Operation of the WESM

An introduction to operation of the Wholesale Electricity Market in the Philippines

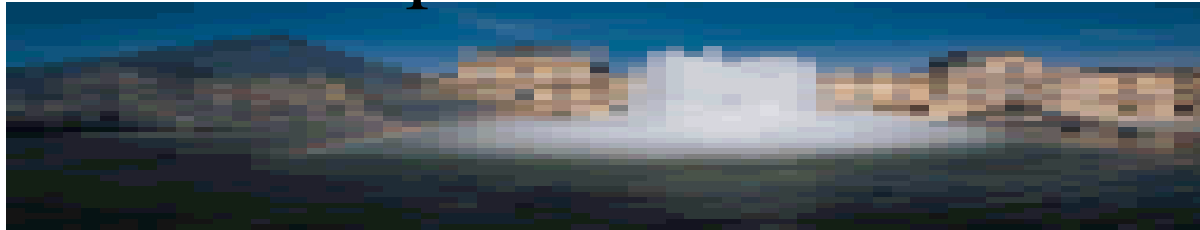**Presented in Cooperation with**

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The WESM

- Principles
- How does the market work?
- Bidding?
- What does it mean to a Participant?
- Prices – who pays what to whom?
- Conclusions.

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How Does The Market Work

- Principles

- Who Does What ?

- Take a Look !

- Timetable

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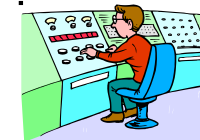
Principles – What is it ?

- Centrally Dispatched Near Real Time Security Constrained Nodal Priced, Gross Pool
  - Trading in Energy, Reserve, and Regulation.
  - Integrated Network Constraint Management.
  - Nodal Pricing and Payment
    - Hourly
  - Zonal Charging (CZP_Z)
  - Contracted Ancillary Services
    - Reactive Power, Voltage Support, Fast Start, Black Start
  - Support for Bilaterals through Volume Notification.
    - Note: Has no Impact on Dispatch.
  - Extension of retail competition.

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Principles - Who Does What

- Market operator (MO)
  - Forecasts Demand
  - Runs the bidding and Settlement Process
  - Runs Economic Dispatch
  - Maintains the Meter Data Collectors
  - Keeps Track of Meter to Participant Mapping (Who owns which Meter)
  - Collects and aggregates Metering Data
  - Settles charges for use of the Transmission System, System Operations, and Market Operations.
- SO (A division of the Transmission Company)
  - Dispatches following MO schedules.
  - Coordinates Synch and De-Synch of Units.
  - Coordinates Maintenance.
  - Dispatches non Market Ancillary Services against Contracts.
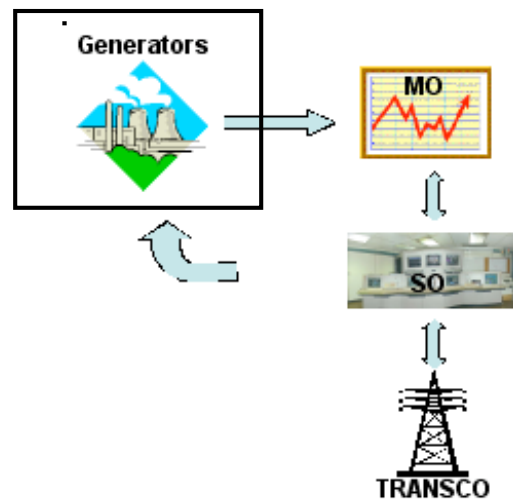 - Takes full control in times of High Risk or Emergency.
- Transmission Licensee (Transco)
  - Maintains the Grid Network
  - Maintains the Metering Infrastructure (Meters)
    - In future the role of MSP can be provided by independent organisations providing they are licensed so to do.

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Take a Look 1

The Generators bid
to the Market

Take a Look 2
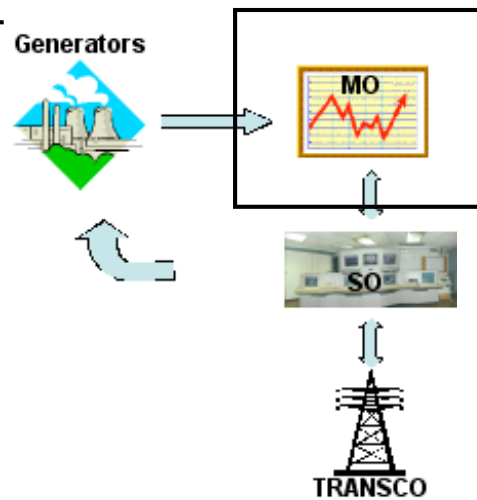
- The MO Runs an Optimiser to schedule the generators to meet demand for Energy, Contingency Reserve, and Regulation for the coming hour. Taking account of the status of the network.
- The MO Publishes Dispatch Schedules on the web site.
- The MO Publishes Demand Forecasts, Nodal and Zonal Prices and the Network Model on the Web Site.
- The MO takes meter data from the TRANSCO and then settles the market exchanging money between each participant.

Take a Look 3
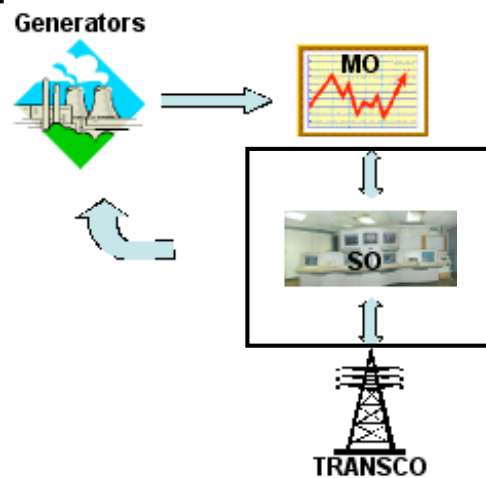
- The SO provides updates to the network status to the MO together with the current operating levels of all the generating units.
- SO receives Dispatch Schedules from the MO.
- The SO dispatches Energy, Contingency Reserve, and Regulation in accordance with the MO Scedule.
- The SO Dispatches ancillary services and calls for reserves in real time.
- The SO coordinates Sych and Desynch of Plant with the Gencos.

Take a Look 4
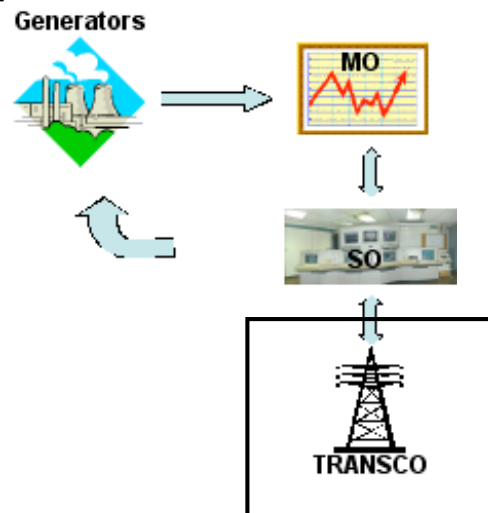
• The TRANSCO looks after the wires and will perform maintenance and switching operations in coordination with the SO.
• As you will see later the TRANSCO is also responsible for reading the meters of the market trading participants and providing these to the MO for settlements purposes.

Take a Look 5

• The Big Energy Users can buy directly from the market. They will have interval meters installed that are capable of adding up their hourly consumption pattern. They can bid services to shed load into the market where they have this capability.
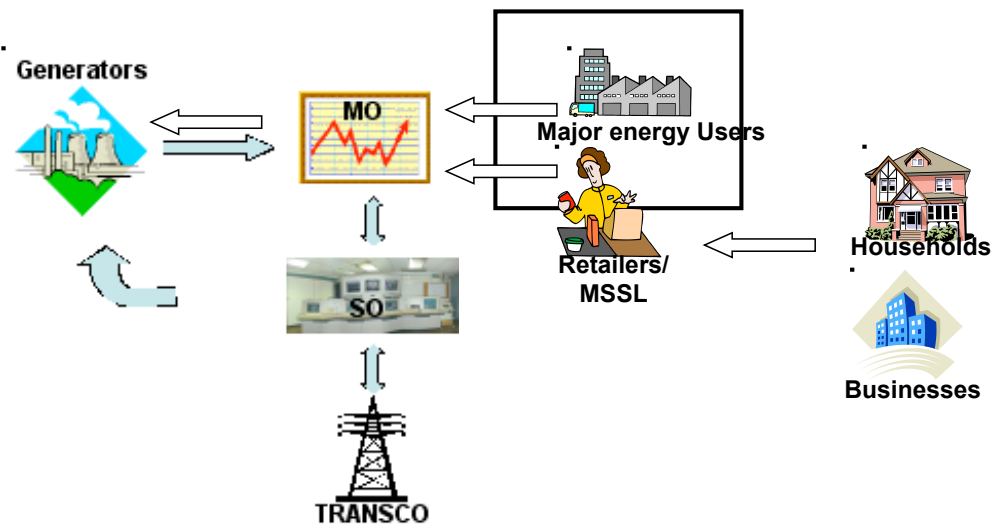
Take a Look 6

• The Suppliers/Distribution companies will buy all of their energy from the market. If they wish to hedge market prices then they will need to enter into Contracts with the Generators. These will be of CfD (Contract for Differences) form as will be seen later in the course..
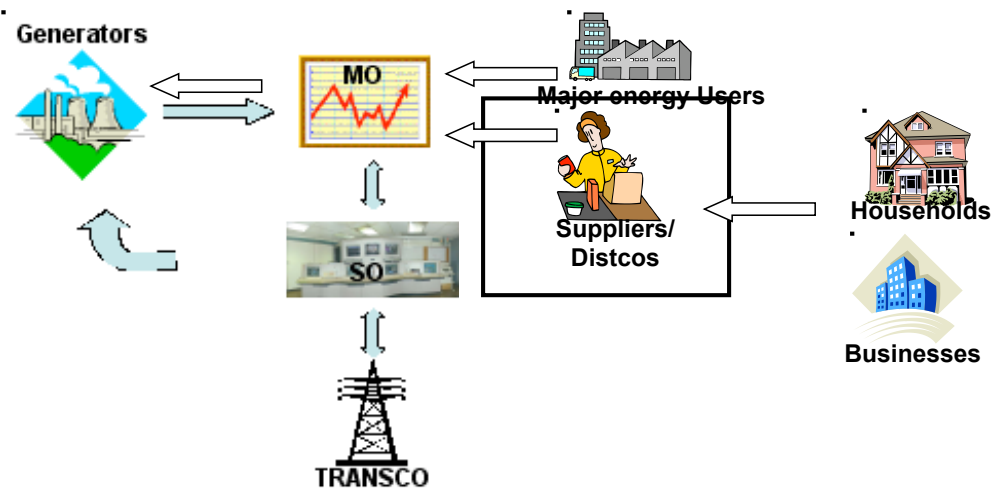
Take a Look 7

• The domestic and commercial customers will buy their energy from retailers. As time goes on there will be more choice in which retailer they can buy from up to the time where all will be able to choose from whom they buy their electricity. This process starts with opening up of the big consumers that are connected to the transmission system immediately. For those embedded in the Distribution networks the process starts one year after opening of the market.
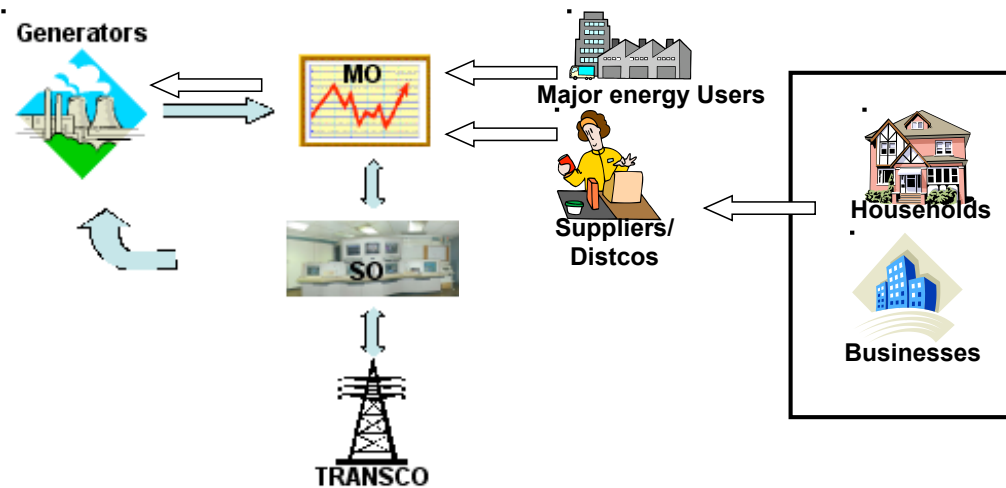
Take a Look 8

• The MSP (Meter Services Provider) will read the meters and pass on the meter readings to the MO for settlements (calculating market payments to Generators and charges to Consumers).

• Initially the job will be done by the TRANSCO. Later it will be possible for other companies to offer these services.
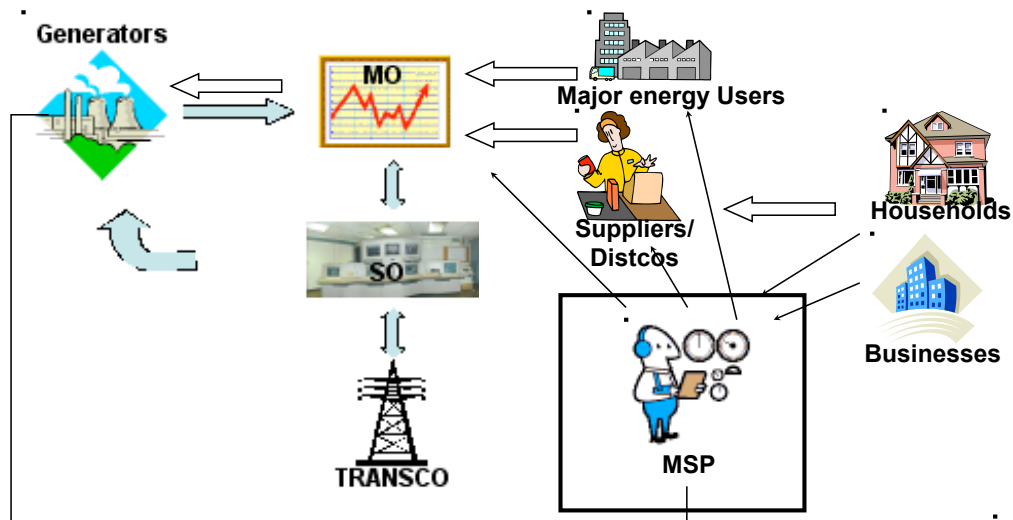
Take a Look 9
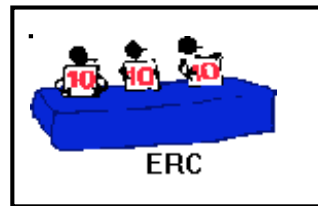
• The ERC (Electricity Regulatory Council) on behalf of the Department of Energy will oversee the market and make sure fairness prevails.

ERC

Generators

MO

Major energy Users

Suppliers/ Distcos

Households

SO

Businesses

TRANSCO

MSP

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WESM
Summary

TRANSCO

SO

Centrally Dispatched Generators and Scheduled Loads CGUs/SLs

MO

$

$

$

$

Direct Market Customers DMCs

Meters

Meter Data Collector MSP

Offers

Instructions/ Information

Meter Volumes

$

$

Retailers

Businesses

Households

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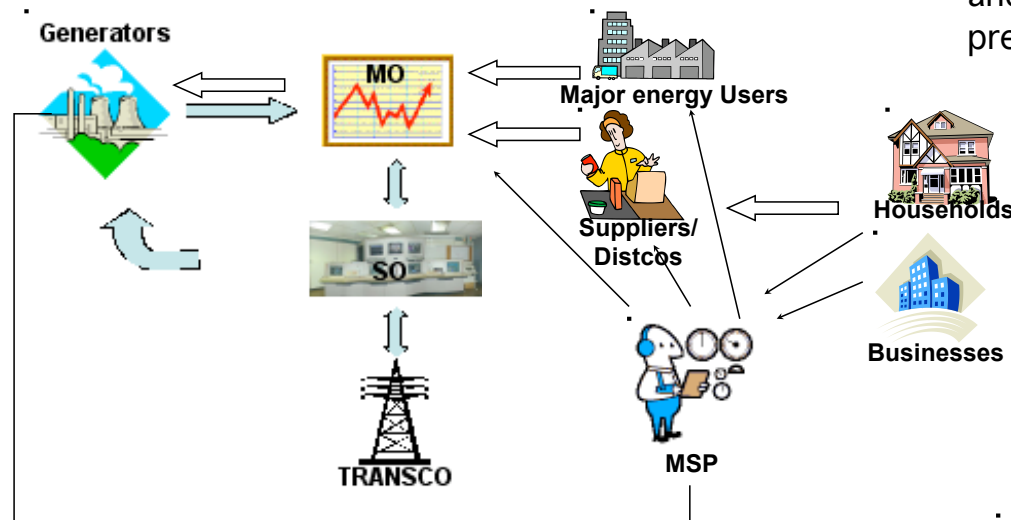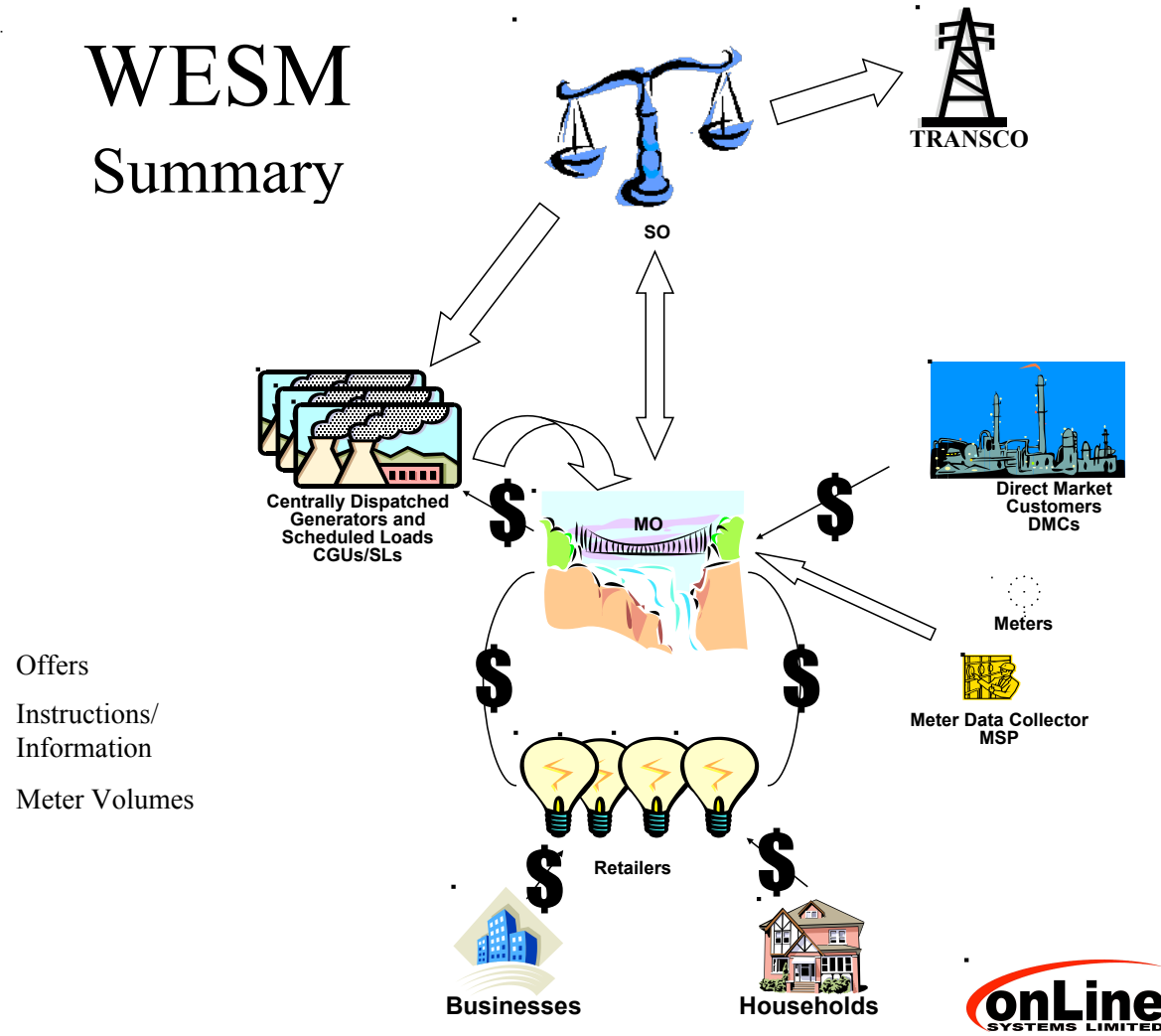
Timetable

One week ahead a market outlook dispatch is performed. This is done using forecast data for the coming week. The outlook is performed everfy day and gives a view on the market prices and likely demands for energy. It is intended to give the trading participants time to plan their activities and in particular for Generators to plan their unit commitment schedules.

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

Settlement ready meter
data provided by the MO.

Initial Settlement
Statement Published by
the MO

Settlement results are
reviewed.

The Market clears and all moneys
are paid into and out of the
market.

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Timetable

One day ahead Pre-Dispatch is run. This is run every four hours and presents a picture of the forecast market prices and demand for the coming 24 hours. This allows participants to prepare their units for the next day's schedule. Pre-dispatch always starts with the most recent offers submitted by participants, and uses the most up to date demand forecast network status and generator loading information available to the MO.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

Settlement ready meter
data provided by the MO.

Initial Settlement
Statement Published by
the MO

Settlement results are
reviewed.

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market.

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Timetable

Real time dispatch runs at the start of each hour (or rather 5 minutes before that to give the systems time to calculate the best schedule). This uses the network status and Generator loadings current at the start of the hour, together with the most recent offers/offer variations lodged with the market for the participant concerned. Real Time Dispatch produces prices which are binding and will be used in market settlements. The schedules it produces will be sent to the market operator and presented on the MO bid site. All trading participants are required to operate their plant in accordance with these schedules unless explicitly dispatched to the contrary by the SO.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

Settlement ready meter
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Initial Settlement
Statement Published by
the MO

Settlement results are
reviewed.

The Market clears and all moneys
are paid into and out of the
market.

Timetable

Within a couple of days of the market operating the meters will all be read by the TRANSCO for the market day concerned. This data will then be sent up to the MO for use in settling the market.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

**Initial Settlement
Statement Published by
the MO**

**Settlement results are
reviewed.**

**The Market clears and all moneys
are paid into and out of the
market.**

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Timetable

Once the meter data is available the MO will perform an initial settlements run. This will calculate and publish the market prices and will inform individual participants of their own settlement quantities and payments. The initial settlment information is provided for information purposes only to give Participants time to make sure they agree with the sums in advance of final settlements taking place.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

Settlement ready meter
data provided by the MO.

Settlement results are
reviewed.

The Market clears and all moneys
are paid into and out of the
market.

Timetable

After the initial settlements there is some time given for participants to review the results and raise any issues they may have with them with the MO.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

Settlement ready meter
data provided by the MO.

Initial Settlement
Statement Published by
the MO

The Market clears and all moneys
are paid into and out of the
market.

Timetable

Around a month after the trading day the MO will publish the final settlements statements. The sums detailed thereon mut be paid to and from participants within a few days of the final statement being issued.

D-7 (by 09:00)
Daily Market Outlook
for next 7 days in hourly
intervals

D-1 (T-15) starting 12:00pm
Pre-Dispatch 4 hourly
covering the periods up to
24:00 on day D

D (T-5)
Real Time Dispatch hourly at 5
minutes prior to the star of the
hour covering the next hour

Settlement ready meter
data provided by the MO.

Initial Settlement
Statement Published by
the MO

Settlement results are
reviewed.

Bidding

- Generating Units
- The Market Bid
- Dispatch
- Price Setting

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Generating Units

A Bid is made for each individually controllable generating unit in the power station.

The Station Below has 4 Units

Transformer

The Transmission Network
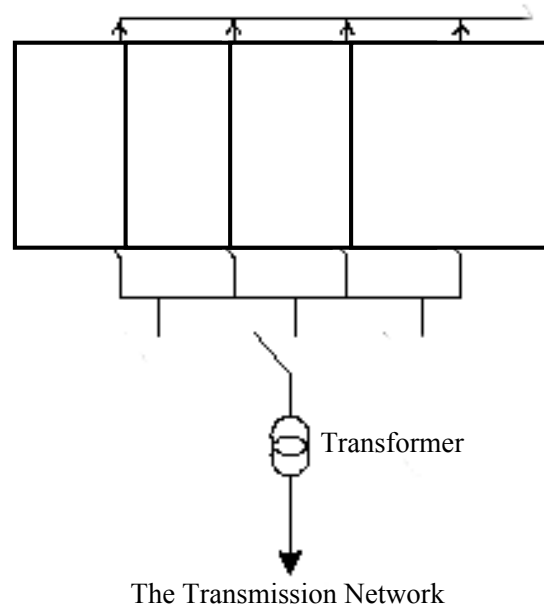
The Market Bid 1

There are 10 Blocks of availability and Energy in each bid. The Availabilities and prices in each block must be greater or equal to those in the block previous. The Availability of the first block represents your minimum generation level. You will only be dispatched by the system at or above this figure.

Unit		MaxAv	Blocks	Avail	Price
1	MaxAv	300			
	MaxAv'	294			
	Minav'	0			
RUR	500				
RDR	500				
InitMw		0			
GLF	2%				
Node		20			
		100	c1	10	50
			c2	20	100
			c3	30	150
		50	r1	10	50
			r2	15	200
			r3	20	500

The Market Bid 2

There are 3 Blocks of available Contingency Reserve and prices in each bid. The Availabilities and prices in each block must be greater or equal to those in the block previous. The Availability of the first block represents your minimum dispatch level. You will only be dispatched by the system at or above this figure.

Unit		MaxAv	Blocks	Avail	Price
1	MaxAv	300	b1	50	0
	MaxAv'	294	b2	100	30
	Minav'	0	b3	120	31
RUR	500		b4	130	32
RDR	500		b5	140	33
InitMw	0		b6	150	34
GLF	2%		b7	160	35
Node	20		b8	200	36
			b9	210	37
			b10	220	80
		100			
		50	r1	10	50
			r2	15	200
			r3	20	500

The Market Bid 3

There are 3 Blocks of available Regulating Reserve and prices in each bid. The Availabilities and prices in each block must be greater or equal to those in the block previous. The Availability of the first block represents your minimum dispatch level. You will only be dispatched by the system at or above this figure.

Unit		MaxAv	Blocks	Avail	Price
1	MaxAv	300	b1	50	0
	MaxAv'	294	b2	100	30
	Minav'	0	b3	120	31
RUR	500		b4	130	32
RDR	500		b5	140	33
InitMw	0		b6	150	34
GLF	2%		b7	160	35
Node	20		b8	200	36
			b9	210	37
			b10	220	80
		100	c1	10	50
			c2	20	100
			c3	30	150
		50			

The Market Bid 4

You also submit your maximum offered Availabilities for Energy, Contingency Reseve and Regulation. The system will not dispatch you above these levels. The price shown in the last block will be the price for all energy from the last block availability up to the maximum offered. The maximum offered figure must be greater than or equal to the availability in the last block.

Unit		MaxAv	Blocks	Avail	Price
1	MaxAv		b1	50	0
	MaxAv'	294	b2	100	30
	Minav'	0	b3	120	31
RUR	500		b4	130	32
RDR	500		b5	140	33
InitMw	0		b6	150	34
GLF	2%		b7	160	35
Node	20		b8	200	36
			b9	210	37
			b10	220	80
			c1	10	50
			c2	20	100
			c3	30	150
			r1	10	50
			r2	15	200
			r3	20	500

The Market Bid 5

Your GLF represents your Generator Losses that will be incurred between your unit location and the connection to the node on the network model to which you are allocated. This will be used together with your Iniit MW, Run up and run Down Rates to adjust your availability down and your price up to reflect the deliverable energy and prices at that node. The adusted availability figures showing the max and min levels the system will dispatch you at are shown in the diagram as MaxAv' and MinAv' respectively
The Init MW shown in blue is the level you are operating at at the start of the hour being scheduled.

Unit		MaxAv	Blocks	Avail	Price
1	MaxAv	300	b1	50	0
			b2	100	30
			b3	120	31
			b4	130	32
			b5	140	33
			b6	150	34
			b7	160	35
Node	20		b8	200	36
			b9	210	37
			b10	220	80
		100	c1	10	50
			c2	20	100
			c3	30	150
		50	r1	10	50
			r2	15	200
			r3	20	500

Dispatch 1

- For each of your units you will receive one dispatch instruction if that unit is in merit.
    - The Dispatch instruction screens will display all or a selection of your power stations and units together with their target output levels.
    - The quantity dispatched represents the target output for your unit at the end of the schedule period (ie end of the hour).
    - You are required to ramp your unit linearly across the hour to meet the target dispatch by the end of that time.
- You will be dispatched for energy that you should actually produce.
- You will be dispatched for Contingency Reserve and Regulation holding that you must keep available.

Dispatch 2

- If reserves or regulating energy is needed within the hour then this will be dispatched by the SO.
  - The real time dispatch of regulation and reserves will result in changes to your energy produced.
  - That will in turn affect your market energy payment (either increase or decrease it).
  - If Contingency reserve is called then your revenues will likely increase from the energy you supply in the hour concerned. Your available reserves at the end of the hour may well be less as a result however so that the next hour will result in an adjustment.
  - If regulating reserve is called then you may generate either more or less than your scheduled level and so may either gain or loose energy revenues respectively.

Price Setting 1

- Price Setting is Nodal

- The Market sets the prices as follows:
  - All Generators are connected to the network at their Market Network Node (MNN)
    - The Market Network Node is the point at which the generator is metered.
  - The Generator is allocated a loss factor from its point of metering to the nearest Transmission Network Node (TNN) defined in the network model.
    - This will normally be one or more transmission substations grouped together representing a localized uncongested region of the transmission system.
  - The Generator bid to the market is adjusted to take account of losses and that produces an adjustment to the volume it offers to the market and the price. The volume is reduced and the price increased respectively reflecting the actual cost of the generator supplying the energy to the TNN.

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Price Setting 2

- The Generators are scheduled such to meet the forecast demand at each TNN
  - taking account of the ability of the network to transport their energy.

- In the scheduling process a shadow price is calculated.
  - This represents the cost of delivery of the next required megawatt of energy to each of the TNNs (above that which is forecast). Where there is congestion in the transmission system there can be different prices seen at each TNN.
  - The generator nodal prices are loss adjusted to the point of their metering. Even where there is no congestion each generator will see slightly different prices since the losses allocated to each will depend on how far they are from the TNN, and on the type of transformer that connects them to the transmission system.

- The Customer Zonal Price is then Calculated
  - The TNN prices are aggregated to form a single weighted average price for each Customer Pricing Zone. The weighted average is calculated by adding up the price at each node multiplied by the demand forecast at each node then dividing this by the total demand in the zone.

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Full Network Diagram

Legend (generation types):
- Geo 220/370
- Thermal 280/650
- Hydro 15/75
- Pump5 50/300
- Gas T 240/620
- Nat Gas 960/1500
- Coal 300/600
- Diesel 120/210

N10
- BAYOMBONG
- TUGUEGARAO
- AMB 15/75
- SANTIAGO
- MAG 140/360
- BIN 40/240

N1n
- SUAL 500/1000
- 4-600
- LABRADOR
- BOT
- MSLC
- 300/600
- OLONGAPO
- S MANUEL
- 2-600
- 50/340

N9
- BPPC 120/210
- BAGUIO
- LAOAG
- BANTAY S ESTEBAN
- BAUANG
- 40/140 AK

N8
- CONCEPCION
- CABANATUAN
- SAN ROQ.
- MEXICO
- MALOLOS
- PAN 10/100
- CASEC 50/140
- 4-600

N7
- SBC2 14/116
- HERMOSA
- BTPP LIMAY
- 240/620

N6
- CND
- DUHAT
- BALINTAWAK
- 3-300
- ARANETA
- 3-300
- SUCAT
- 3-300
- **METRO-MANILA**

N5
- S JOSE
- 4-600
- DOLORES
- 4-300
- MAL
- 280/650
- KAL
- 50/300

N1s
- ZAPOTE
- 3-300
- 3-600
- DASMA

N4
- BINAN
- S ROSA

N3
- MAKBAN
- MAKBAN
- MAKBAN
- MAKBAN
- CALAUAN
- GUMACA
- 220/370
- BTGAS
- PCN 14/111
- 720/1200

N2
- CLC
- ST. RITA/SAN LO
- 380/560
- 960/1500

N1s
- TAYABAS
- 3-600
- LABO
- 200/450
- GPPL 240/764
- NAGA
- PBL
- 500 kV line (energized @ 230 kV)
- 180/440 HVDC
- BAKMAN 79/148
- DARAGA TIWI TIWI TIWI
- 210/330

LEGEND:

500 kV	
230 kV	
115 kV	

LINE CAPACITY:
- = 150 MW
- = 300 MW
- = 600 MW
- = 1200 MW
- = 2650 MW

NOTES:
1. → 1 – 795 MCM ACSR
2. Only 230/115 kV Transmission System are reflected in this SLD.
3. Metro Manila is represented up to 230 kV bulk substations.

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Reduced Network Diagram

•Bin
•Mag
•Amb — Exp 675 Dem 0

•San Roc
•Casec
•Pan — Exp 580 Dem 500

•SBC2 — Exp 735 Dem 0

•Limay

Node10 — 600 → Node8 — 600 → Node7

L13

600 L12

BPPC
BAK — Exp 350 Dem 500

2400 L10

600 L8

1200 L7

Node9 ← 600

L11

Node1N — 3000 → Node5

L6

•MAL — Exp 650 Dem 1500

•SUAL
•MSLC — Exp 1600 Dem 1000

L5 — Exp 0 Dem 1500

2400

600

•Iljan
•Tiwi
•HVDC
•PBL
•QPPL
•Bakman — Exp 3342 Dem 1000

3200 L3

Node6

Node1S

1800

•Makaban

PCN — Exp 481 Dem 0

600 L14

L4

1200 L1

Node2 — 1200 L2 → Node4 ← 600 — Node3

L15

Exp 0 Dem 0

•St Rita/San Lorenzo
•CLC — Exp 2060 Dem 0

What Does it mean to Participants

- Generators
- Retailers
- Customers

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Generators

- Need to contract with retailers, end customers and traders in order to guarantee revenues
- Need to take account of the impact of network constraints on nodal prices and adjust trades accordingly.
- Need to plan and operate self commitment of plant.
- Need to adjust bids as the market dispatch interval approaches in order to optimise trading position.
- Need to lodge Bilateral contracts that are to be settled inside the market.
- Need to operate in accordance with the MO produced Schedules
- Need to record any SO instructions and take them into account when checking market settlements.

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Retailers

- The opening of the market to full competition in stages following live operation of the WESM means the retailer needs to be able to win and manage potentially large numbers of customers (provide quotes, contract take on, issue bills and handle customer inquiries).
    - Likely emergence of different types of retailer to address different segments of the market.
- Need to forecast customer demand in order to maintain the buy and sell balance of energy as closely as possible to needs.
- Need to trade contracts to manage the cost base.
- The retailer needs to design products that will be acceptable to its customers whilst managing its business risks.
- The retailer needs to be able to verify its accounts and settle invoices with the market on a daily basis.

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What does it mean to the Customer?

- Initially Major Energy users can opt to operate in the market as Scheduled Loads.

- Major Energy Users can buy direct from the market (Direct Market Customers)

- Over Time More customers will have choice of supplier.

  – Then, if service levels are not good, you can change supplier.

  – If prices are too high then you can move to someone cheaper.

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Who pays what and to whom ?

- The MO Levies Payments and charges for Energy, Regulation and Reserves with:
    - Market Participant Generators
    - Scheduled Loads
    - Direct Market Customers
    - and Retailers (The existing Distribution Companies).
- MO levies charges on all Market Participants for:
    - Use of the Transmission System;
    - Market Operations;
    - and System Operations
- Participants pay the MSP (Transco) for their metering installations.

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What are the market payments

Settlements

NOTE- Indicative only at this stage

- You get Paid: (Note Payments may be –ve)

$NASC_h = NESC_h + NFSC_h + NRSC_h + NTSC_h$

$- (HEUC_h) * WEQ_h$

where:

h = a settlement interval – 1 hour

- NESC= Net Energy Settlement Credit
- NFSC=Net Regulation Settlement Credit
- NRSC=Net Reserve Settlement Credit
- NTSC=Net Transmission Right Settlement Credit (0)
- HEUC=Hourly Energy Uplift Charge *
- WEQ=Withdrawal Energy Quantity

Net Energy Settlement Credit

- $$NESC_h = GESC_h - LESD_h + BESC_h$$

- GESC = Generation Energy Settlement Credit
  - This is the money paid for metered generation at the price set for the market network node in the real time dispatch schedule for the half hour concerned.

- LESD = Load Energy Settlement Debit
  - This is the money charged for energy usage at the price set at the Customer Zone – the Customer Zonal Price (CZP_z).

- BESC = Bilateral Energy Settlement Credit
  - This is the difference between the quantity of energy consumed and the quantity contracted charged at the CZP_z for any bilateral CfD lodged with the market for the period concerned. It has the effect of removing the bilateral volumes from the market energy charges.

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Net Regulation Settlement Credit

- $$NFSC_h = FSC_h - FSD_h + FCC_h{}^a$$

- FSC = Regulation Settlement Credit
  - This is paid at the Regulation Price (single price for the market for the period) for the total regulation scheduled in the real time dispatch run.

- FSD = Regulation Settlement Debit
  - This is calculated to recover the cost of regulation across all participants.

- FCC = Regulation Contract Credit
  - This is the difference between the quantity of regulation scheduled and the quantity contracted charged at the equivalent unit rate for any bilateral regulation CfD lodged with the market for the period concerned.

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Net Reserve Settlement Credit

- $$NRSC_h = \Sigma_r (RSC_{r,h} + RCC_{r,h}) - RSD_h$$

- RSC = Reserve Settlement Credit
  - This is the amount of reserve scheduled in each reserve zone multiplied by the reserve price for the zone.

- RCC = Reserve Contract Credit
  - This is the difference between the quantity of reserve scheduled and the quantity contracted charged at the reserve rate per reserve zone for any bilateral regulation CfD lodged with the market for the period concerned.

- RSD = Reserve Settlement Debit
  - This is the charge levied across generators and consumers to recover the cost of reserve.

Net Transmission Right Settlement Credit

- NTSC
    - The intent of FTRs is to provide a financial instrument that can allow market participants to hedge the difference between their nodal price and the prices seen in each Zone, and further to hedge the price differences between Zones.

    - Details of how the transmission rights will be handled and who will manage them remains an open issue for now.

Settlement Surplus

- $$HEUC_h = HEUA_h / \Sigma_a WEQ_h{}^a$$

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- HEUC is an uplift charge or payment which recovers the financial imbalance in the market in each settlement interval (the difference between moneys paid and moneys received) pro rata across all consumption.

- HEUA = the total financial imbalance in the period.

- WEQ = the total energy consumed in the period.

- Note: This charge may in the end not be levied/paid as it is possible the imbalance profit in the market will be used to finance FTRs, or may be paid in the form of incentives to the System Operator.

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Conclusions

- Generators will have a lot of new things to do:
    - Plan their operation
    - Commit their own plant
    - Get their bids right
    - Compete
- Existing retailers will see the rise of competition as the customers are able to choose their suppliers.
- Customers will be able to choose their suppliers and get better service and prices as a result.
- New investors will come along as market prices rise developing new cost effective generation.