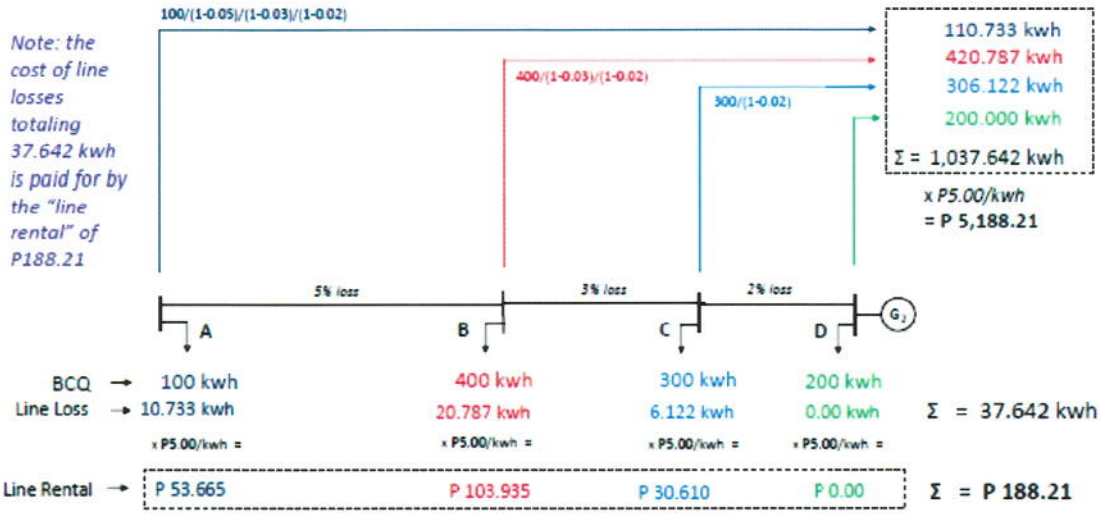
## How Line Rental Balances Kwhs and Costs - Illustrative Example (2 of 3)

*Note: the cost of line losses totaling 37.642 kwh is paid for by the "line rental" of P188.21*




| | A | B | C | D | |
|---|---|---|---|---|---|
| BCQ → | 100 kwh | 400 kwh | 300 kwh | 200 kwh | |
| Line Loss → | 10.733 kwh | 20.787 kwh | 6.122 kwh | 0.00 kwh | Σ = 37.642 kwh |
| | x P5.00/kwh = | x P5.00/kwh = | x P5.00/kwh = | x P5.00/kwh = | |
| Line Rental → | P 53.665 | P 103.935 | P 30.610 | P 0.00 | Σ = P 188.21 |

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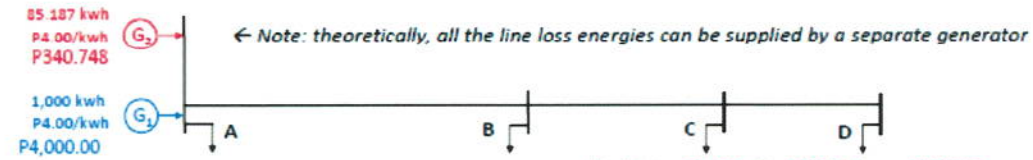
## How Line Rental Balances Kwhs and Costs - Two Cases (3 of 3)

### Case 1 - Same Generator Supplies Energy for BCQ and Line Losses


Line Loss 85.187 kwh x P4.00/kwh = P340.748
Delivered Energy (BCQ) 1,000 kwh x P4.00/kwh = P4,000.00

### Case 2 - Different Generator Supplies Energy for Line Losses




Line Loss 85.187 kwh x P4.00/kwh = P340.748
Delivered Energy (BCQ) 1,000 kwh x P4.00/kwh = P4,000.00

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# 3. Derivation of Line Rental Rate Formula

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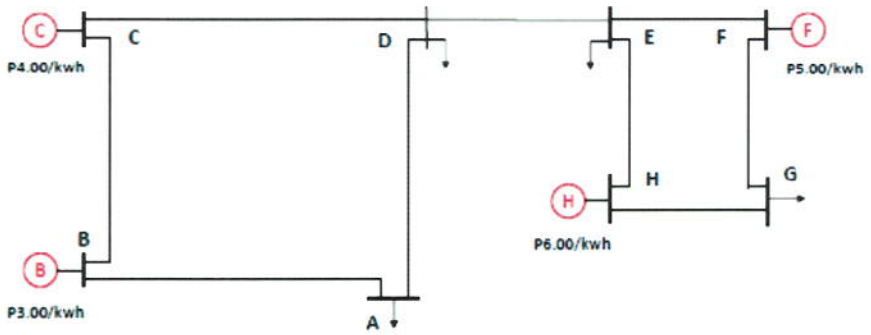
## Line Rental in a Multiple-Generator System




The preceding method of calculating line rental, based on transmission losses directly attributable to a generator-BCQ pair, is only feasible for a one-generator/one price system.

For a multiple-generator system, the transmission losses directly attributable to the various pairs of generators and BCQs are no longer easily calculatable. In addition, the line losses for a BCQ-ed energy can come from a different generator. Thus, a more workable method is needed for computing line rental.



dgcc

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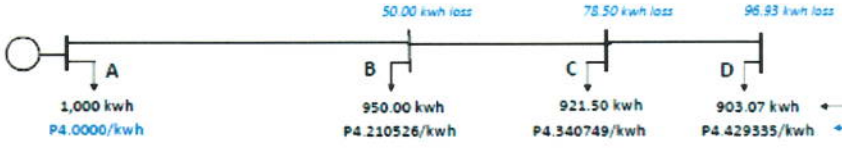
## A. Derivation By Numerical Example

(1 of 4)




Line Rental Cost = [Line loss energy] x [Price at generator node]

A to B = *50.00 kwh* x P4.0000 = P200.00
A to C = *78.50 kwh* x P4.0000 = P314.00
A to D = *96.93 kwh* x P4.0000 = P387.72

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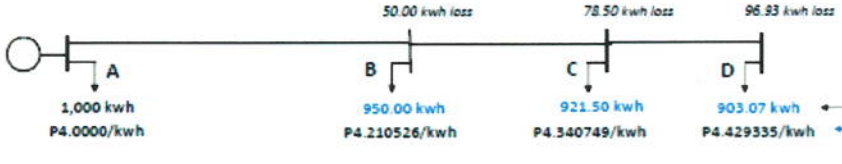
## A. Derivation By Numerical Example

(2 of 4)




Line Rental Cost = [Line loss energy] x [Price at generator node]

**Line Rental Rate per kwh of BCQ** (Customer Viewpoint)

A to B = *50.00 kwh* x P4.0000 = P200.00 → A to B = P200.00 / 950.00 kwh = P0.210526/kwh
A to C = *78.50 kwh* x P4.0000 = P314.00 → A to C = P314.00 / 921.50 kwh = P0.340749/kwh
A to D = *96.93 kwh* x P4.0000 = P387.72 → A to D = P387.72 / 903.07 kwh = P0.429335/kwh

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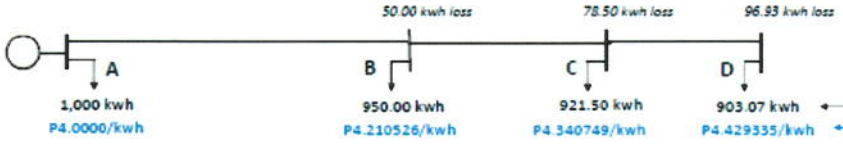
## A. Derivation By Numerical Example

(3 of 4)




**Line Rental Cost** = [Line loss energy] x [Price at generator node]

A to B = *50.00 kwh* x P4.0000 = P200.00
A to C = *78.50 kwh* x P4.0000 = P314.00
A to D = *96.93 kwh* x P4.0000 = P387.72

**Line Rental Rate per kwh of BCQ** (Customer Viewpoint)

A to B = P200.00 / 950.00 kwh = P0.210526/kwh
A to C = P314.00 / 921.50 kwh = P0.340749/kwh
A to D = P387.72 / 903.07 kwh = P0.429335/kwh

**Line Rental Rate as Difference in Nodal Prices**

A to B = P4.210526 - P4.000000 = P0.210526/kwh
A to C = P4.340749 - P4.000000 = P0.340749/kwh
A to D = P4.429335 - P4.000000 = P0.429335/kwh

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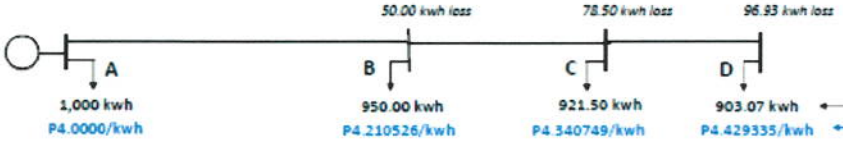
## A. Derivation By Numerical Example

(4 of 4)




Line Rental Cost

A to B = *50.00 kwh* x P4.0000 = P200.00 = 950.00 kwh x (P4.210526 - P4.0000) = P200.00
A to C = *78.50 kwh* x P4.0000 = P314.00 = 921.50 kwh x (P4.340749 - P4.0000) = P314.00
A to D = *96.93 kwh* x P4.0000 = P387.72 = 903.07 kwh x (P4.429335 - P4.0000) = P387.72

**Line Rental Cost** = [Line loss energy] x [Price at generator node] = [Delivered energy] x [Difference in price between load node and generator node]

Line Rental Cost = BCQ x Line Rental Rate

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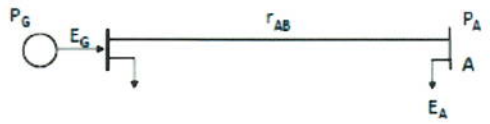
## B. Mathematical Derivation




where $P_G$ - Price at generator node *(P/kwh)*
$E_G$ - Energy produced by generator *(kwh)*
$r_{AB}$ - line loss rate *(decimal)*
$P_A$ - Price at node A *(P/kwh)*
$E_A$ - Energy delivered at node A *(kwh)*

From the diagram

Line Loss Energy (LLE) = $E_G \times r_{AB}$
Delivered Energy ($E_A$) = $E_G \times (1 - r_{AB})$

Nodal Cost Equality

$E_G \times P_G = E_A \times P_A = [E_G \times (1 - r_{AB})] P_A$
$P_G = (1 - r_{AB}) P_A$
$P_G = P_A - r_{AB} \times P_A \longrightarrow r_{AB} P_A = (P_A - P_G)$
$r_{AB} = (P_A - P_G)/P_A$

Line Rental Cost (LRC) = (Line Loss Energy) x (Generation Cost)

$LRC = LLE \times P_G = (E_G \times r_{AB}) \times P_G$

$$\text{Line Rental Rate (LRR)} = \frac{\text{Line Rental Cost}}{\text{Delivered Energy}} = \frac{LRC}{E_A}$$

$$LRR = \frac{(E_G \times r_{AB}) \times P_G}{E_G \times (1 - r_{AB})} = \frac{r_{AB} \times P_G}{(1 - r_{AB})} = r_{AB} \frac{P_G}{(1 - r_{AB})}$$

$$= r_{AB} \times P_A = \left[\frac{(P_A - P_G)}{P_A}\right] P_A$$

$$LRR = (P_A - P_G)$$

Line rental rate (LRR) can be obtained from the difference in nodal prices between the load node ($P_A$) and the generator node ($P_G$)

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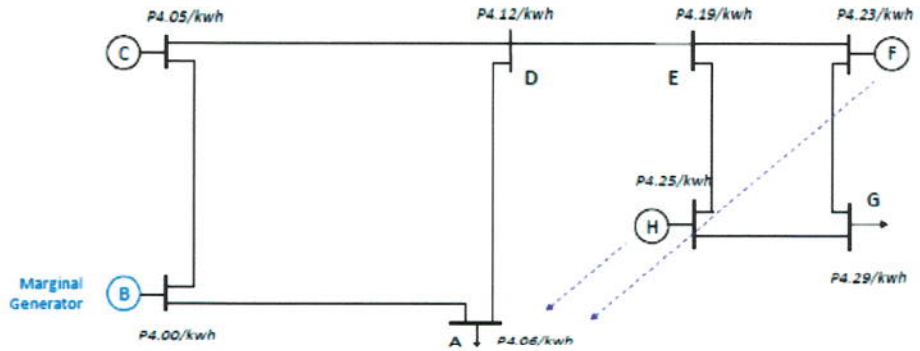
## C. How Negative Line Rental Occurs (1 of 2)




Negative Line Rental rates naturally occur when the BCQ recipient happens to be nodally closer to the marginal generator than the BCQ-ing generator

**Negative Line Rentals for BCQ Declaration**
from F to A = 4.06 - 4.23 = -0.17
from H to A = 4.06 - 4.25 = -0.19

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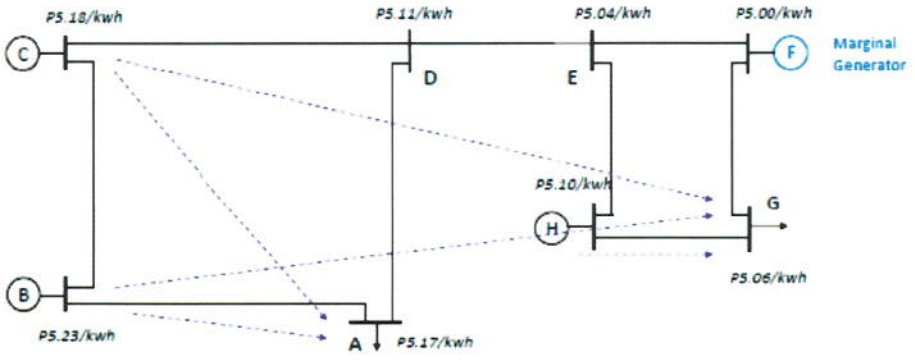
## C. How Negative Line Rental Occurs (2 of 2)




Negative Line Rental rates naturally occur when the BCQ recipient happens to be nodally closer to the marginal generator than the BCQ-ing generator

**Negative Line Rentals for BCQ Declaration**

from B to A = 5.17 - 5.23 = -0.06
from B to G = 5.06 - 5.23 = -0.17
from C to A = 5.17 - 5.18 = -0.01
from C to G = 5.06 - 5.18 = -0.12
from H to G = 5.06 - 5.10 = -0.04

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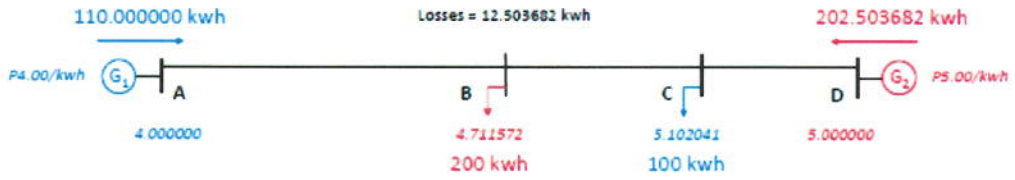
# 4. Do Negative Line Rentals Make Sense?

23

## A. Illustrative Examples

(1 of 4)




**Line Rental Amounts Receivable (+)/ Payable (-) by WESM**

| | | | | |
|---|---|---|---|---|
| For BCQ from G1 to C | 100 (5.102041 - 4.000000) | = | 100 (1.102041) | = P110.204082 |
| For BCQ from G2 to B | 200 (4.711572 - 5.000000) | = | 100 (-0.288428) | = -P57.685672 |
| Total | (net receivable of WESM from loads) | | | P52.518409 |

← Negative Line Rental

**Cost of Energy Purchased by WESM for Line Losses**

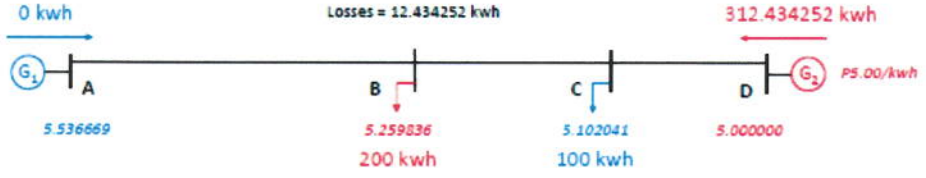
| | | | | |
|---|---|---|---|---|
| From G1 | 4.000000 (110.000000 - 100) | = | 4.00 (10.00000) | = P40.000000 |
| From G2 | 5.000000 (202.503682 - 200) | = | 5.00 (2.503682) | = P12.518409 |
| Total | (total payable of WESM to generators) | | | P52.518409 |

Net collection from line rental matches cost of energy for line losses

24

## A. Illustrative Examples

(2 of 4)




**Line Rental Amounts Receivable (+)/ Payable (-) by WESM**

| | | | | |
|---|---|---|---|---|
| For BCQ from G1 to C | 100 (5.102041 - 5.536669) | = | 100 (-0.434629) | = -P43.462854 |
| For BCQ from G2 to B | 200 (5.259836 - 5.000000) | = | 200 (0.259836) | = P51.967179 |
| Total | (net receivable of WESM from loads) | | | P8.504324 |

← Negative Line Rental

**Cost of Energy Purchased (+) and Sold (-) by WESM for BCQ and Line Losses**

| | | | | |
|---|---|---|---|---|
| Sold to G1 | 5.536669 (0.00000000 - 100) | = | 5.536669 (-100.0) | = -P553.666936 |
| Bought from G2 | 5.000000 (312.434252 - 200) | = | 5.00 (112.434252) | = P562.171260 |
| Total | (net payable of WESM to generators) | | | P8.504324 |

Net collection from line rental matches cost of energy for BCQ and line losses

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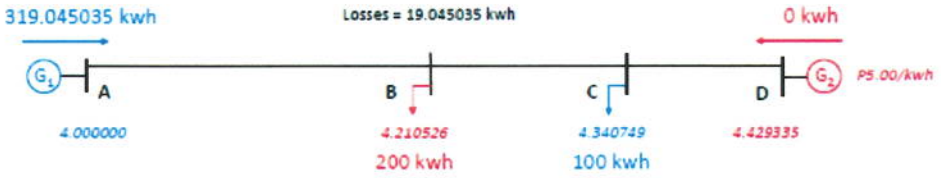
## A. Illustrative Examples

(3 of 4)




**Line Rental Amounts Receivable (+)/ Payable (-) by WESM**

| | | | | |
|---|---|---|---|---|
| For BCQ from G1 to C | 100 (4.340749 - 4.000000) | = | 100 (0.340749) | = P34.074878 |
| For BCQ from G2 to B | 200 (4.210526 - 4.429335) | = | 200 (-0.218809) | = -P43.761835 |
| Total | (net payable by WESM to load B) | | | -P9.686957 |

← Negative Line Rental

**Cost of Energy Purchased (+) and Sold (-) by WESM for BCQ and Line Losses**

| | | | | |
|---|---|---|---|---|
| Bought from G1 | 4.00000 (319.045035 - 100) | = | 4.00 (219.045035) | = P876.180141 |
| Sold to G2 | 4.429335 (0.0000000 - 200) | = | 4.429335 (-200.0) | = -P885.867098 |
| Total | (net receivable by WESM from G2) | | | -P9.686957 |

Net collection from line rental matches cost of energy for BCQ and line losses

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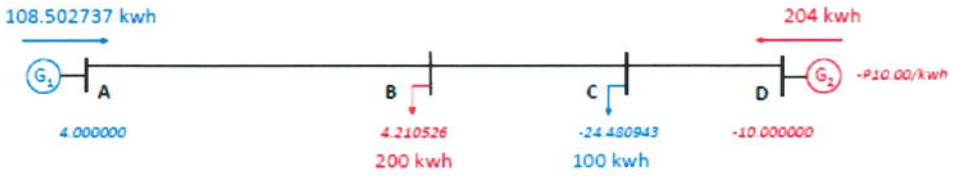
## A. Illustrative Examples

(4 of 4)




**Line Rental Amounts Collectible (+)/ Payable (-) by WESM**

| | | | | |
|---|---|---|---|---|
| For BCQ from G1 to C | 100 (-24.480943 - 4.00000) | = | 100 (-28.480943) | = -P2,848.094316 |
| For BCQ from G2 to B | 200 (4.210526 - (-10.0000) | = | 200 (14.210526) | = P2,842.105263 |
| Total | (net payable of WESM to load C) | | | -P5.989053 |

← Negative Line Rental

**Cost of Energy Purchased (+) and Sold (-) by WESM for Line Losses**

| | | | | |
|---|---|---|---|---|
| Bought from G1 | 4.00000 (108.502737 - 100) | = | 4.00 (8.502737) | = P34.010947 |
| Sold to G2 | -10.0000 (204.000000 - 200) | = | -10.00 (4.0000) | = -P40.000000 |
| Total | (net receivable by WESM from G2) | | | P5.989053 |

Net collection from line rental matches cost of energy for line losses

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## Observation

Even if the results may seem "unfair", line rental may yet be the best method for costing line losses, as other options are just as problematic:

1. Uniform Cost of Loss Method (constant P/kwh cost regardless of distance between generator and load) - not cost reflective and does not factor in the demand (MW) of loads
2. Megawatt-Mile Method (cost varies with load and distance) - the "mile" component is difficult to proxify in a meshed grid.
3. Zonal Loss Pricing Method - can also give rise to negative line rental

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## 5. How Line Rental is Used By DUs for Initial Evaluation of Generator Offers

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## Illustrative Example

Line Rental is used by the DU to determine the ex-plant, ex-VAT rate of prospective power suppliers

| | | A | B | C = A + B | D | E | F = C + D + E | |
|---|---|---|---|---|---|---|---|---|
| Power Supplier | Proposed Outage Allowance (days/yr) | Plant Gate Pre-vat Rate* | VAT | **Plant Gate Post-vat Rate** | Average Annual Line Rental** | Annualized Cost of Replacement Power*** | Annualized All-in Rate at Delivery Point | |
| Gen A | 55.00 | 3.7869 | 0.4544 | **4.2413** | 0.2514 | 0.1802 | **4.6729** | |
| Gen B | 50.00 | 3.8315 | 0.4598 | **4.2913** | 0.2072 | 0.1570 | **4.6555** | |
| Gen C | 45.00 | 3.8742 | 0.4649 | **4.3391** | 0.1618 | 0.1354 | **4.6363** | ← Lowest |
| Gen D | 45.00 | 4.5900 | - | **4.5900** | 0.3000 | 0.1044 | **4.9944** | |
| Gen E | 45.00 | 4.6800 | - | **4.6800** | 0.1875 | 0.0934 | **4.9609** | |

* normalized using a common annual capacity factor (e.g., 80%)

** determined based on the location of supplier's power plant. Line rental figures greater than P0.30/kwh are capped at P0.30/kwh for evaluation purposes (excess to be shouldered by power supplier)

*** calculated from proposed outage allowance and forecast WESM price of P5.4372/kwh

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## Observation

Line Rental provides DUs with an important criterion for evaluating PSA proposals from prospective power suppliers, thereby helping DUs meet their mandate of ensuring the least-cost of power to its customers.

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# 6. How the WESM Makes Cross-Grid Energy "Flows" Possible

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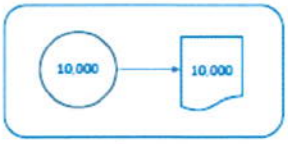
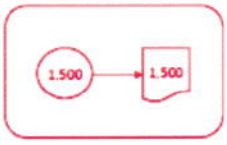
## How the WESM Makes Cross-Grid Energy "Flows" Possible

1. Energy Generation and Consumption Balance




Luzon




Visayas

Note: to simplify energy balancing and not to clutter the illustration, energy losses have been disregarded

Note also that there is no physical power flow from Luzon to Visayas or vice versa (HVDC assumed out)

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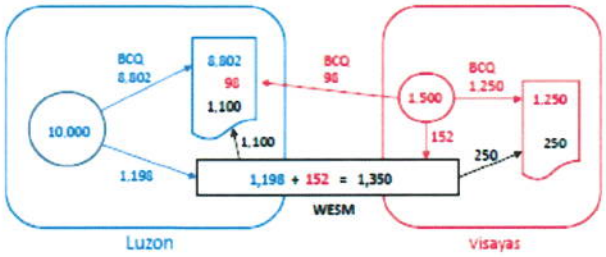
## How the WESM Makes Cross-Grid Energy "Flows" Possible

1. Energy Generation and Consumption Balance


Note: to simplify energy balancing and not to clutter the illustration, energy losses have been disregarded

Note also that there is no physical power flow from Luzon to Visayas or vice versa (HVDC assumed out)

2. Energy Accounting Balance




Visayas Generation Balance
1,500 = 1,250 + 98 + 152

WESM Energy Balance
Sold to WESM = 1,198 + 152 = 1,350
Bought from WESM = 1,100 + 250 = 1,350

*Note: the BCQ declaration by a Visayas generator for a Luzon DU (98 MWh) can be made even if the HVDC line is out*

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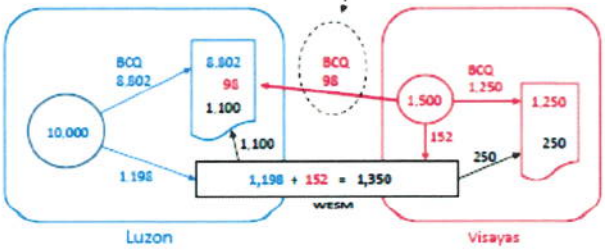
## Observations

One benefit of the WESM is that it makes possible cross-grid energy flows by serving as a virtual energy reservoir into which generators can inject energy, and from which, customers can draw energy, while maintaining supply-demand balances in both grids.




Cross-grid energy flows benefit consumers because they can avail of bilaterally-contracted energy that is cheaper than energy sourced from the spot market.

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# 7. What Forces Generators to Offer Negative Prices

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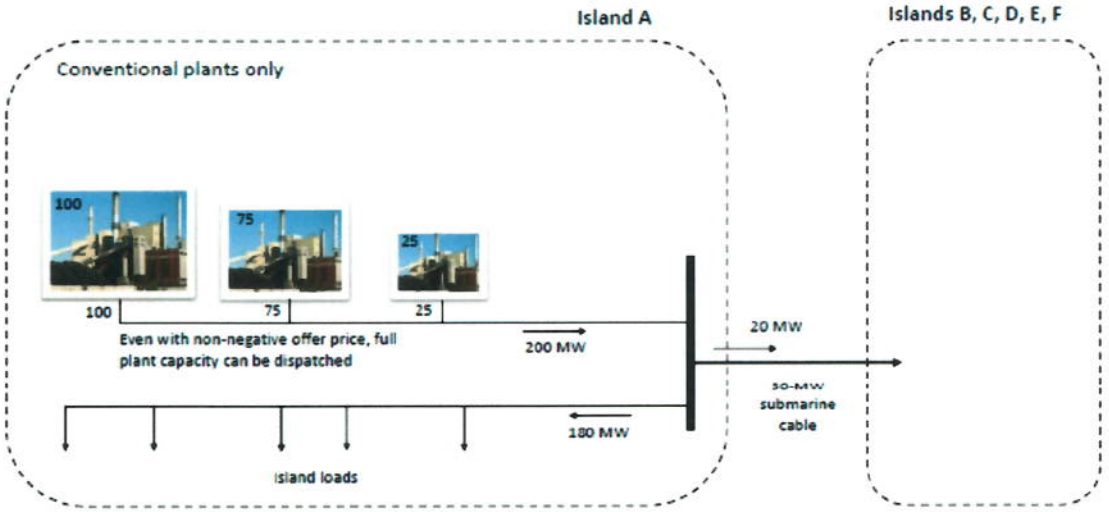
## Case 1: Sufficient Transmission Capacity




Note: the conventional plants can be fully dispatched; they need not offer negative prices to ensure dispatch

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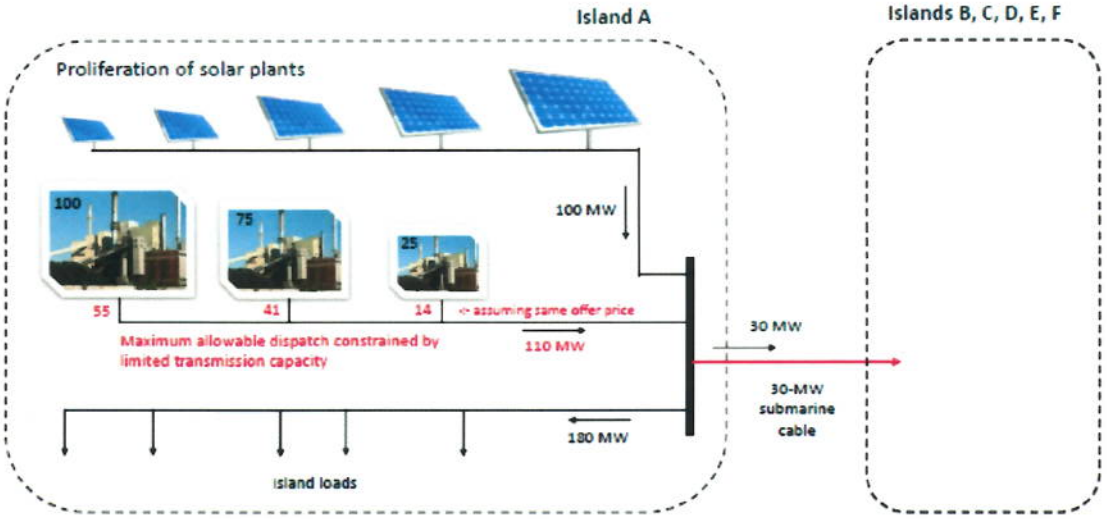
## Case 2: Insufficient Transmission Capacity




Non-RE plants compete for constrained dispatch by offering the lowest allowable offer price -- negative P10/kwh, to increase probability of dispatch

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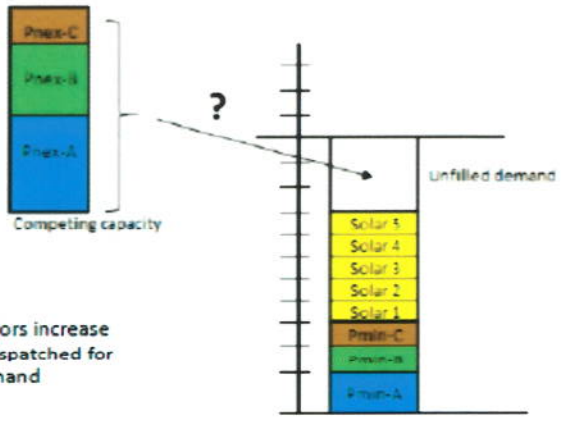
## A Graphical View of the Problem




Problem: How can generators increase their chances of being dispatched for the limited available demand window?

Solution: Offer the lowest permissible price, negative P10/kwh.

Question: What if all of them offered negative P10/kwh?



dgcc

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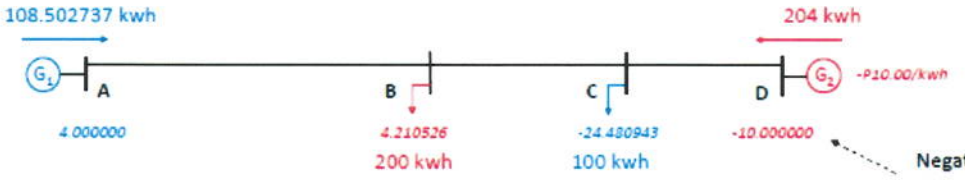
## Impact of Negative Clearing Price – Illustrative Example (1 of 2)




**Line Rental Amounts Collectible (+)/ Payable (-) by WESM**

| | | | |
|---|---|---|---|
| For BCQ from G1 to C | 100 (-24.480943 - 4.00000) = 100 (-28.480943) | = | -P2,848.094316 |
| For BCQ from G2 to B | 200 (4.210526 - (-10.0000) = 200 (14.210526) | = | P2,842.105263 |
| Total | (net payable of WESM to load C) | | -P5.989053 |

Very high line rental rate

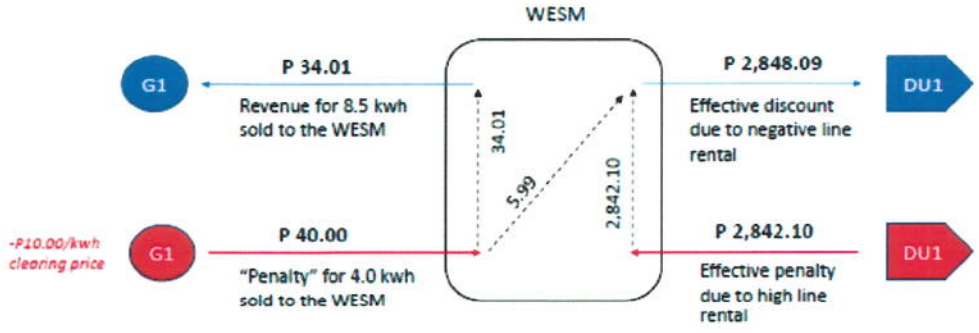
**Cost of Energy Purchased (+) and Sold (-) by WESM for Line Losses**

| | | | |
|---|---|---|---|
| Bought from G1 | 4.00000 (108.502737 - 100) = 4.00 (8.502737) | = | P34.010947 |
| Sold to G2 | -10.0000 (204.000000 - 200) = -10.00 (4.0000) | = | -P40.000000 |
| Total | (net receivable by WESM from G2) | | P5.989053 |

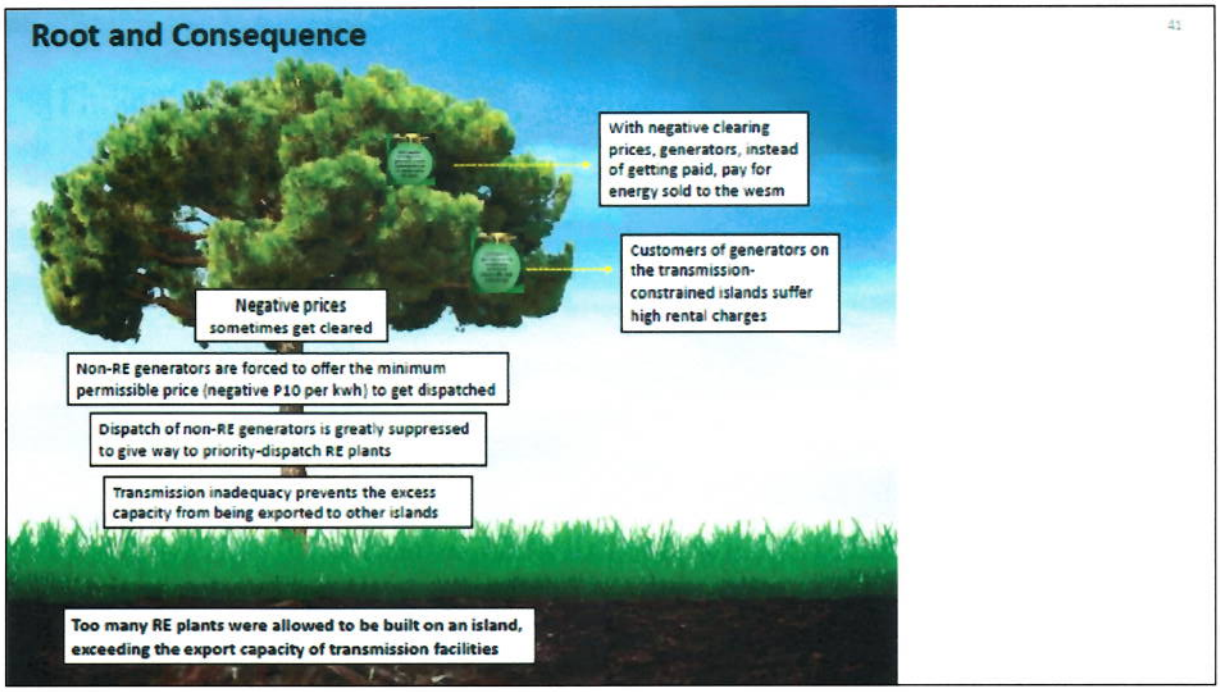
Negative price for energy sold to the WESM

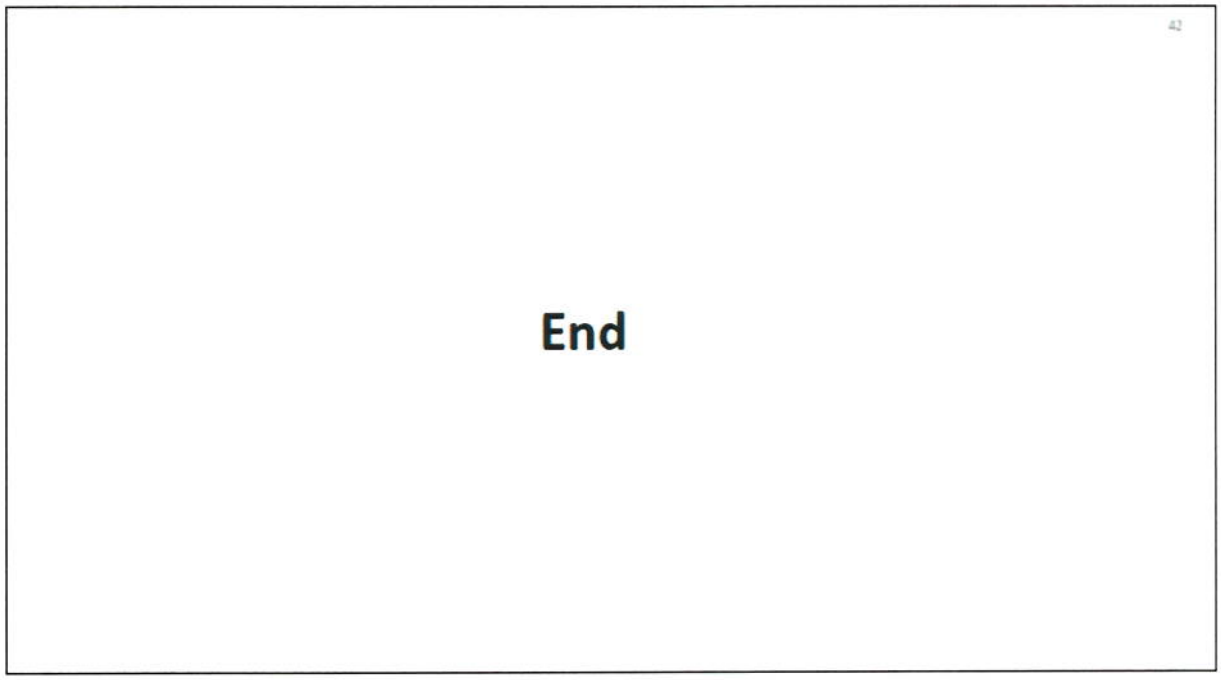
40

## Impact of Negative Clearing Price – Illustrative Example (2 of 2)




Both the generator (in the area where negative prices cleared) and its BCQ-ed customer are penalized by negative clearing prices caused by excess generation capacity


Root and Consequence
41
With negative clearing prices, generators, instead of getting paid, pay for energy sold to the wesm
Customers of generators on the transmission-constrained islands suffer high rental charges
Negative prices sometimes get cleared
Non-RE generators are forced to offer the minimum permissible price (negative P10 per kwh) to get dispatched
Dispatch of non-RE generators is greatly suppressed to give way to priority-dispatch RE plants
Transmission inadequacy prevents the excess capacity from being exported to other islands
Too many RE plants were allowed to be built on an island, exceeding the export capacity of transmission facilities


42
End