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WESM Manual

Catalogue of Market Monitoring Data and Indices

Issue 2.0 | WESM – CMMDI

This document covers the list of market monitoring indices to be used in assessing the development of the wholesale electricity spot market.

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In case of inconsistency between this document and the DOE Circulars, the latter shall prevail.

Document Change History

Issue No.	Proponent	Date of Effectivity	Reason for Amendment
1.0	MAG	17 May 2006	Original document.
2.0	MAG	29 October 2021	Revisions were made to introduce additional indices on supply margin-price index, generator offer indices and spot price indices, as well as to incorporate updates and revisions to align with the implementation of 5-minute dispatch interval, and in consideration of the Market Surveillance Manual, as amended.

Document Approval

Issue No.	MSC Approval	MSC Resolution No.
1.0	17 May 2006	
2.0	26 October 2021	Resolution No. 61

Reference Documents

Document ID	Document Title
	Wholesale Electricity Spot Market (WESM) Rules
TA 4073-PHI	Transition to Competitive Electricity Market, Report on Market Monitoring Indices prepared by Soluziona and Mercados Energy Market Group for the Department of Energy and Asian Development Bank under the Implementation Plan for WESM Institution Building, dated 02 March 2006
WESM-MSCEM 3.0	Market Surveillance, Compliance and Enforcement Manual Issue 3.0

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SECTION 1 INTRODUCTION

1.1 PURPOSE

1.1.1 This document was developed and accordingly revised pursuant to the Market Surveillance, Compliance and Enforcement Market Manual Issue 3.0 which requires the Market Surveillance Committee (MSC) to develop monitoring data and indices and prepare a catalogue thereof to effectively carry out its market surveillance function.

1.1.2 This document provides a list of market monitoring data and indices that will be used as a tool to assess competition and market outcomes.

1.2 SCOPE

This catalogue covers the following:

1.2.1 Monitoring data that shall be routinely provided by the Market Operator (MO) and System Operator (SO); and

1.2.2 Monitoring indices that will be used to process and analyze the monitoring data collected.

SECTION 2 MARKET MONITORING DATA

2.1 MONITORING DATA

2.1.1 Market monitoring data shall be routinely collected from MO and SO, such as but not limited to:

a) Generating facilities registration information
b) Network data
c) Market offer/bid data
d) Scheduling and dispatch data
e) System operations data
f) Settlement data

2.1.2 Other data that will complement the MO/SO data may also be collected such as hydro generation data, publicly – available corporate documents (e.g., registration with the Securities and Exchange Commission), among others. Details of the monitoring data are contained in Appendix A.

SECTION 3 MARKET MONITORING INDICES

3.1 TYPES OF INDICES

The indices provide indication of market trends, performance, possible drivers and signals which require more in-depth analysis. The types of indices are summarized as follows:

a) Market Performance Indices
b) Supply (Generation) Indices
c) Spot Market Price Indices
d) Transmission Constraints Indices
e) Structural: Market Concentration Indices and Pivotal Dynamic Indices
f) Generator Offer Indices

Details of the market monitoring indices are contained in Appendix B.

3.2 CALCULATION OF INDICES

3.2.1 The monitoring indices shall be calculated using the data generated from market projection, real-time and settlement processes.

3.2.2 Depending on the type of index, the indices may be calculated as follows:

a) Per dispatch interval;
b) Aggregated on an hourly, daily, weekly, monthly, quarterly, seasonal, and annual basis;
c) By unit of generating plant, generating plant, trading participant or by related participant grouping (portfolio);
d) System-wide or on a regional basis (i.e., Luzon, Visayas, Mindanao); and
e) Working days, non-working days, peak and off-peak hours.

3.2.3 The indices may be calculated other than the cases cited above, depending on the analysis that will be undertaken.

3.3 REPORTORIAL REQUIREMENTS

The MAG shall prepare and submit market assessment reports to the MSC, containing an analysis of the market monitoring indices.

3.4 CONFIDENTIALITY

The market monitoring data shall remain subject to any confidentiality provisions contained in the WESM Rules and Market Operator Information Disclosure and Confidentiality Manual.

3.5 REVIEW AND UPDATE

The MSC, with the assistance of the Market Assessment Group (MAG), shall undertake a periodic review of this Catalogue and enhance the same as it deems appropriate, in view of findings and issues established or determined during the market surveillance process.

SECTION 4 APPENDICES

Appendix A Market Monitoring Data

Type of Data	Description	Source
1. Generating Facilities Registration Information	a. Maximum stable load (Pmax)	MO
	b. Minimum stable load (Pmin)	
	c. Maximum capacity per reserve category	
	d. Ramp up and ramp down rates	
	e. Classification (e.g., scheduled, non-scheduled, must dispatch, priority dispatch)	
	f. Plant type (e.g., coal, natural gas, geothermal, hydro)	
2. Market Network Data	a. Maps and diagrams showing the location of each registered generating plant/unit and load, and ratings of transmission lines	SO
	b. Market Network Model	MO
3. Market Offer/ Bid Data	a. Standing and working profiles of generation offers of scheduled generating units	MO
	b. Standing and working profiles of nomination of loading levels of non-scheduled generating units	
	c. Standing and working profiles of projected outputs of must dispatch and priority dispatch generating units	
	d. Standing and working profiles of demand bids of scheduled loads	
	e. Standing and working profiles of reserve offers of scheduled generating units	
	f. Standing and working profiles of reserve offers of customers for their interruptible load facilities	

Type of Data	Description	Source
4. Scheduling and Dispatch (Market Projections and Real-time Dispatch)	a. Dispatch schedules and prices for energy per node	MO
	b. Dispatch schedules and prices for reserve	
	c. List of pricing conditions	
	d. List of transmission lines and equipment constraints	
	e. HVDC line flow	
	f. Aggregate Data (e.g., load, loss)	
5. System Operations Data (Market Projections and Real-time Dispatch)	a. Outage schedules	MO
	b. Contingency lists	
	c. Reserve requirements	
	d. Over-riding constraints	
	e. System advisories	
	f. System snapshot	
6. System Operations Data (Post-dispatch Reports and Information)	a. Daily operations report	MO/SO
	b. Dispatch deviation report	
	c. Market intervention report	
	d. Report on must-run units	
7. Settlement Data	a. Energy trading amount details per dispatch interval	MO
	b. Reserve trading amount details per dispatch interval	

Appendix B Market Monitoring Indices

Type	Purpose	Calculation
I. Market Performance Indices		
1. Load Characteristics a. Load profile b. Load distribution c. Load factor	• To identify typical load profiles and nodes where load is more concentrated. • To determine correlation between loads and prices as well as correlation between typical loads and market participant bidding behavior.	$$LoadDist_{r,cn,t} = \frac{\sum_{i \in t} Load_{cn,i}}{\sum_{i \in t} TotalLoad_{r,i}}$$ $$LoadDist_{r,cp,t} = \frac{\sum_{i \in t} TotalLoad_{cp,i}}{\sum_{i \in t} TotalLoad_{r,i}}$$ $$LoadFactor_{r,t} = \frac{\sum_{i \in t} TotalEnergy_{r,c,i}}{\max_{i \in t}(TotalLoad_{r,i})\ x\ NoOfIntervals_t}$$ Where: $TotalLoad_{r,i}$ is the sum of all the loads in region r at interval i
2. Load Forecast Variation	To assess the quality of the market projection processes in estimating expected load requirement.	$$LoadVar_{r,i} = \frac{ActualTotalLoad_{r,i} - ForecastTotalLoad_{r,i}}{ForecastTotalLoad_{r,i}}$$
3. Reserve Margin Index (RMI)	To measure the generation-demand balance, including the operating reserve requirement as demand.	$$RMI_{r,i} = \frac{TotalOffer_{r,i} - (TotalLoad_{r,i} + TotalLoss_{r,i} + TotalRes_{r,i})}{(TotalLoad_{r,i} + TotalLoss_{r,i} + TotalRes_{r,i})}$$

Type	Purpose	Calculation
4. Spot Market Exposure	To calculate the percentage of energy injected (for generators) and withdrawn (for customers) not covered by bilateral contracts.	$SpotExpo_{cn,t} = \frac{\sum_{i \in t} Energy_{cn,i} - \sum_{i \in t} Bilateral_{cn,i}}{\sum_{i \in t} Energy_{cn,i}}$ $SpotExpo_{cp,t} = \frac{\sum_{i \in t} TotalEnergy_{cp,i} - \sum_{i \in t} TotalBilateral_{cp,i}}{\sum_{i \in t} TotalEnergy_{cp,i}}$ $SpotExpo_{r,c,t} = \frac{\sum_{i \in t} TotalEnergy_{r,c,i} - \sum_{i \in t} TotalBilateral_{r,c,i}}{\sum_{i \in t} TotalEnergy_{r,c,i}}$ $SpotExpo_{gn,t} = \frac{\sum_{i \in t} Energy_{gn,i} - \sum_{i \in t} Bilateral_{gn,i}}{\sum_{i \in t} Energy_{gn,i}}$ $SpotExpo_{gp,t} = \frac{\sum_{i \in t} TotalEnergy_{gp,i} - \sum_{i \in t} TotalBilateral_{gp,i}}{\sum_{i \in t} TotalEnergy_{gp,i}}$ $SpotExpo_{r,g,t} = \frac{\sum_{i \in t} TotalEnergy_{r,g,i} - \sum_{i \in t} TotalBilateral_{r,g,i}}{\sum_{i \in t} TotalEnergy_{r,g,i}}$
5. Spot Frequency Distribution	To identify the frequency for which the spot exposure value was recorded	$Spot\ Exposure\ Frequency_t = Count\ of\ Spot\ Exposure_t$
6. Spot Duration Curve	To identify the percent of time for which the spot exposure value was recorded	$Spot\ Exposure\ Probability_t = \frac{Count\ of\ Spot\ Exposure_t}{No\ of\ Intervals_t}$

Type	Purpose	Calculation
		Spot Duration Curve is obtained by plotting the Spot Exposure Probability for each Spot Exposure value (in ascending order) over a duration of time set as 100%.
7. Dispatch Constraints	To assess the effect of system constraints in the economic use of offered capacity. • Calculate the percentage of generation scheduled by merit compared to total capacity offered • Calculate the generation scheduled out of merit due to system constraints	$SchedByMerit_{r,i} = \frac{\sum_{gn \in g} SchedbyMerit_{r,gn,i}}{TotalOffer_{r,i}}$
II. Supply (Generation) Indices		
1. Capacity factor for each generating plant	To determine the extent by which the generating plant is utilized as well as to identify trends, such as whether the capacity factor is decreasing or increasing.	$CapFactorSched_{gp,t} = \frac{\sum_{i \in t} TotalSched_{gp,i} + \sum_{i \in t} TotalRes_{gp,i}}{TotalRegCap_{gp}\ x\ NoOfIntervals_t}$ $CapFactorEnergy_{gp,t} = \frac{\sum_{i \in t} TotalEnergy_{gp,i}}{TotalRegCap_{gp}\ x\ NoOfIntervals_t}$
2. Outage of each generating plant a. Frequency of outages b. Outage factor c. Outage capacity	To measure the reliability of generation and to assess the impact of outages in the spot market.	$OutageFactor_{gp,t} = \frac{\sum_{i \in t} TotalOutageCap_{gp,i}}{TotalRegCap_{gp}\ x\ NoOfIntervals_t}$
3. Outage Duration	To measure the time a generating unit/plant is incapable of producing energy at full load	$OutageDuration_{g,t} = \sum_{i \in t} \frac{OutageCap_{g,i}\ x\ NoOfIntervals_t}{TotalRegCap_{g,i}}$

Type	Purpose	Calculation
4. Outage Rate	To measure the failure probability of a generating unit/plant	$OutageRate_{g,t} = \frac{OutageDuration_{g,t}}{NoOfIntervals_t}$
5. Capacity gap of each generating plant	To determine if the generator is offering to the market less than its capacity.	$CapGap_{gn,i} = RegCap_{gn,i} - Offer_{gn,i}$ $CapGap_{r,g,i} = \sum_{gn \in g} RegCap_{r,gn,i} - \sum_{gn \in g} Offer_{r,gn,i}$
6. Price Setting Indices a. Price Setting Generators b. Price Setting Frequency	To identify generators that are "price setters" in an interval and the frequency by which these generators set the market prices.	$If\ AcceptedOfferPrice_{gn,i} \geq (95\%)(NodalPrice_{gn,i})$ and $AcceptedOfferPrice_{gn,i} \leq (100\%)(NodalPrice_{gn,i})$, $PriceSetter_{gn,i} = 1$ $PSFI_{gn,t} = \frac{\sum_{i \in t} PriceSetter_{gn,i}}{NoOfIntervals_t}$ $If \sum_{gn \in gp} PriceSetter_{gn,i} > 1,\ PriceSetter_{gp,i} = 1$ $PSFI_{gp,t} = \frac{\sum_{i \in t} PriceSetter_{gp,i}}{NoOfIntervals_t}$

Type	Purpose	Calculation
III. Spot Price Indices		
1. Price Characteristics	To assess spot price levels, distribution, trends and volatility.	
2. Price Forecast Variation	To assess the quality of the market projection processes in estimating expected spot prices.	$PriceVar_{r,i} = \frac{ActualAvgPrice_{r,i} - ForecastAvgPrice_{r,i}}{ForecastAvgPrice_{r,i}}$
3. Spot Price Node Variation Index (SPNVI)	To assess the difference of spot prices in the different market trading nodes.	$SPD_{r,i} = \sqrt{\frac{\sum_{n \in N}\left(NodalPrice_{r,n,i} - AvgPrice_{r,i}\right)^2}{NoOfNodes_{r,i}}}$ $If\ AvgPrice_{r,i} > 0,\ SPNVI_{r,i} = \frac{SPD_{r,i}}{AvgPrice_{r,i}}$
4. Price Duration Curve	To identify the percent of time for which the price was recorded	$Price\ Probability_t = \frac{Count\ of\ Price_t}{NoOfIntervals_t}$ Price Duration Curve is obtained by plotting the price probability for each price point (in ascending order) over a duration of time set as 100%.
5. Supply Margin-Price Index (SMPI)	To identify the intervals with very high or very low prices based on the historical relationship of supply margin and price. Prices within or equal to the upper and lower reference price thresholds are considered as “normal prices”.	The reference price levels for peak and off-peak hours per season are based on the historical monthly GWAP.

Type	Purpose	Calculation
6. Price Spike	To identify the occurrence of a high spot price	The reference price levels for peak and off-peak hours per season are based on the historical monthly GWAP.
7. Sustained High Price	To identify the occurrence of high spot prices for a sustained period.	The reference price level, which is lower than the reference level for the price spike, is exceeded for a specific frequency of consecutive intervals.
8. Price Creep Up	To determine the magnitude of the upward movement of price in terms of percent increase.	The reference price level is exceeded for a specific frequency of consecutive days or weeks with increasing average prices.
IV. Transmission Indices		
1. Transmission Congestion Frequency Indices a. Frequency of constraints b. Duration of constraints (percentage of time in a period)	To assess the impact of transmission congestions on the spot market.	

Type	Purpose	Calculation
2. Transmission Congestion Cost Index (TCI)	To compare the impact of congestion in different periods and/or regions.	$$TCI_{r,i} = \frac{CongestionCost_{r,i}}{TotalEnergy_{r,g,i}}$$ $$TCIP_{r,i} = \frac{TCI_{r,i}}{AvgPrice_{r,i}}$$ $$TCI_{r,t} = \frac{\sum_{i \in t} CongestionCost_{r,i}}{\sum_{i \in t} TotalEnergy_{r,g,i}}$$ $$TCIP_{r,t} = \frac{TCI_{r,t}}{AvgPrice_{r,t}}$$ $$CongestionCost_{r,i} = ConstrainedCost - UnconstrainedCost$$
V. Structural: Market Concentration Indices – Measure the concentration of a market, to assess if existing conditions facilitate or impede competition.		
1. Market Share	To measure the percentage of capacity or energy that a market participant controls in the monitored market.	$$ShareRegCap_{r,gp,t} = \frac{\sum_{i \in t} TotalRegCap_{r,gp,i}}{\sum_{i \in t} TotalRegCap_{r,i}}$$ $$ShareAvailCap_{r,gp,t} = \frac{\sum_{i \in t} TotalAvailCap_{r,gp,i}}{\sum_{i \in t} TotalAvailCap_{r,i}}$$ $$ShareOfferCap_{r,gp,t} = \frac{\sum_{i \in t} TotalOffer_{r,gp,i}}{\sum_{i \in t} TotalOffer_{r,i}}$$

Type	Purpose	Calculation
		$ShareUnschedOffer_{r,gp,t} = \frac{\sum_{i \in t} TotalUnschedOffer_{r,gp,i}}{\sum_{i \in t} TotalUnschedOffer_{r,i}}$ $ShareActualGen_{r,gp,t} = \frac{\sum_{i \in t} TotalEnergy_{gp,i}}{\sum_{i \in t} TotalEnergy_{r,i}}$ $ShareSpotQty_{r,gp,t} = \frac{\sum_{i \in t} TotalSpotQty_{gp,i}}{\sum_{i \in t} TotalSpotQty_{r,i}}$ $ShareTTA_{r,gp,t} = \frac{\sum_{i \in t} TotalTTA_{gp,i}}{\sum_{i \in t} TotalTTA_{r,i}}$
2. Herfindahl-Hirschman Index (HHI)	To measure the degree of concentration. Defined as the sum of squares of the market participants' market shares.	$HHIRegCap_{r,gp,t} = \sum_{gn \in g} \left(ShareRegCap_{r,gp,t}\right)^2$ $HHIAvailCap_{r,gp,t} = \sum_{gn \in g} \left(ShareAvailCap_{r,gp,t}\right)^2$ $HHIOfferCap_{r,gp,t} = \sum_{gn \in g} \left(ShareOfferCap_{r,gp,t}\right)^2$ $HHIUnschedOffer_{r,gp,t} = \sum_{gn \in g} \left(ShareUnschedOffer_{r,gp,t}\right)^2$ $HHIActualGen_{r,gp,t} = \sum_{gn \in g} \left(ShareActualGen_{r,gp,t}\right)^2$

Type	Purpose	Calculation
		$HHISpotQty_{r,gp,t} = \sum_{gn \in g} \left(ShareSpotQty_{r,gp,t}\right)^2$ $HHITTA_{r,gp,t} = \sum_{gn \in g} \left(ShareTTA_{r,gp,t}\right)^2$
VI. Structural: Pivotal Dynamic Indices – Measure market power (and potential benefit of exercising market power) taking into consideration the variables that change dynamically, mainly demand (energy withdrawn), required spinning (or operational) reserve and generation availability.		
1. Pivotal Supply Index (PSI)	To measure how critical a particular generator is in meeting the total demand at a particular time	$ResDem_{r,gp,i} = \left(TotalLoad_{r,i} + TotalLoss_{r,i} + TotalRes_{r,i}\right) - \left(TotalOffer_{r,i} - TotalOffer_{gp,i}\right)$ $If\ ResDem_{r,gp,i} > 0,\quad PivotalSupplier_{r,gp,i} = 1$ $PSI_{gp,t} = \frac{\sum_{i \in t} PivotalSupplier_{r,gp,i}}{NoOfIntervals_t}$
2. Residual Supply Index (RSI) a. RSI of a Generating Plant b. RSI of the whole market	• To measure the ratio of the available generation without a Generator to the total generation (including operational reserve) required to supply the demand. • To determine whether there are pivotal suppliers in an interval	$RSI_{r,gp,i} = \frac{\left(TotalOffer_{r,i} - TotalOffer_{gp,i}\right)}{\left(TotalLoad_{r,i} + TotalLoss_{r,i} + TotalRes_{r,i}\right)}$ $MarketRSI_{r,i} = \min_{gp \in g}\left(RSI_{r,gp,i}\right)$
VII. Generator Offer Indices	To determine trends, pattern or strategy in the offer behavior of generators (i.e., offer curves and segments, frequency and quantity of offer changes).	
1. Offer Curve	To determine the price at which each MW is offered in the market	Offer Curve is obtained by plotting the price point (in ascending order) at which each 1-MW block was offered up to *n* for each *gp* in a given period *t*

Type	Purpose	Calculation
		Where: *n = maximum offered MW* *gpϵg = set of generator groups (e.g. per generator, per resource type, per major participant group)* *t = specific period*
2. Offer Outlier Detection	To measure and detect significant changes in offer prices that fall beyond the upper and lower limit reference offers.	Using historical offer prices and statistical methods, the upper limit (UL) and lower limit (LL) reference offers are calculated. $Within\ Limits = No.\ of\ P_{subject}, \{LL_j \le P_{subject,j} \le UL_j\}$ $Within\ \ Limits_{generator}\% = \frac{\sum_i^k\ (Within\ \ Limits_i)}{\sum_i^k (n_i)} x100\%$ $Within\ \ Limits_{porfolio}\% = \frac{\sum_g^{g_p}\ \sum_i^k\ (Within\ \ Limits_{i,g})}{\sum_g^{g_p}\ \sum_i^k (n_{i,g})} x100\%$ $Higher\ than\ Limits = No.\ of\ P_{subject}, \{P_{subject,j} > UL_j\}$ $Higher\ \ than\ \ Limits_{generator}\% = \frac{\sum_i^k\ (Higher\ \ than\ \ Limits_i)}{\sum_i^k (n_i)} x100\%$ $Higher\ \ than\ \ Limits_{portfolio}\% = \frac{\sum_g^{g_p}\ \sum_i^k\ (Higher\ \ than\ \ Limits_{i,g})}{\sum_g^{g_p}\ \sum_i^k (n_{i,g})} x100\%$

Type	Purpose	Calculation
		$Lower\ than\ Limits\ = No.\ of\ P_{subject}\ , \{LL_j > P_{subject,j}\}$ $Lower\ \ than\ \ Limits_{generator}\% = \frac{\sum_i^k\ \ (Lower\ \ than\ \ Limits_i)}{\sum_i^k (n_i)} x100\%$
3. Offer Average Price Difference	To measure the magnitude of change of offers from reference offers in terms of price and percentage	$PD_{generator,peak/offpeak} = \frac{\sum_i^k \sum_{j=Offer_1}^n (P_{subject,j,i} - P_{reference,j,i})}{\left\|\sum_i^k \sum_{j=Offer_1}^n (P_{reference,j,i})\right\|} \times 100\%$ $PD_{portfolio,peak/offpeak} = \frac{\sum_{g=1}^{gp} \sum_i^k \sum_{j=Offer_1}^n P_{subject,j,i,g} - P_{reference,j,i,g}}{\left\|\sum_{g=1}^{gp} \sum_i^k \sum_{j=Offer_1}^n (P_{reference,j,i,g})\right\|} \times 100\%$ $APD_{generator,peak/offpeak} = \frac{\sum_i^k \sum_{j=Offer_1}^n (P_{subject,j,i} - P_{reference,j,i})}{\sum_i^k n_i}$ $APD_{portfolio,peak/offpeak} = \frac{\sum_{g=1}^{gp} \sum_i^k \sum_{j=Offer_1}^n (P_{subject,j,i} - P_{reference,j,i})}{\sum_{g=1}^{gp} \sum_i^k n_i}$ Where: Within Limits = count of price offers per megawatt of a generator that are within limits $APD_{generator}$ = the average difference between the average subject

Type	Purpose	Calculation
		offered price and the average reference offered price of a generator. $PD_{generator}$ = Percent Difference on the offered price of a generator between the subject offer and the reference offer. $APD_{portfolio}$ = the average difference between the average subject offered price and the average reference offered price $PD_{portfolio}$ = Percent Difference on the offered price of a portfolio between the subject offer and the reference offer. $P_{subject}$ = Subject Offered price on a particular MW, the average of offers on a particular MW during days with high prices $P_{reference}$ = Reference Offered price on a particular MW, the average of offers on particular MW during days with Normal Prices n = maximum offered MW j = MW value I = starting interval k = ending interval g = generator gp = total number of generators within the portfolio $Offer_1$ = 1st offered MW
4. Bid Splitting Behavior	To determine if a generating unit or a generator group offers majority or almost its entire capacity at lower prices while simultaneously bidding a small portion of its capacity at high prices.	The reference price level for the high prices is close or equal to the market offer price cap.

Subscripts Notation

i - specific interval
t - specific period
iϵt - all interval ***i*** in period ***t***

r - system or regional (Luzon, Visayas, and Mindanao)
c - customers
cn - customer node
cp - customer group (i.e., Trading Participant, Major Participant Group)
cn∈c - set of customer nodes
cg∈c - set of customer groups
g - generators
gn - generator node
gp - generator group (i.e., Generating Plant, Trading Participant, Major Participant Group)
gn∈g - set of generator nodes
gp∈g - set of generator groups