

# Energy Trade Economics

Day 1 – Session 2  
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# Agenda

1. Cost minimization via economic dispatch
2. Proposed PAEM Pricing Mechanism

# Costs of Power Supply and Delivery

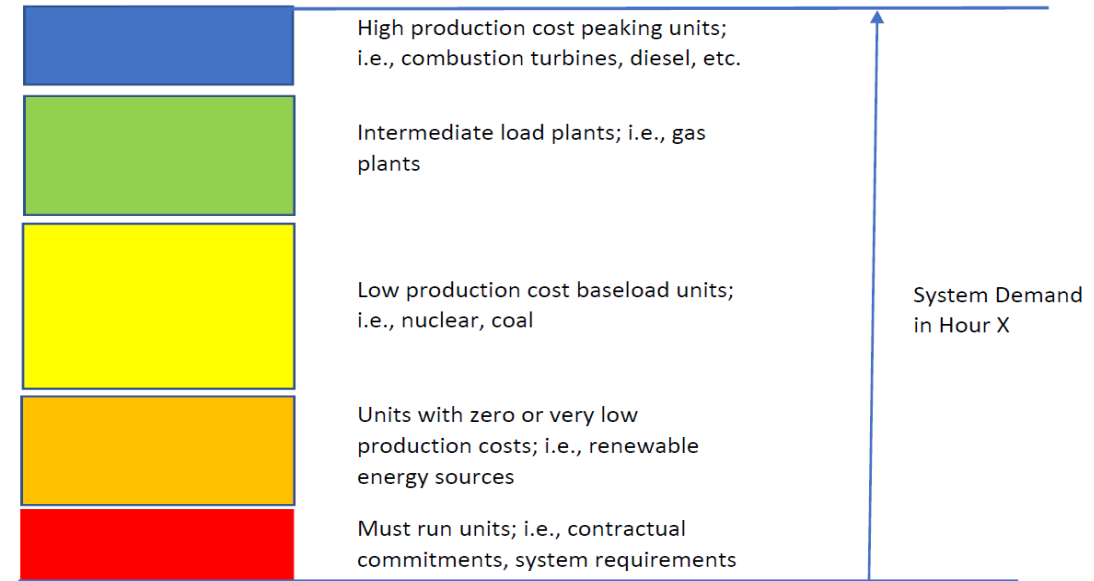
- Costs of power supply and delivery are categorized as fixed and variable
- Variable costs vary with energy production (e.g., fuel); fixed costs do not vary with energy production (e.g., capital)
- There is limited control over fixed costs once required levels of power supply and delivery are met
- Variable costs include fuel and variable operation and maintenance costs, There is greater control over variable costs and considerable effort has been expended in the industry to minimize such costs
- The primary level of control over variable costs relates to fuel which has led to production modeling to foster economic dispatch

# Economic Dispatch

- Economic dispatch is used to meet demand at lowest cost via the progressive loading of generating units starting with the units with the lowest production/variable costs and adding units with higher production costs until the demand is met
- The last unit loaded to meet demand in the period is referred to as the marginal unit
- The production/variable cost of the marginal unit represents the marginal cost of production in that period, usually an hour, and includes the cost of fuel and variable operation and maintenance cost of the marginal unit
- Marginal production costs are often averaged over periods of time that have similar production costs; i.e., winter peak, winter off-peak, summer peak, summer off-peak, spring/fall peak, spring/fall off peak

# Economic Dispatch (continued)

- The first units loaded are generally those that must run owing to contractual commitments or to meet system requirements such as voltage control
- IPPs may be included in the must run category, but not necessarily if contracts include two-part tariffs with the first part recovering capital costs, and the second part recovering variable costs. Two-part tariffs enable inclusion of IPPs in the merit order for economic dispatch
- Next units loaded are those with zero or very low fuel costs such as generators using renewable energy sources
- These units are followed by low production cost and efficient baseload units, followed by, as required, intermediate units and finally high production cost peaking units until the demand is met in that hour



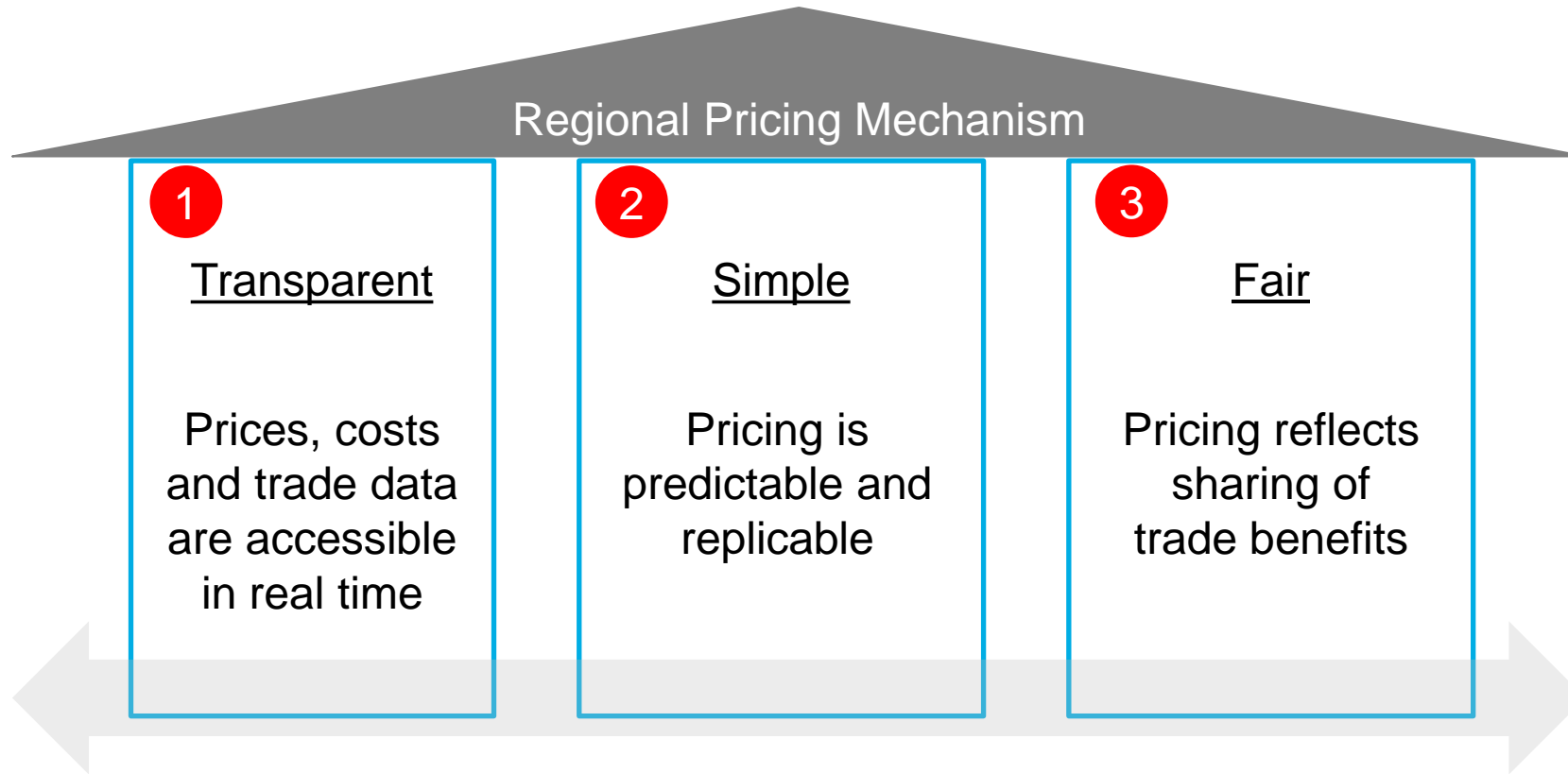
# Economic Dispatch (continued)

- Broadening the geographic region over which economic dispatch is practiced reduces the marginal cost of production and increases the benefits (reduces costs) to customers in the broader region
- For example, if a country has sub-regions that are poorly interconnected, economic dispatch must be practiced on a sub-regional basis. If transmission is enhanced between sub-regions, economic dispatch can be practiced across the entire country, increasing the benefits to customers by further reducing the marginal cost of production

# Proposed PAEM Pricing Mechanism

- Currently in the PAEM:
  - Trade volume and price discovery are limited, so traders do not know what constitutes a fair price; e.g., market liquidity and price transparency are limited
  - Economic dispatch is not promoted from a regional perspective
  - Generation fuel prices are often subsidized, meaning that a trade would result in a country exporting its fuel price subsidy for the benefit of electricity consumers in another country
- The World Bank has proposed a simple, fair and transparent pricing mechanism based on international fuel prices for use during PAEM Transitional Phase 1. It promotes economic dispatch across the broader PAEM region. The proposed mechanism is based on the power pool concept previously used in the United States and Canada
- Training on the proposed pricing mechanism was provided by the World Bank in FY-2022

# Proposed PAEM Pricing Mechanism (continued)





# The Pricing Mechanism includes THREE Types of Bilateral Trade

## Exchanges-in-kind

- Recognizes different energy values at different times of year and exchanges energy accordingly

1

## Cost/benefit Sharing

- Seller receives its marginal production cost plus 1/2 the difference between its marginal production cost and the marginal production cost of the buyer

2

## Emergency Support

- Seller receives its marginal production cost plus 15% fixed profit
- Improves energy security with cost savings

3

# Proposed PAEM Pricing Mechanism (continued)

## **Exchanges-in-kind – recognizes different value of energy at different times of year**

- Value of energy in Region M (comprising several countries including Country A and Country B) during low load period is about 100 US\$/MWh, versus 123 US\$/MWh during high load period
- Therefore, if Country A provides 20 GWh to Country B high load period, Country B should return 24.6 GWh to Country A in low load period (based on regional valuations)
- This is calculated using the ration of 123/100, i.e. 20 GWh in high period worth 1.23 times in low period, i.e. 24.6 GWh

# Proposed PAEM Pricing Mechanism (continued)

## **Cost/benefit sharing: $(\text{Cost} + \text{Value})/2$**

- Cost of energy produced in low load period in Bahrain is 86 US\$/MWh, versus 136 US\$/MWh in Saudi Arabia
- Therefore, price of trade would be 111 US\$/MWh, meaning Bahrain would earn a profit of 25 US\$/MWh while Saudi Arabia would realize a savings of 25 US\$/MWh

# Proposed PAEM Pricing Mechanism (continued)

## Cost + fixed profit for emergency transactions

- Country A has an emergency on its power system during the high load period and it is short capacity
- Country B would supply energy to Country A during the emergency at 193 US\$/MWh (Country B cost of 168 US\$/MWh + 15% = 193 US\$/MWh)
- This would encourage Country B to supply the needed energy without overcharging Country A during a time of need

# Application and transition to competitive bilateral contracts

- The PAEM pricing mechanism:
  - Is proposed for use in the near-term while generation fuel subsidies exist in many of the Member States. It does not require Member States to reduce generation fuel subsidies in their national power systems
  - Promotes economic dispatch and cost reduction
  - Prices trade fairly while avoiding the export of generation fuel subsidies to electricity consumers in another country
- In the longer term, the pricing mechanism could evolve to include a fully competitive bilateral contracts market supported by various bid-based pools and a power exchange.

Thank You