Philippine Electricity Market Corporation

WESM PRICE DETERMINATION METHODOLOGY

Expository Presentation

08 NOVEMBER 2017
GENERAL SANTOS CITY

WESM Price Determination Methodology

- ✓ Central Scheduling and Pricing
    - ▪ Locational Marginal Pricing
- ✓ Mechanism for Automatic Pricing Re-run when Pricing Error Occurs
- ✓ Special Pricing Conditions
- ✓ Settlement
- ✓ Reserve Co-optimization

Central Scheduling and Pricing

BACKGROUND
Central Scheduling and Dispatch of Electricity

Generating Plants
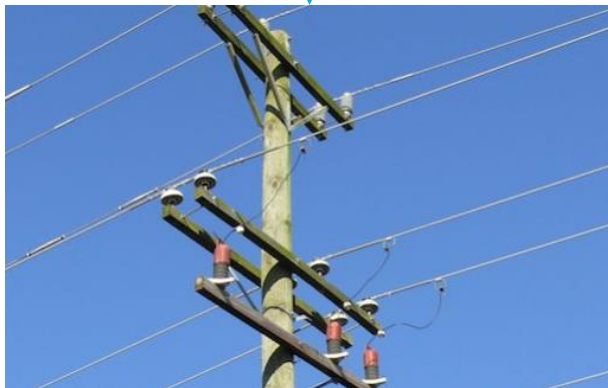
High Voltage Transmission System (NGCP)

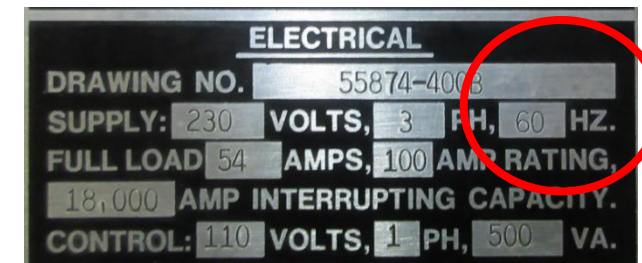**Generating Plants (Operating Reserve Provider)**

Distribution System (Electric Coops)

System Balance ~ 60 Hz

Customers

Metering Services Provider

BACKGROUND
EPIRA (RA 9136)

- New Generating Plants
- Transmission Development
- System Operation
- Central Scheduling
- Metering Services

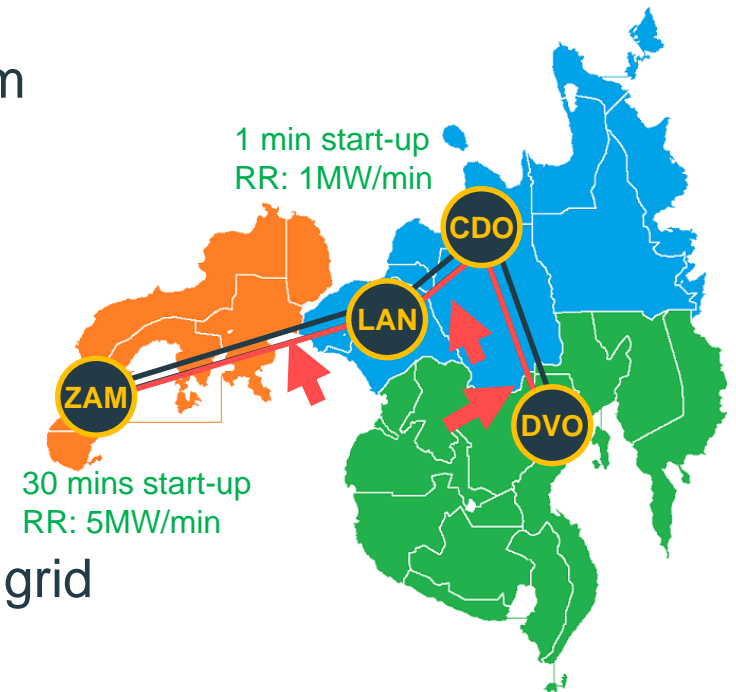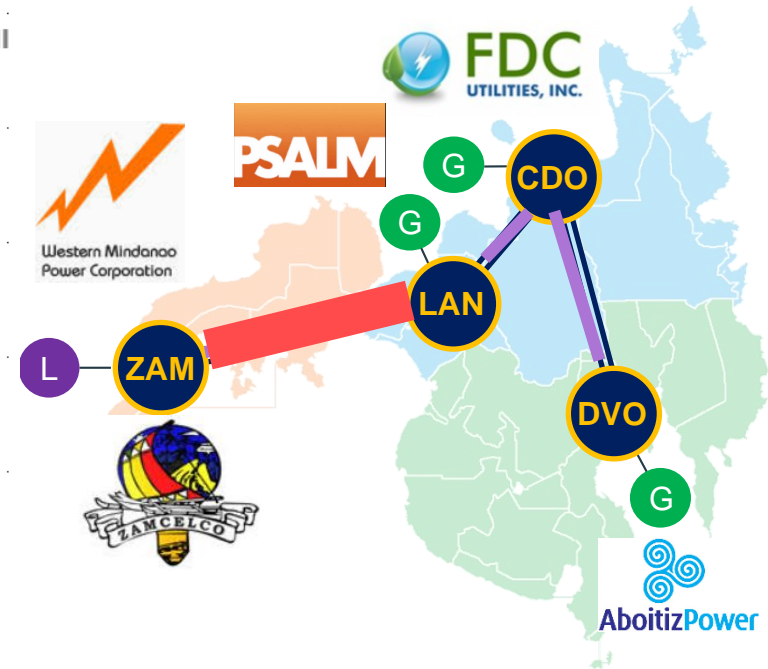**Generating Companies**

Ecozones

Electric Coops

Private DUs

DCCs

BACKGROUND
Power Systems

✓ The Grid is centrally scheduled to maintain system balance at all times (Frequency = 60 Hertz)

✓ The transmission system has limited capacity

✓ Any transmission line must not be overloaded to prevent tripping (and system blackout)

✓ Generators and Load centers are geographically dispersed.

✓ Electricity from a generator once injected into the grid can not be identified or directed to specific consumers.

✓ Generators are also subject to physical limitations (ramping limits)

1 min start-up
RR: 1MW/min

CDO

LAN

ZAM

DVO

30 mins start-up
RR: 5MW/min

Demand
1MW

Coal	Solar
Geo	Nat Gas

WHOLESALE ELECTRICTY SPOT MARKET
POWERING PROGRESS
2006 - 2016

Philippine Electricity Market Corporation

Scheduling and Pricing
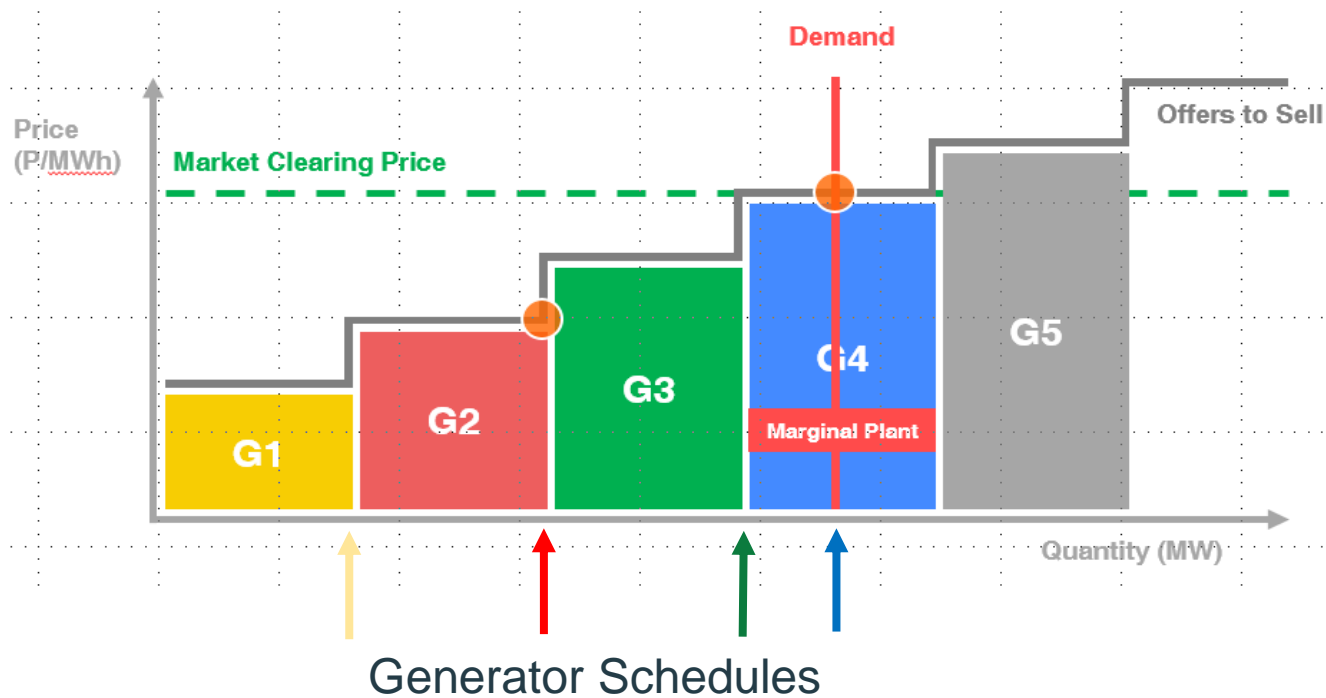
Locational Marginal Price = System Marginal Price + cost of losses + cost of congestion (if any)

Cost of Losses

Scheduling and Pricing
Cost in Transporting Goods

P 100 per box
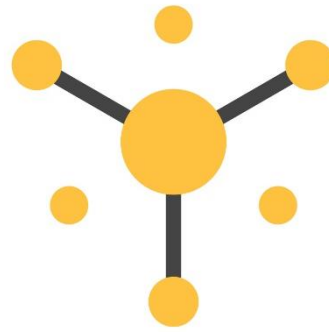
Cagayan de Oro

Davao

Scheduling and Pricing
Cost in Transporting Goods

P 110 per box

Cagayan de Oro

P 100 per box

Davao

Cost of Delivery = P 10 per box

The cost of transporting the commodity (e.g. gas, toll) represents the cost of losses.

Scheduling and Pricing
Delivery of Electricity

Actual losses are affected by size of cable, length, and current loading (I^2R)

3% losses (3.09 MW)

Since loss is a result of the delivery of electricity to the load, cost of losses is attributed to the load

G

103.09 MW

× P 3,000 / MWh

P 309,278

Cost of losses is accounted for in the load price

100 MW

× P 3,092.78 / MWh

P 309,278
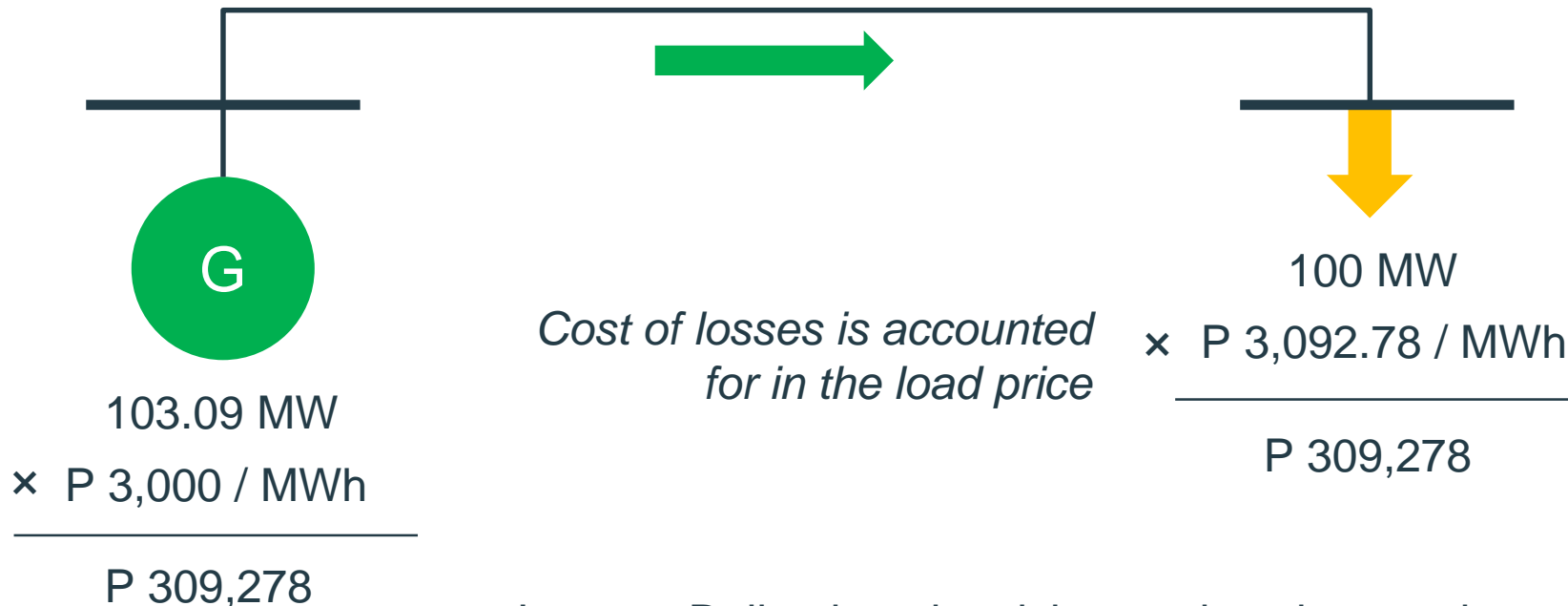
Losses: Delivering electricity to a location results in natural technical losses

WHOLESALE ELECTRICTY SPOT MARKET
POWERING PROGRESS 2006 - 2016

Cost of Congestion

Scheduling and Pricing
Cost due to Limited Road Infrastructure

P 100 per box

Cagayan de Oro

Davao

Scheduling and Pricing
Cost due to Limited Road Infrastructure

Constraint: Bukidnon-Davao highway was damaged and Davao can not serve all of Cagayan de Oro's demand

P 100 per box

Cagayan de Oro

Davao

Additional Cost Resulting from Constraint = P 30

P 130 per box

The additional cost of sourcing the commodity from more expensive sources due to constraints represent the cost of congestion.

Cagayan de Oro would have to source from another place

Zamboanga

Market Corporation

Scheduling and Pricing
Delivery of Electricity

150 MW

2 × 100 MW

G1

G2

Offer: 300 MW
@ P 3,000 / MWh

Demand:
150 MW

Offer: 100 MW
@ P 5,000 / MWh

Total Cost = 150 × 3,000
= PhP 450,000

Scheduling and Pricing
Delivery of Electricity

If one line is on outage, transfer capacity is reduced.

Outage requires dispatch of generators with higher offers

100 MW →

2 × 100 MW

← 50 MW

1 × 100 MW

Demand: 150 MW

G1

G2

Offer: 300 MW @ P 3,000 / MWh

Offer: 100 MW @ P 5,000 / MWh

Total Cost = 100 × 3,000 + 50 × 5,000
= **PhP 550,000**

Additional Cost from Congestion = 550,000 – 450,000
= **PhP 100,000**

PRICING IN THE WESM

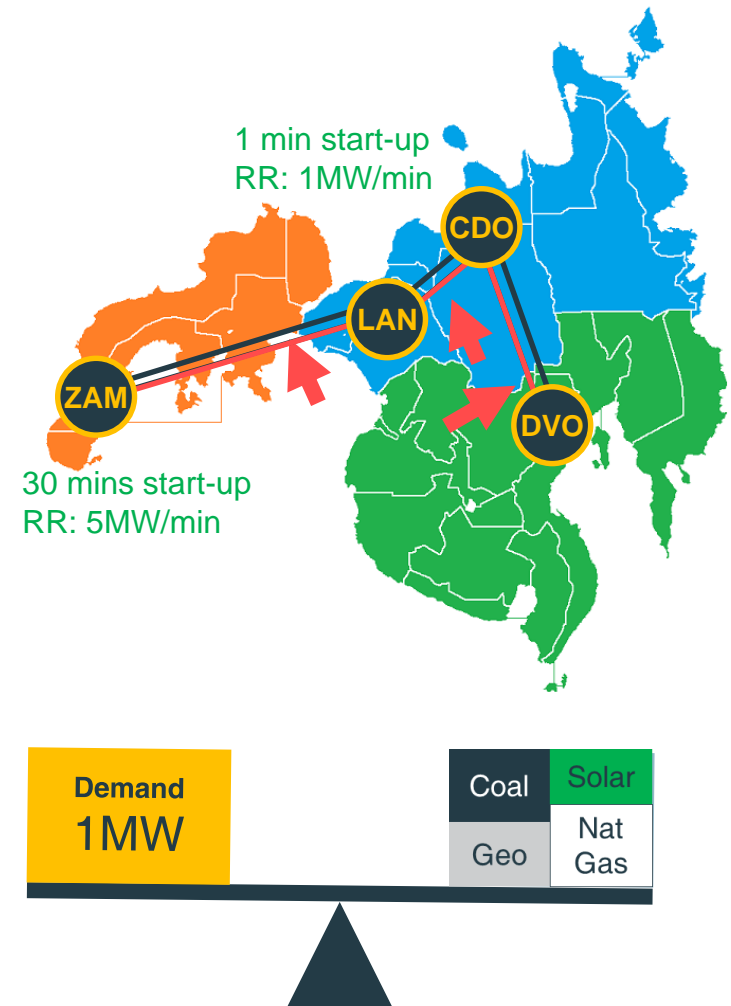**Locational Marginal Price** = System Marginal Price + Cost of Losses + Cost of Congestion
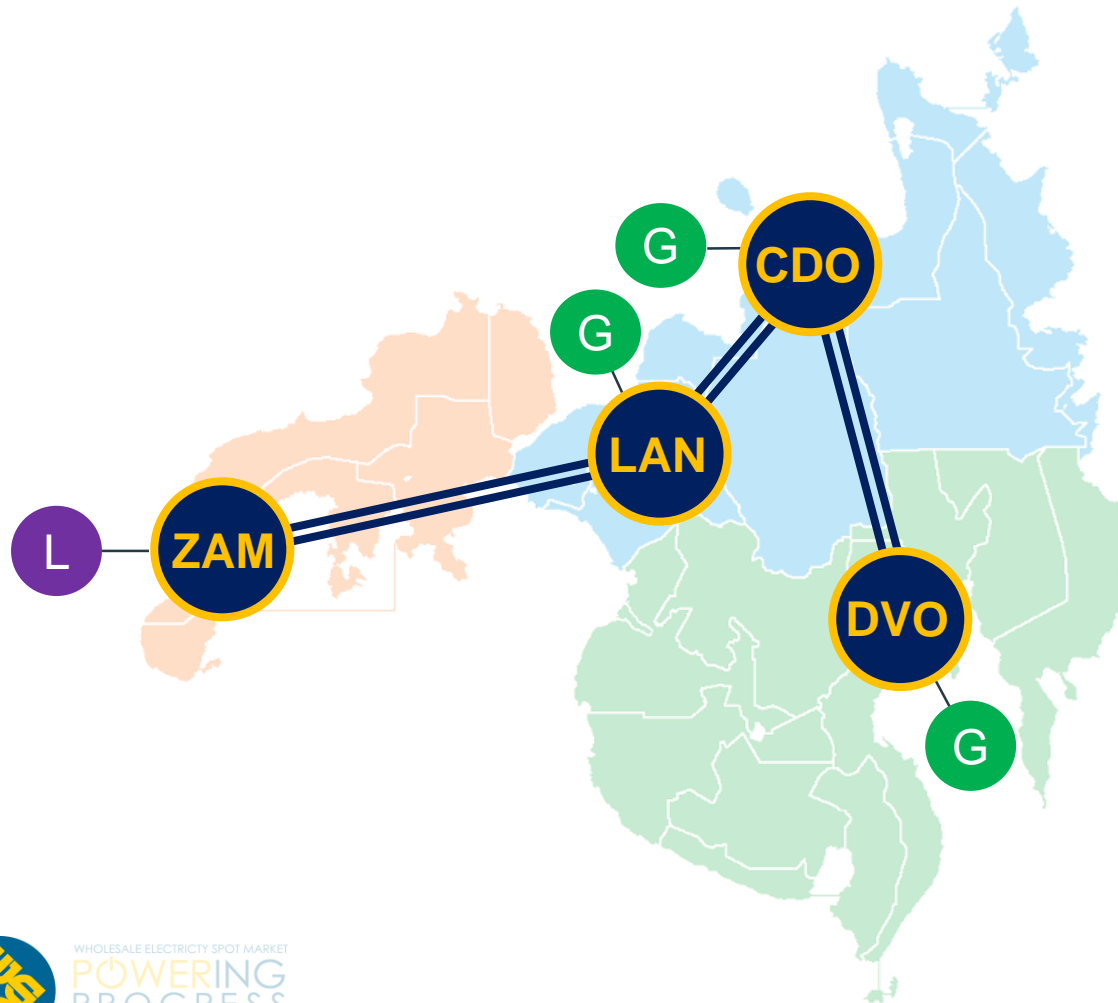
PRICING IN THE WESM
Why locational marginal pricing?

- ✓ LMP incorporates the costs of all factors that contribute to the cost of energy in an efficient and transparent manner (true cost of energy)
- ✓ Provides the economic signals to generators and consumers
  - When and where to invest on generation
  - When and where to consume electricity
- ✓ Makes the power system transparent in terms of its condition (providing signals for efficient operation and investment)

1 min start-up
RR: 1MW/min

CDO

LAN

ZAM

DVO

30 mins start-up
RR: 5MW/min

Demand
1MW

Coal	Solar
Geo	Nat Gas
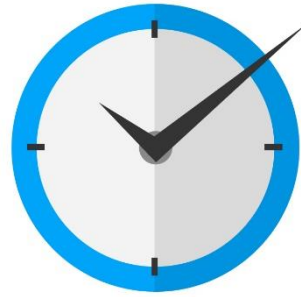
Automatic Pricing Re-run

Automatic Pricing Re-run
Occurrence of Pricing Error Condition

- Demand is greater than Supply (Under Generation)

  - Supply is greater than Demand (Over Generation)

    - Transmission line or transformer becomes congested

      - ✓ Due to demand growth
      - ✓ Unplanned Generator outage
      - ✓ Imposition of N-1 Contingency

Pricing Re-run Process

1. Relax the constraint
2. Re-run the MDOM to get valid prices
3. Use the Schedules in the original run as Generator Schedules
4. Use the Re-run prices in the settlement
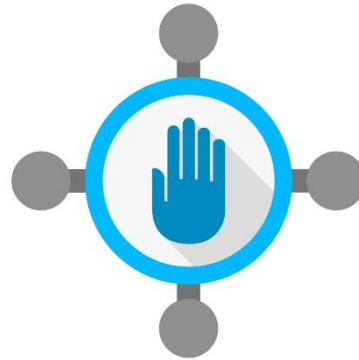
Special Pricing Conditions

SPECIAL PRICING CONDITIONS

- ✓ **Price Substitution Methodology (PSM)**
- ✓ **Administered Price Determination Methodology (APDM)**
- ✓ **Must-Run Units (MRU)**

SPECIAL PRICING CONDITIONS
Price Substitution Methodology (PSM)

1. Identify if congestion qualifies for PSM
   - Is there Network Congestion?
   - Are the Price Spread more than 20%

If Yes

P/MWh   Unconstrained Price

Both generators are paid at unconstrained-price

Western Mindanao Power Corp (WMPC)

1. Identify Constrained-on Plant
2. Pay the Plant at the offer price at which he was cleared/scheduled
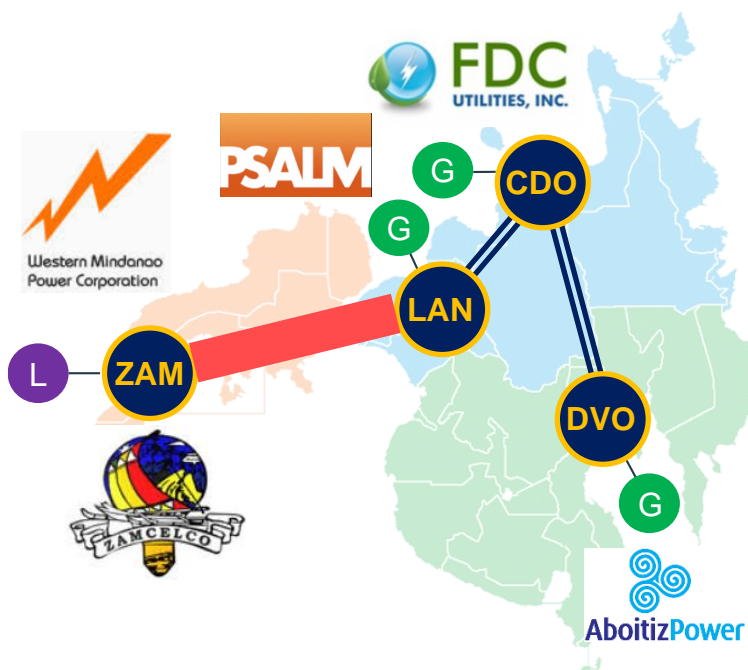
SPECIAL PRICING CONDITIONS
Administered Price Determination Methodology (APDM)

Administered Price Determination Methodology (APDM)	
When is it used?	**How are prices determined?**
During natural calamities, significant outages, market system failure	Average of prices from past four (4) weeks

SPECIAL PRICING CONDITIONS
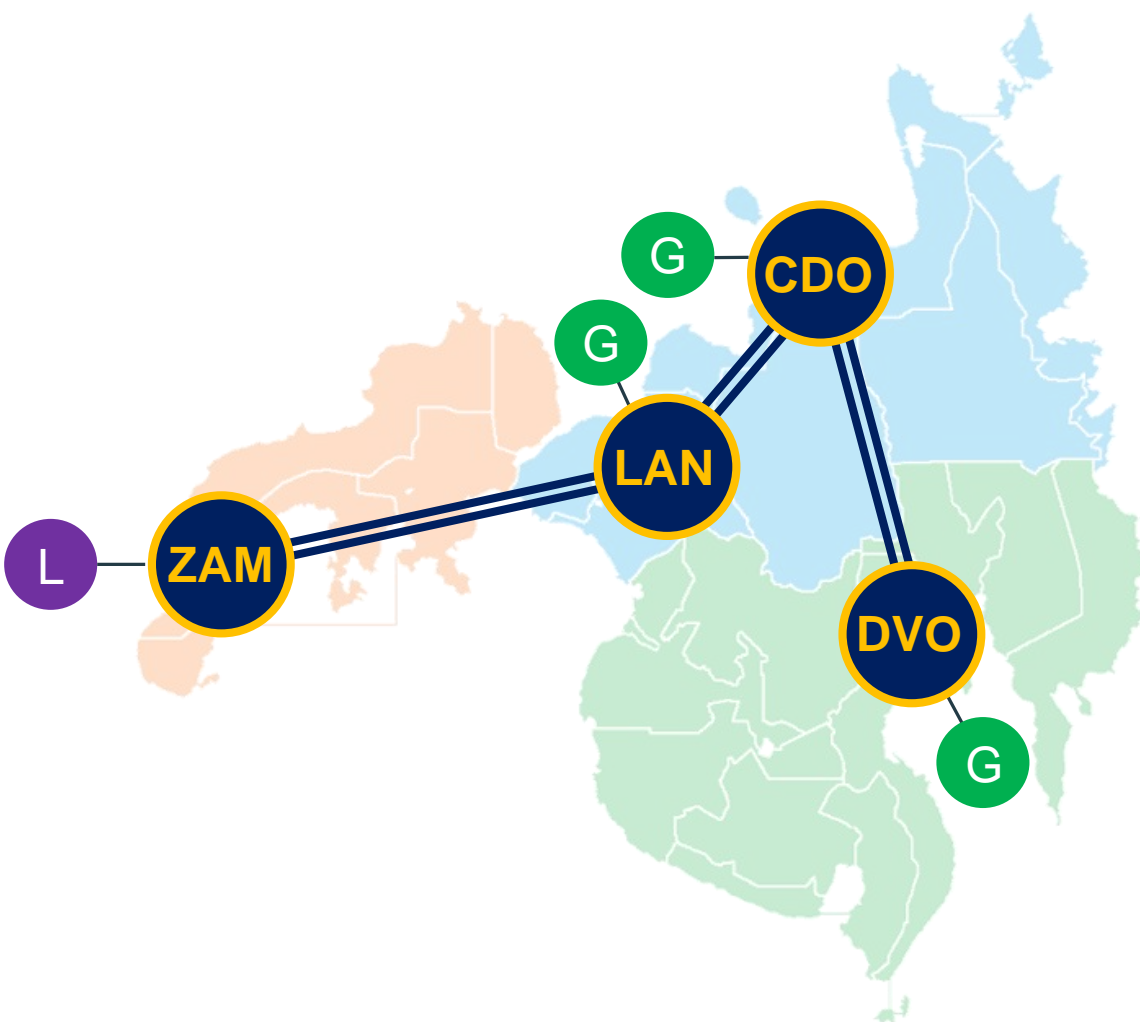## Administered Price Determination Methodology (APDM)

Designate as must-run unit to address low voltage

No local generation may result in low voltage
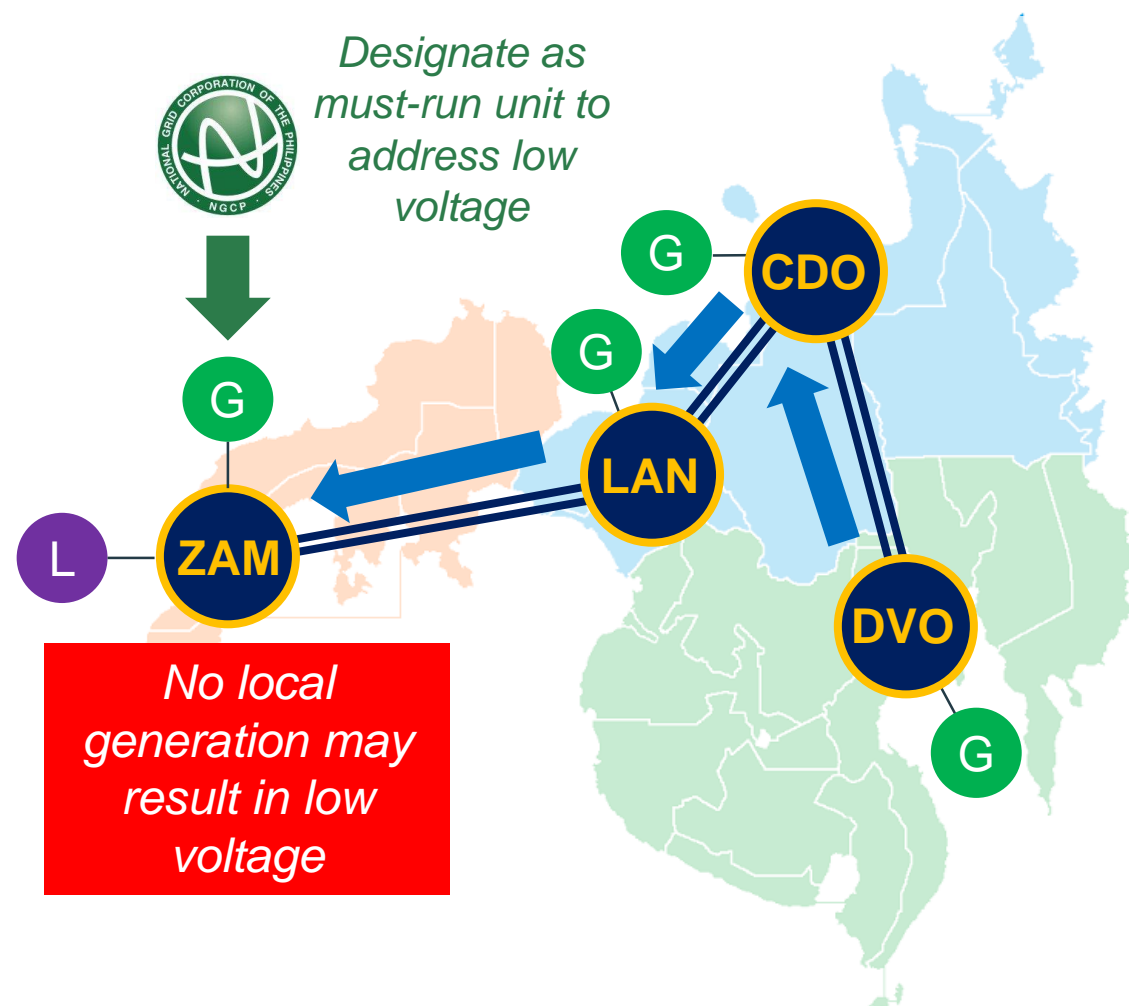
Must Run Unit (MRU) Compensation

When is it used?	How are prices determined?
For specific generators to address local problems such as low voltage or congestion	Based on market price with additional compensation (fuel and variable O&M)

Settlement Calculations

SETTLEMENT CALCULATIONS

Ex-Ante and Ex-Post Settlement Mechanism (Current Design)

Imbalance Quantity

Generator MW Schedule

Ex-Ante Run for 9 AM

Deviation

Ex-Post run at 9AM

Output Ex-Post Prices (EPP)

Ex-Ante Quantity

Actual metered quantity (MQ)

8 AM

Trading Interval 9:00H

9 AM
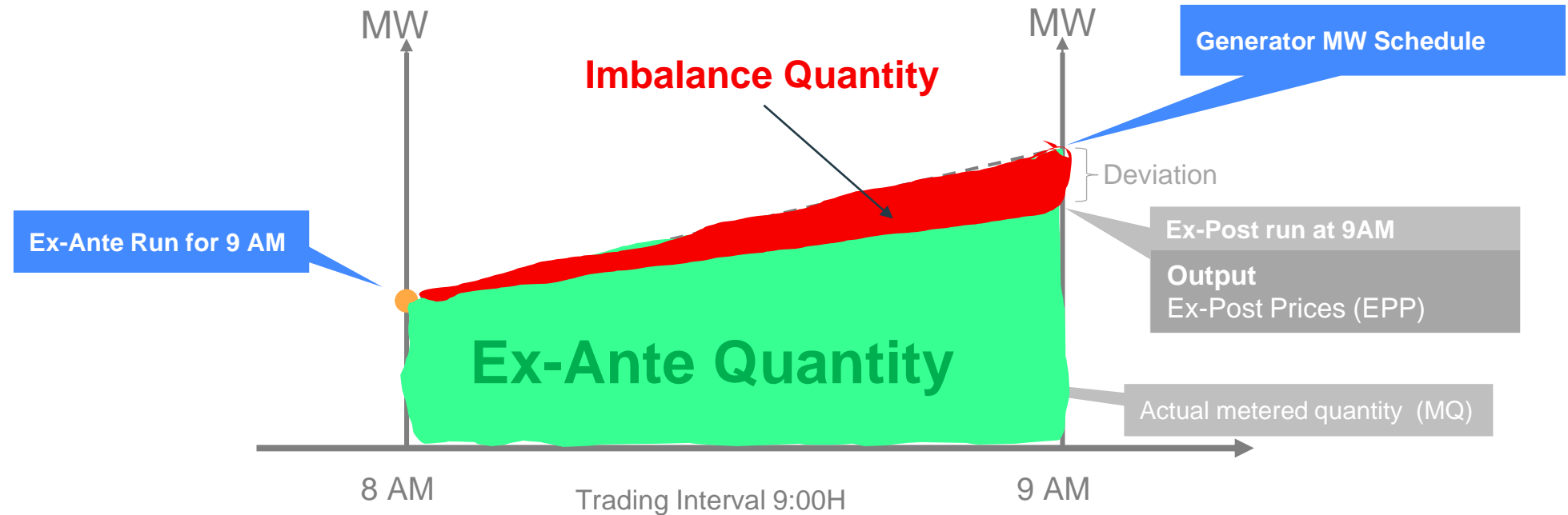
Ex-Ante Trading Amount

Ex-Post Trading Amount

Total Trading Amount = **(EAQ - BCQ) x EA Price** + **[(MQ- EAQ) * EP Price]**

SETTLEMENT CALCULATIONS
Why do we need to reduce trading intervals to 5 Minutes?

MW

Ex-Ante Run Output Generator MW Schedule (EAQ)

MW

Ex-Ante Run for 9 AM

Intra-hour Deviations
- Bumps off other generators
- Increases reserve dispatch
  - Possible ACB

8 AM

Trading Interval 9:00H

9 AM

SETTLEMENT CALCULATIONS
Ex-Ante and Ex-Post Settlement Mechanism (Current Design)

Real Time Dispatch Run Generator MW Schedule

Ex-Ante Run for 8:10 AM

Output
Final Energy Dispatch Price (FEDP)**

Actual metered quantity (MQ)

8:05 AM   8:10 AM

5 Minute Dispatch Interval
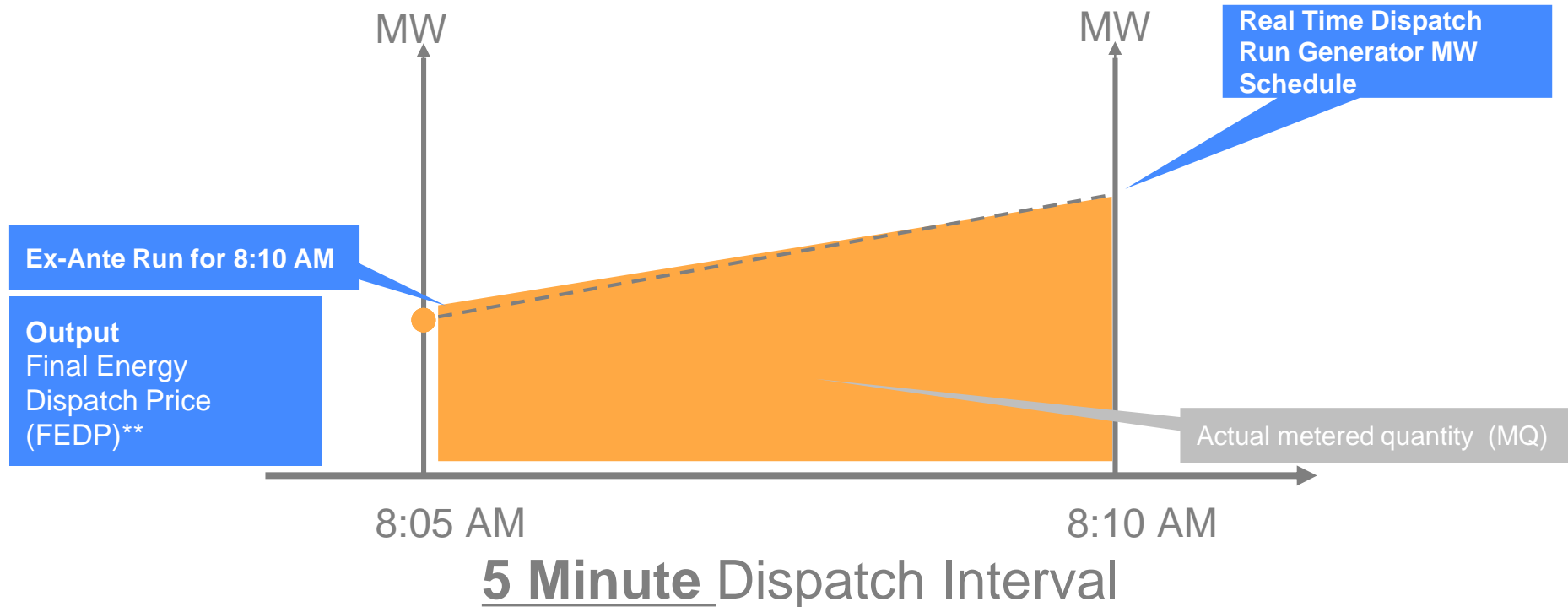
Trading Amount(dispatch interval) *   **= Gross Amount – Bilateral Amount**

= (GESQ × FEDP) – (BCQ × FEDPs)

SETTLEMENT CALCULATIONS

Energy Trading Amount

$Schedule_{G-CDO} = 0$

$LMP_{CDO} = P\ 2,020.66\ /\ MWh$

100 MW @ P 3,000 / MWh

$Schedule_{G-LAN} = 50.0$

$LMP_{LAN} = P\ 2,000.61\ /\ MWh$

50 MW @ P 1,000 / MWh

100 MW

$LMP_{ZAM} = P\ 2,061.69\ /\ MWh$

200 MW @ P 2,000 / MWh

$Schedule_{G-DVO} = 51.52$

$LMP_{DVO} = P\ 2,000.00\ /\ MWh$
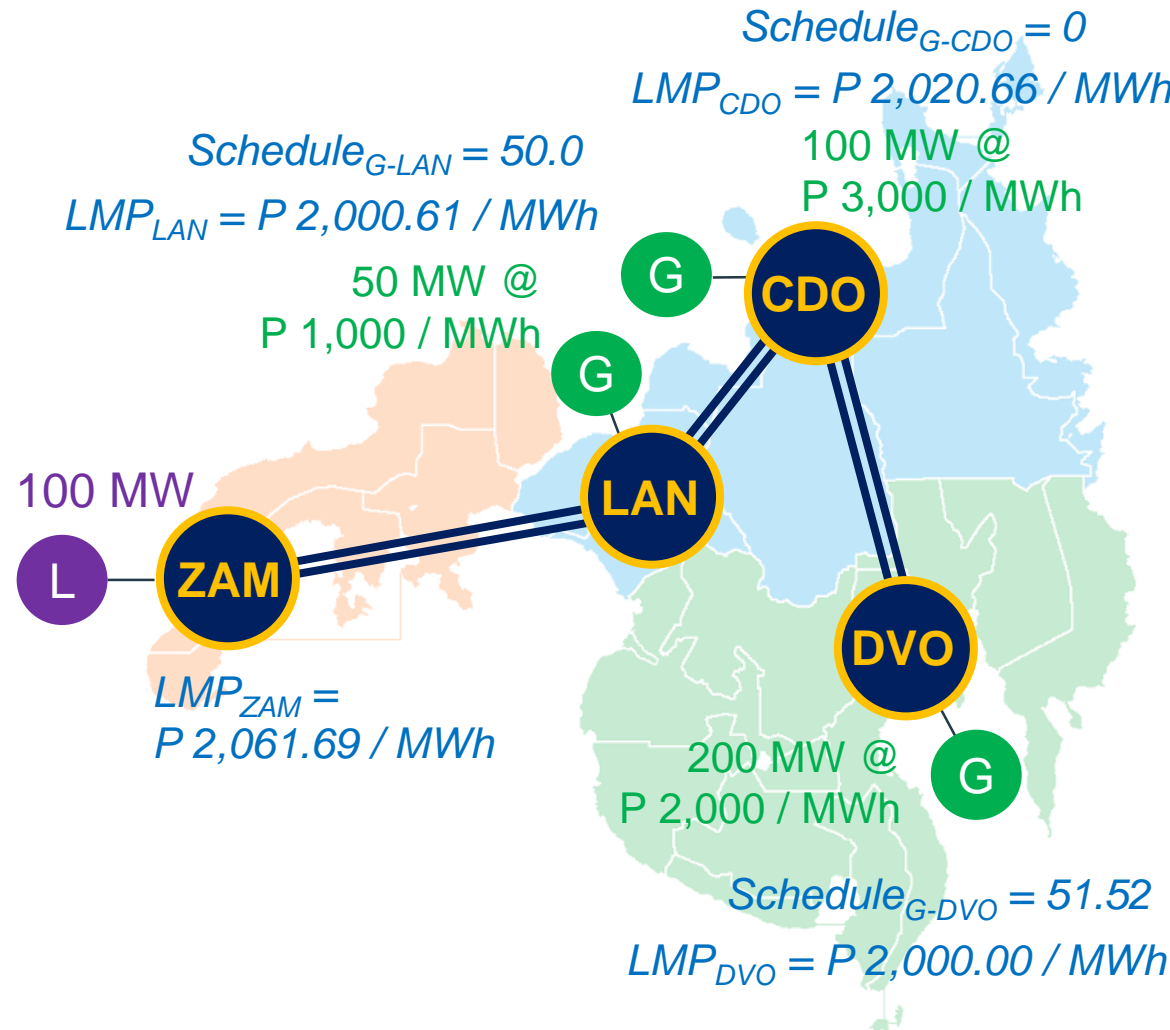
Item	L_{ZAM}	G_{LAN}	G_{CDO}	G_{DVO}
MQ[1] [A] (MWh)	(100)	50	0	51
MP [B] (PhP/MWh)	2,062	2,001	2,021	2,000
ETA[2] [C=A×B] PhP	(206,169)	100,030	0	103,046

1\ Negative – withdrawal from grid; Positive – injection to grid
2\ Negative – will pay to WESM; Positive – will be paid by the WESM

SETTLEMENT CALCULATIONS
Energy Trading Amount

$Schedule_{G-CDO} = 0$
$LMP_{CDO} = P\ 2,020.66\ /\ MWh$
100 MW @ P 3,000 / MWh

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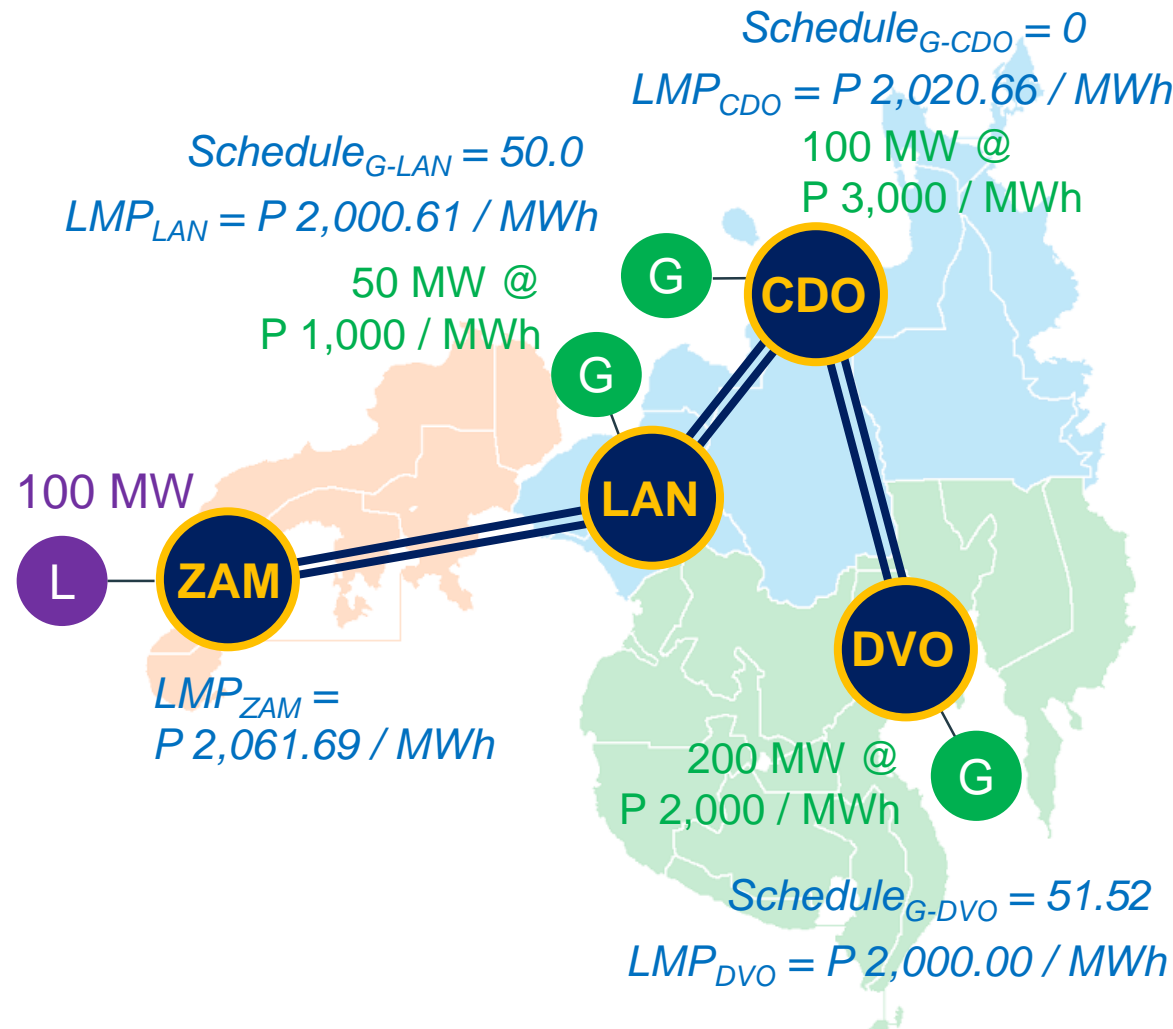
Example: Zamboanga load has a contract with Lanao and Davao generator for delivery at Zamboanga node.

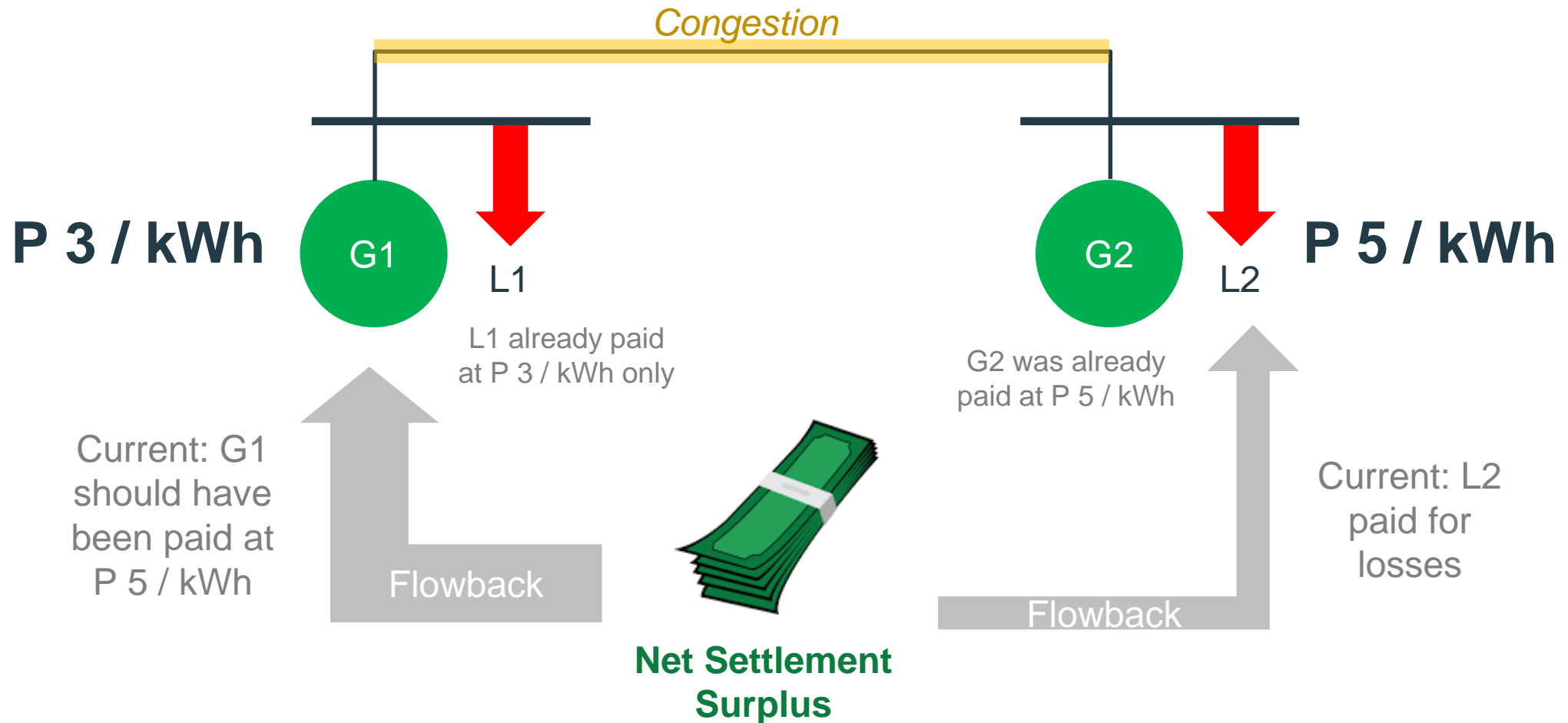| Item	L_{ZAM}	G_{LAN}	G_{CDO}	G_{DVO}
MQ[1] [A] (MWh)	(100)	50	0	51
MP [B] (PhP/MWh)	2,062	2,001	2,021	2,000
CQ[2] [C] (MWh)	(100)	50	0	50
MP$_{DelivPt}$ [D] (PhP/MWh)	2,062	2,062	N/A	2,062
ETA[3] [E=A×B – C×D] PhP	0	(3,054)	0	(39)
		Net Settlement Surplus		

1\ Negative – withdrawal from grid; Positive – injection to grid
2\ Negative – contract buyer; Positive – contract seller
3\ Negative – will pay to WESM; Positive – will be paid by the WESM
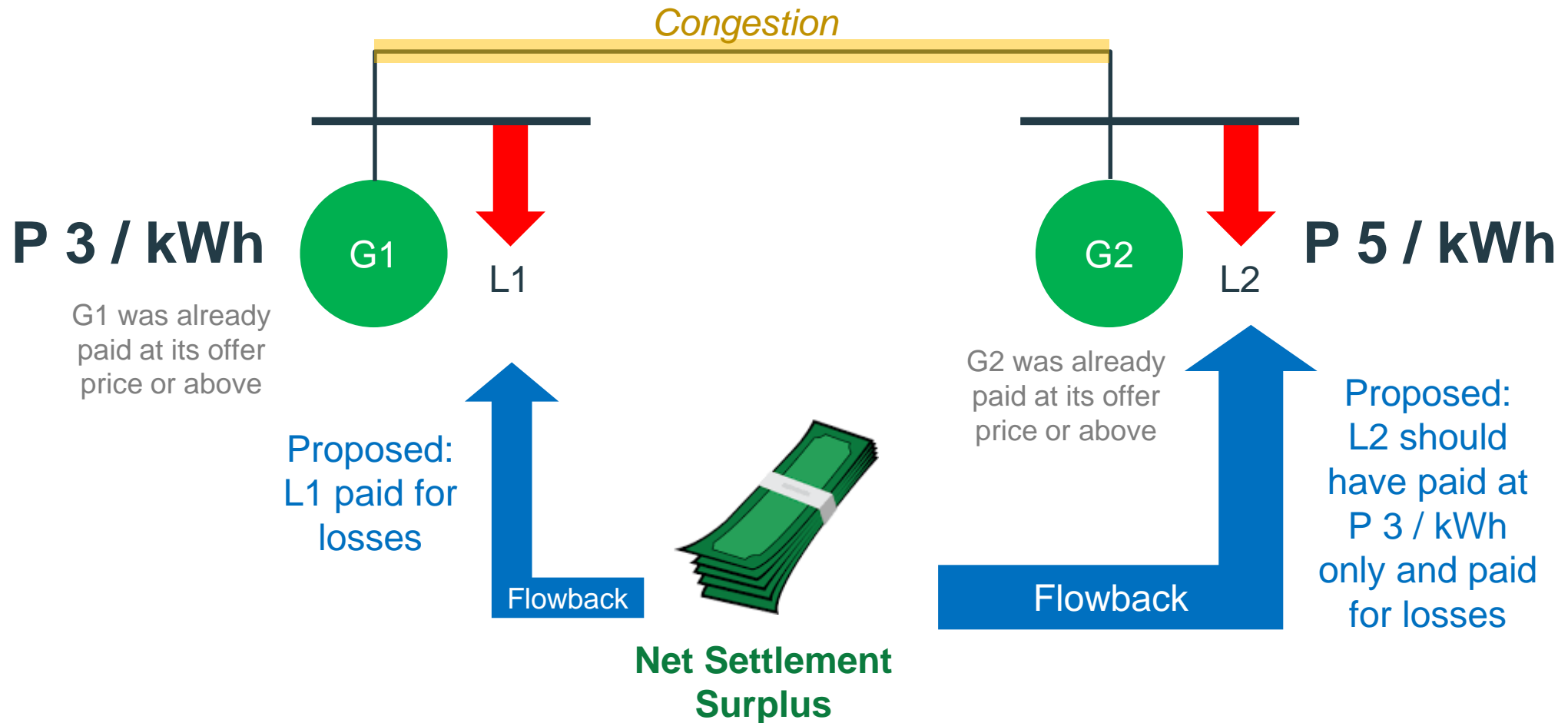
SETTLEMENT CALCULATIONS
Net Settlement Surplus

Congestion

P 3 / kWh   G1   L1

L1 already paid at P 3 / kWh only

Current: G1 should have been paid at P 5 / kWh

Flowback

Net Settlement Surplus

P 5 / kWh   G2   L2

G2 was already paid at P 5 / kWh

Current: L2 paid for losses

Flowback

SETTLEMENT CALCULATIONS
Net Settlement Surplus

Congestion

P 3 / kWh

G1

L1

G1 was already paid at its offer price or above

Proposed: L1 paid for losses

Flowback

Net Settlement Surplus

P 5 / kWh

G2

L2

G2 was already paid at its offer price or above

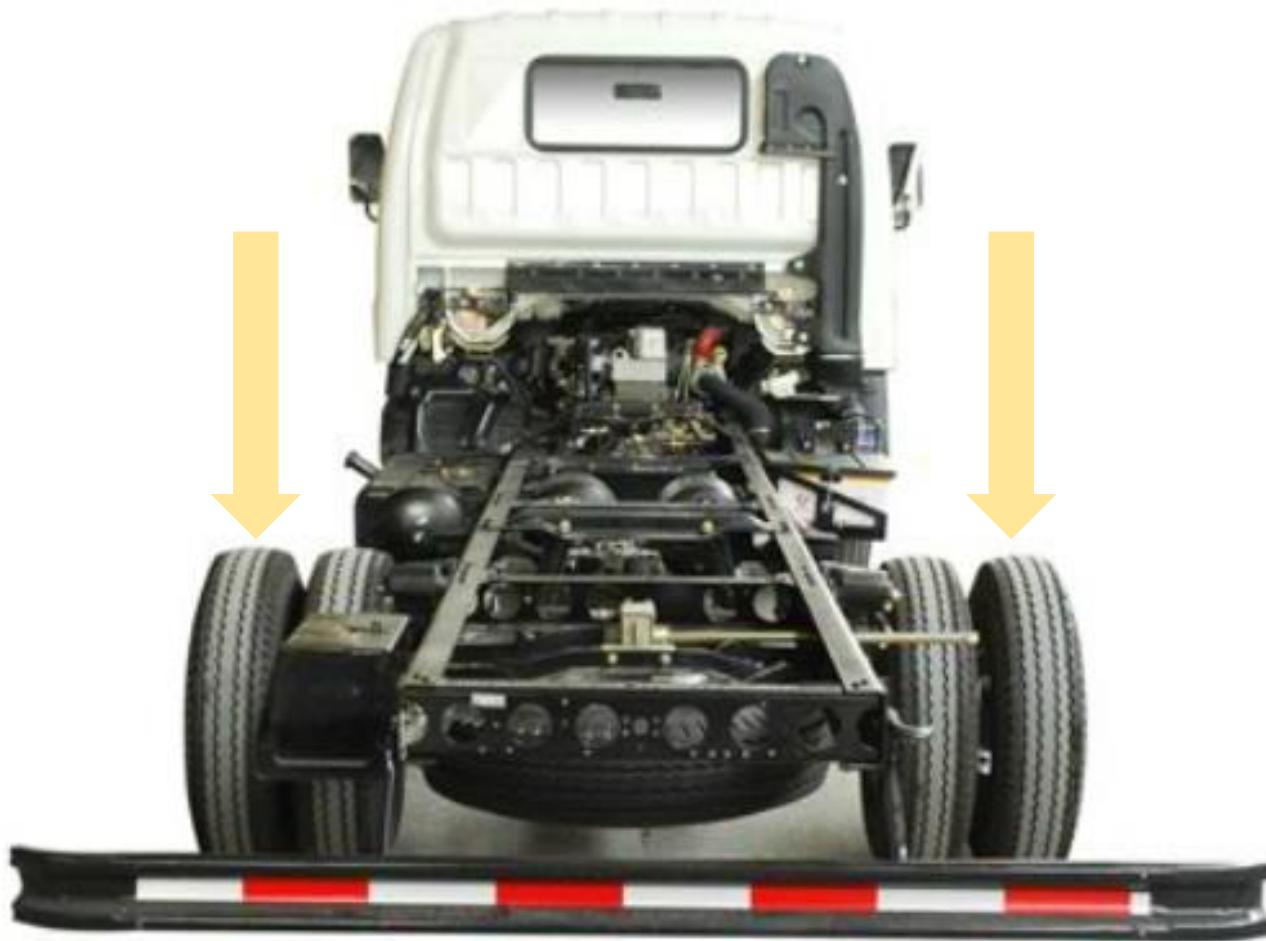Proposed: L2 should have paid at P 3 / kWh only and paid for losses

Flowback

RESERVE CO-OPTIMIZATION

RESERVE CO-OPTIMIZATION
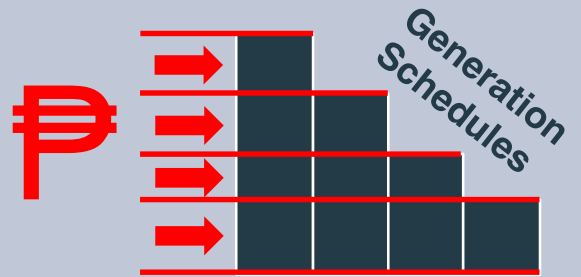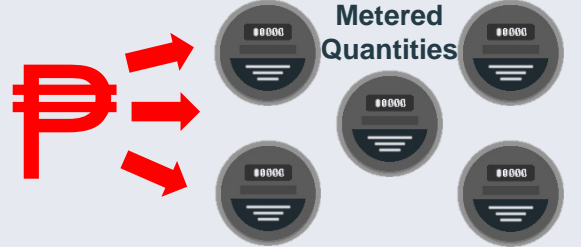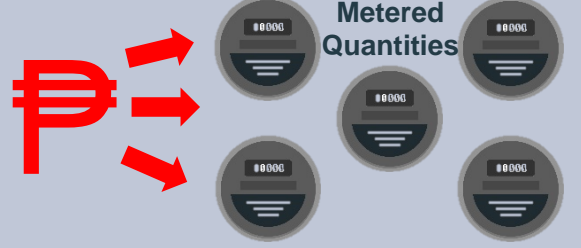
RESERVE CO-OPTIMIZATION
Reserve Categories

| PGC 2016 / NGCP ASPP	Old PGC	Filed PDM	Revised PDM (Tentative)
Primary	Contingency	Contingency Raise and Lower	Primary Raise and Lower
Secondary	Regulating	Regulating Raise and Lower	Secondary Raise and Lower
Tertiary	Dispatchable	Contingency Raise and Lower	Tertiary Raise and Lower

RESERVE CO-OPTIMIZATION
Requirements and Cost Recovery

PGC 2016 / NGCP ASPP	Revised PDM (Tentative)	Requirement	Proposed Cost Recovery
Primary	Primary Raise and Lower	Largest Unit Online	Generation Schedules
Secondary	Secondary Raise and Lower	4% of Demand	Metered Quantities
Tertiary	Tertiary Raise and Lower	4% of Demand	Metered Quantities

SETTLEMENT CALCULATIONS
Enhanced
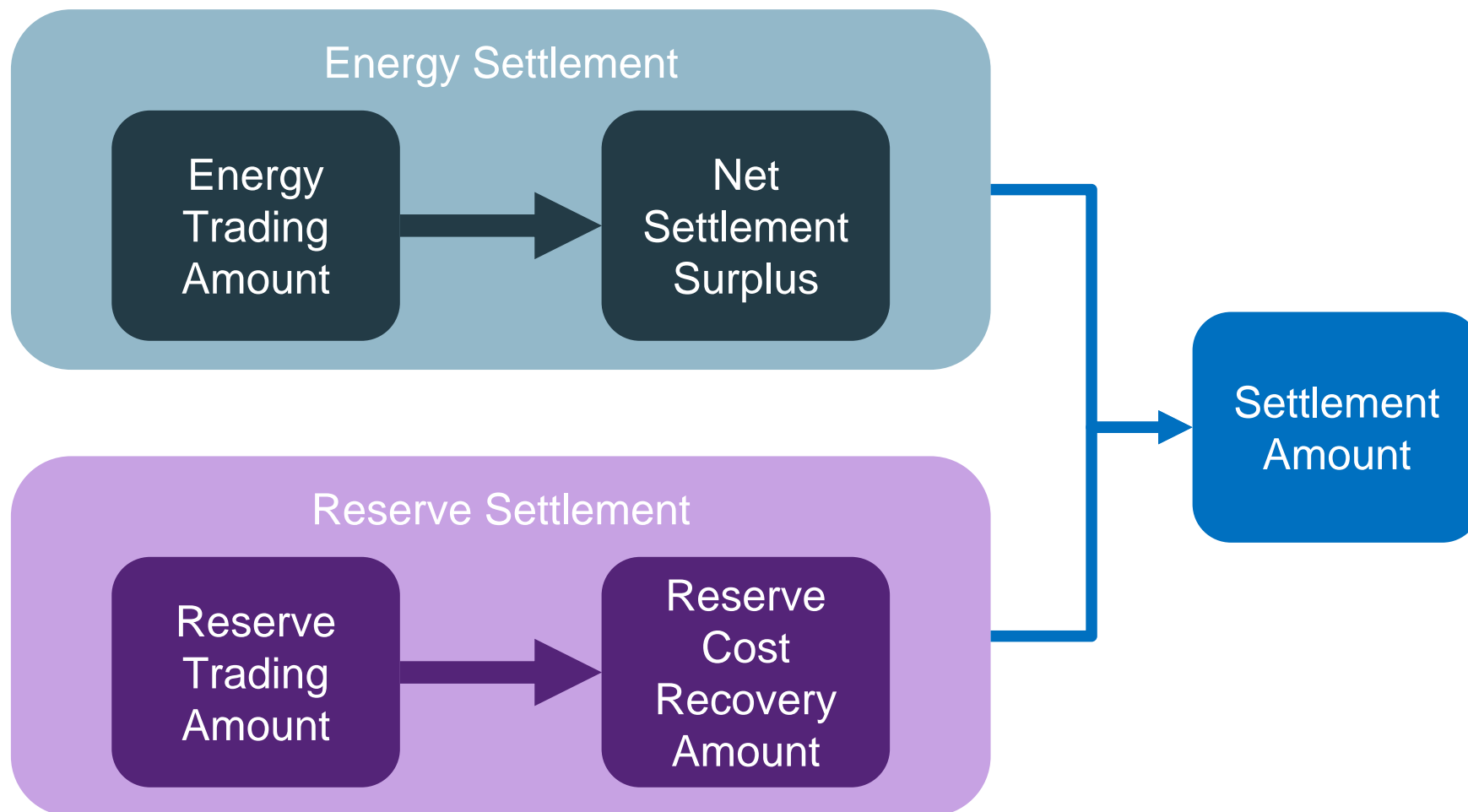
END OF PRESENTATION

WESM Works.

🎫 WESM Helpdesk Ticketing System
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📠 +63.2.634.0985

🌐 www.wesm.ph