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Market Operator

# The Day Ahead Market - An Overview

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Independent Electricity Market Operator



# DAM Agenda

- What is a DAM?
- Why should we create a DAM?
- What is the timing for the project?
- What are the features of the proposed DAM?
- How would I participate in a DAM?
- What are the next steps?

# Disclaimer

- DAM design is not finalized
- Content is subject to change
- Presentation is high level
- Presentation seeks to simplify concepts to ease understanding
- Strawman posted on web is best source for more detail

# DAM – What is it?

A Day Ahead Market allows participants to lock in a price today for energy supplied or consumed tomorrow\*.

\*Can include “virtual” transactions where energy is neither generated or consumed.



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# How Can I Participate?



# DAM Participation

- Price Sensitive Load
- Price Responsive Load
- Generator
- Importer/Exporter
- Virtual Transactions
- Through a Retailer



# Price Sensitive Load

- Provide the IMO with your price sensitivity (5 MW @ \$100, 10 MW @ \$75)
- Receive a DAM schedule
- Settled against DAM position in real-time
- Non-dispatchable. No need to bid for consumption in real-time
- Must inform IMO if real-time consumption is significantly different than normal (in RTEM)

# Price Responsive Load

- Supply IMO with multi-part bid
- Receive a DAM Schedule
- Eligible for PCG
- Can bid as dispatchable load or not
- Can deviate from DAM schedule
  - Real-time dispatchable follows dispatch instructions
  - Real-time non-dispatchable normally follows DAM schedule, notifies IMO if they deviate



# Generator

- Dispatchable generators offer into DAM as price responsive generators
- multi-part bidding
- Non-dispatchable generators submit to DAM as now:
  - Self-schedulers submit schedules
  - Intermittent and transitional scheduling generators submit forecasts of injection



# Virtual Trader

- Must post prudential with IMO to cover trading limits (loads must post prudentials in IMO-administered markets as well)
- Can buy or sell energy
- Cannot sell OR



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# Why have a DAM?



# DAM – Why?

## Provide price certainty in advance of real-time

- Participants can lock in a price today for energy to be consumed or supplied tomorrow
- Day Ahead Market gives participants time to respond to price signals
- Provides financial protection against real-time events influencing price

# DAM – Why?

## **Provide greater operational certainty in advance of real-time**

- Loads, generators, imports and exports can obtain financially binding schedules a day in advance
- Participants with start up and shut down costs will be guaranteed recovery of these costs in DAM
- Loads, imports, generators and exports can specify “blocks” of capacity

# DAM – Why?

## **Increase demand responsiveness to price**

- Day ahead prices should be a good indicator of real-time prices
- With advance warning, loads can take action to reduce consumption during periods of high prices
- Production Cost Guarantee ensures that savings from DAM schedule covers the costs of reducing consumption
- DAM will allow all wholesale loads to manage operations and price risk

## Improved Reliability

- Better scheduling of imports and exports
- Commitment of generators and price responsive loads day ahead to ensure sufficient resources available real-time
- Production Cost Guarantee reduces risk for generators and price responsive loads showing up in real-time
- Increased demand responsiveness

## Improved Efficiency

- Multi-part bids and offers allow participants to more accurately reflect costs
- Resources are optimized over a 24-hour period rather than one hour a time
- Resources are committed day ahead to ensure adequate resources in real-time
- Improved scheduling of imports/exports

## In Summary

- Provide price certainty in advance of real-time
- Provide greater operational certainty in advance of real-time
- Increase demand responsiveness to price
- Improved reliability
- Improved efficiency



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# How did we get here?



# DAM – The Design Process

- A five-part project, initiated February 2003
- The IMO has gathered participant input through almost 50 DAM Working Group meetings
- Stakeholdered at MAC and MOSC
- DAM Design Strawman (Release 4.0) - May 14, 2004
- Currently in phase 4 - started Q3, 2004



# Phase 4

- Goals of Phase 4
  - Market Rules
  - Business Design
  - System Architecture and Design
  - User Requirements
  - Systems Procurement (short of signed contracts)
  - IMO Board Approval for Build (early '05)



## Phase 5

- Final stage leading up to opening of DAM
- Expected market launch date: Q1/06
- Activities include:
  - IMO Business Procedures/Revisions
  - Market Manuals/Revisions
  - Systems Development
  - Systems Integration Testing
  - IMO User Testing, Market Trials
  - Market Launch



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# DAM Features



# Features of DAM

## Similar to Real-time Market

- Bid and offer based auction with clearing prices
- Buy and sell energy and sell OR (operating reserve)
- Uniform clearing price (and associated CMSC calculations)

# Features of DAM

## “New” Features of DAM:

- Lock in price today for energy tomorrow
- Optimize over 24-hour period
- Multi-part bids and offers
- Financially commits resources to satisfy forecast load and OR requirements
- Production Cost Guarantee
- Imports/exports are financially scheduled Day Ahead, FTRs settled on DAM prices
- Virtual Transactions



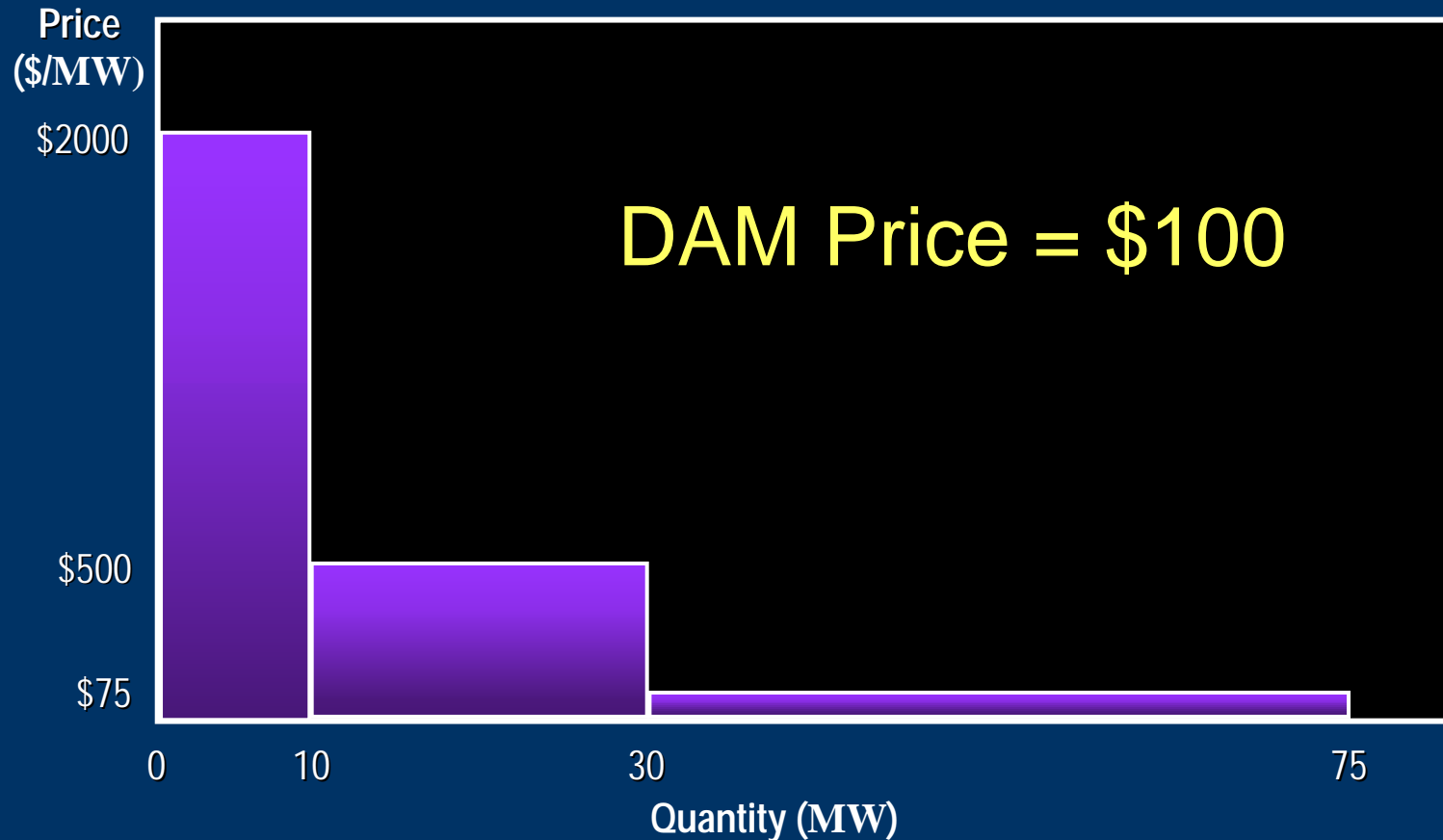
# Features of DAM

## **Lock-in prices day ahead for purchases and sales**

- Helps participants manage price risk
- Advance warning allows participants to be more responsive to price
- Lets participants take a position on Day Ahead prices, creates opportunities for participants that can respond quickly

# Price Sensitive Load

A plant which typically consumes about 100 MW of electricity puts in the following bid in the DAM:



# Price Sensitive Load



- DAM schedule for the load is 30 MW
- This schedule does not limit the activity of the load in real-time
- Essentially, the first 30 MW of consumption on real-time will be billed at the DAM price of \$100

# Two-Settlement System

- Settlement based on net position due to activity in the DAM and activity in the real-time market
- Load pays or generator receives:

- $Q_{DA}(P_{DA} - P_{RT}) + Q_{RT} P_{RT}$

- DAM Quantity X (difference between DAM and Real-time Prices) +  
Real-time Quantity X Real-time Price

- or

- $Q_{DA} P_{DA} + P_{RT} (Q_{RT} - Q_{DA})$

- DAM Quantity X DAM Price + Real-time Price X (Difference between  
Real-time Quantity and DAM Quantity)

## Price Sensitive Load

- DAM schedule is 30 MW;  
the DAM price is \$100
- In real-time the price is \$110
- If the load consumes 30 MW in real-time:

Load pays  $Q_{DA} P_{DA} + P_{RT} (Q_{RT} - Q_{DA})$

$$30 \times 100 + 110 (30 - 30) = \$3,000$$

# Features of DAM

## Optimize over 24-hour period

- 24-hour optimization will result in a least cost set of resources to meet requirements (more efficient dispatch)
- Commits generators, based on submitted fixed costs, to meet forecast load in excess of that bid in the DAM

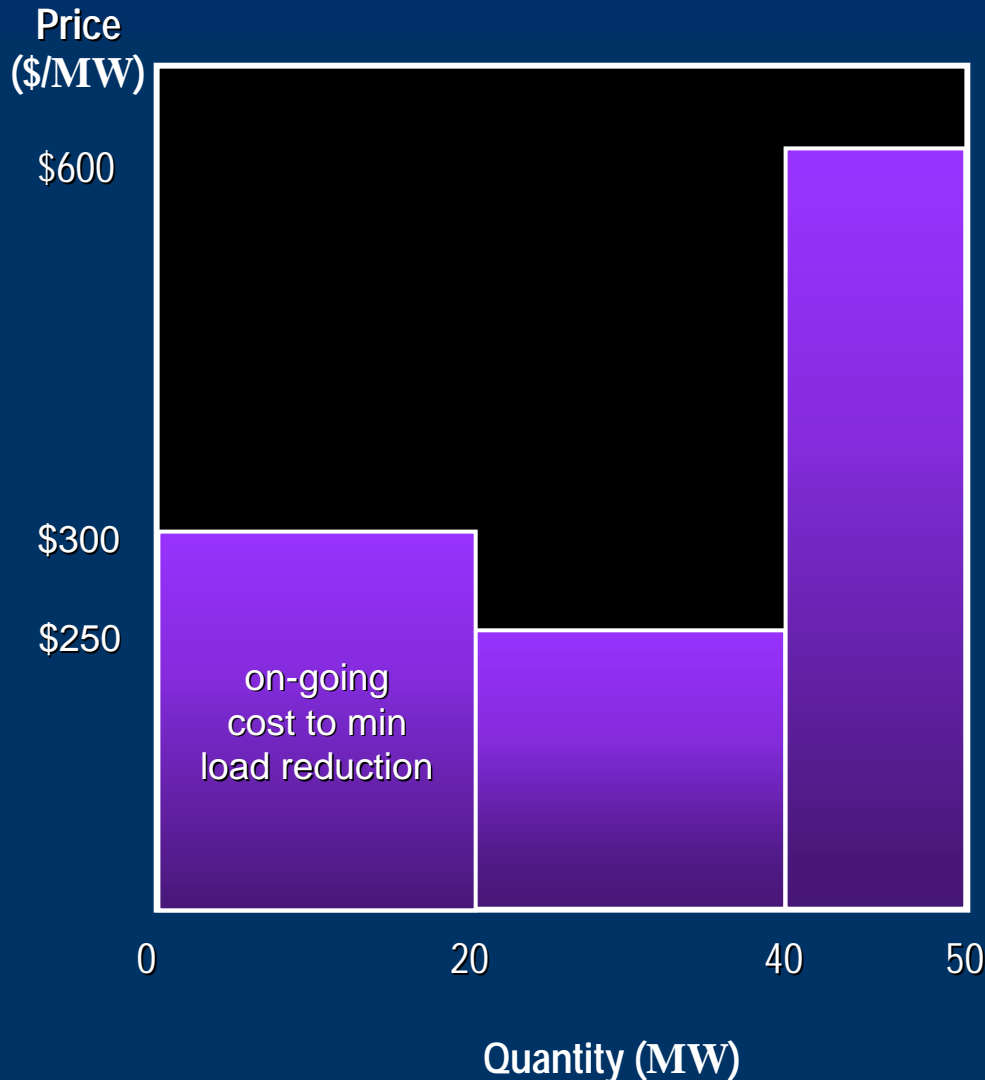
# Features of DAM

## **Multi-part bids and offers means schedules reflect physical characteristics**

- Specify the minimum cut a load can take, or the minimum level of generation
- Specify a fixed cost for a load making the minimum possible load cut, or a generator starting up to minimum output
- Specify the on-going cost of staying down or operating at minimum level
- Specify the minimum downtime for a load, or minimum run time for a generator



# Price Responsive Load

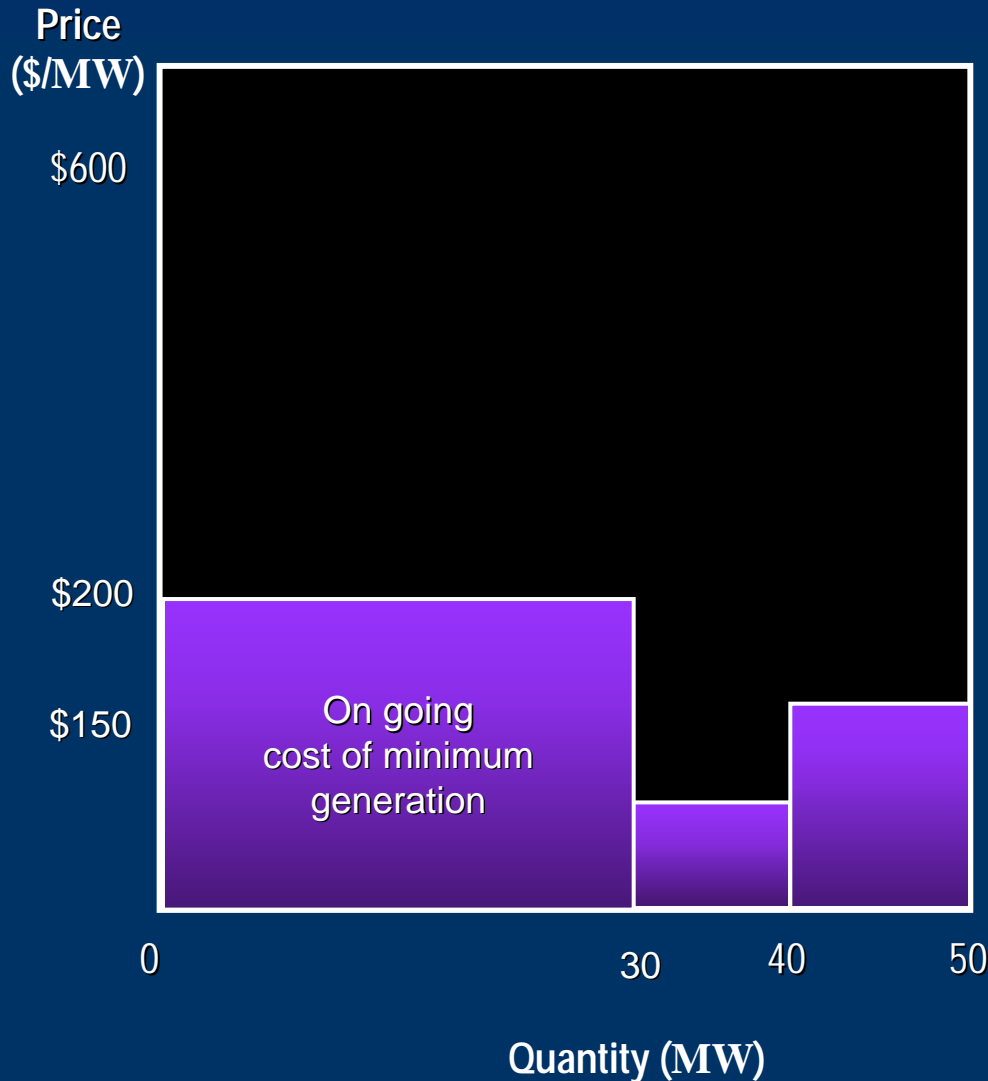


## 50 MW Load Offers Demand Response:

- Fixed cost to lower consumption of \$5,000
- On going cost of minimum 20 MW load reduction of \$6,000/hr
- Minimum downtime is 4 hours, minimum load reduction is 20 MW
- The incremental price for a MW of reduction
  - 20 to 40 MW is \$250
  - 40 to 50 MW is \$600



# Generator



- 50 MW Generator
- Minimum output is 30 MW
- Start up cost to min gen is \$10,000
- On going cost of minimum generation is \$6,000/hr
- Minimum run-time is 4 hours
- The incremental price per MW above min is:
  - 30 to 40 MW: \$100
  - 40 to 50 MW: \$150

# Features of DAM

## **Commits resources to satisfy forecast load and OR requirements**

Generators, imports and price-responsive load scheduled day ahead have financial obligations to deliver or to buy-out of their positions in real-time:

- Day-ahead schedules can be translated into physical schedules with near-certainty in real-time through submission of offers
- Interchange scheduled day-ahead has sufficient time to firm-up the transaction in advance of real-time

## Features of DAM

# Commits resources to satisfy forecast load and OR requirements

Day Ahead Bid Load = 1000 MW

IMO Forecast for reliability = 1800 MW

DAM will financially commit sufficient energy supply for 1800 MW

# IMO Commits to Forecast

- 1,000 MW bid into DAM
- 1,800 MW forecast load

	MW	Min	Min Cost	Incremental
Gen A	500	100	5,000	50
Gen B	500	0	0	65
Gen C	500	30	2,000	75
Gen D	500	0	0	100

# IMO Commits to Forecast

- 1,000 MW bid into DAM
- 1,800 MW forecast load
- Gen A and B together at 1000 MW satisfy Bid Load
- Must have another 800 MW available for forecast load
- Gen D can respond but Gen C must be taken to minimum generation of 30 MW

# IMO Commits to Forecast

- 1,000 MW bid into DAM
- 1,800 MW forecast load
  
- Gen A at 500
- Gen B at 470
- Gen C at 30
- Satisfies load bid into DAM and sets up resources for RTEM to satisfy demand forecast

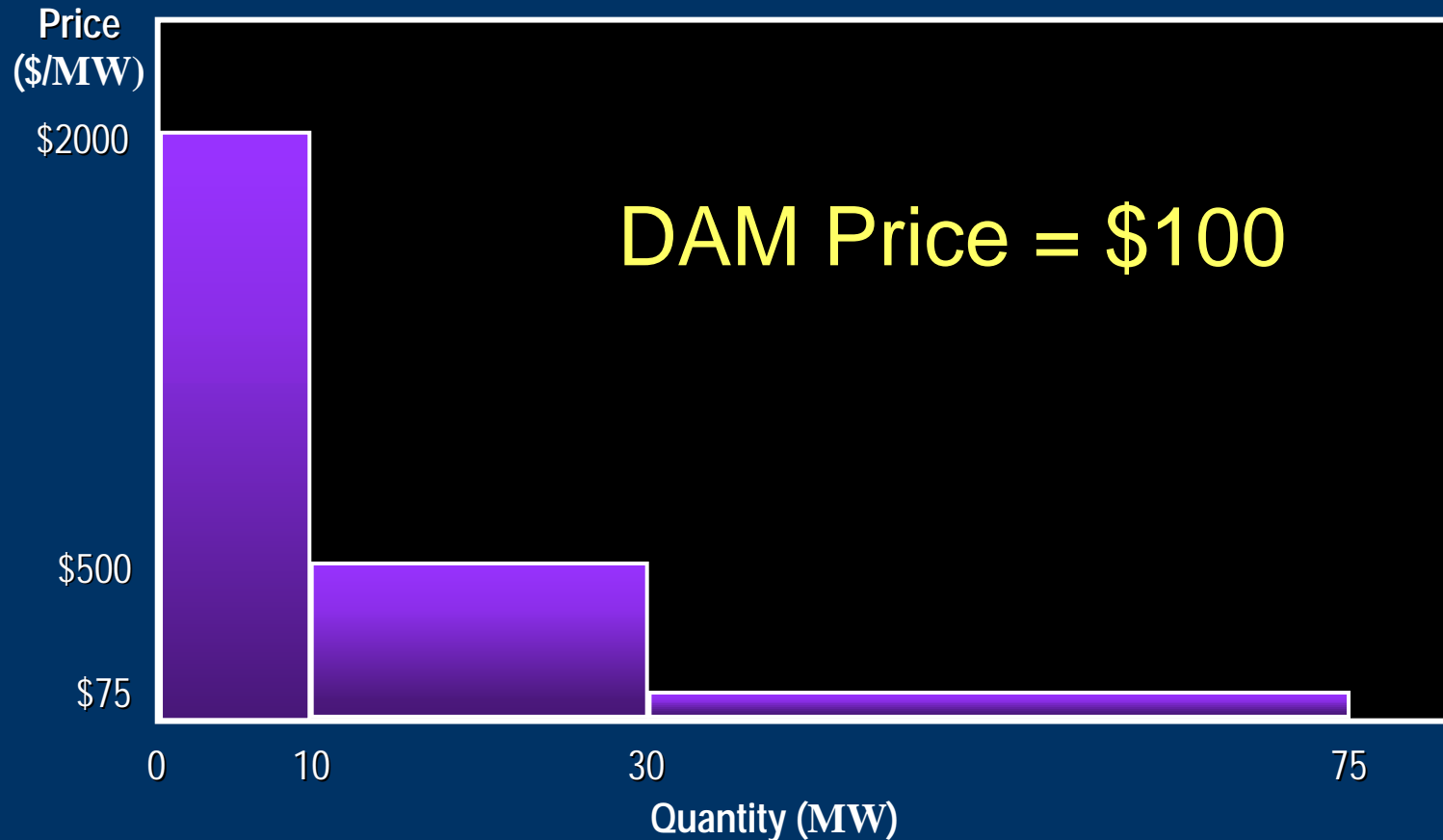
## Outcomes are financial commitments

- Participants can still operate in RTEM just as they do now
  - Price Responsive Non-dispatchable Load must notify IMO of significant deviations from DAM Schedule
- Cash flows will be netted out against the DAM position



# Price Sensitive Load

A plant which typically consumes about 100 MW of electricity puts in the following bid in the DAM:





## Price Sensitive Load

- DAM schedule is 30 MW;  
the DAM price is \$100
- In real-time the price is \$90
- If the load consumes 0 MW:

Load Pays  $Q_{DA} P_{DA} + P_{RT} (Q_{RT} - Q_{DA})$

$$30 \times 100 + 90 \times (0 - 30)$$

$$\$3,000 - \$2,700 = \$300$$



# Generator

- DAM schedule is 30 MW;  
the DAM price is \$100
- In real-time the price is \$110
- If the generator is off-line - produces 0 MW:

Generator Receives  $Q_{DA} P_{DA} + P_{RT} (Q_{RT} - Q_{DA})$

$$30 \times 100 + 110 (0 - 30)$$

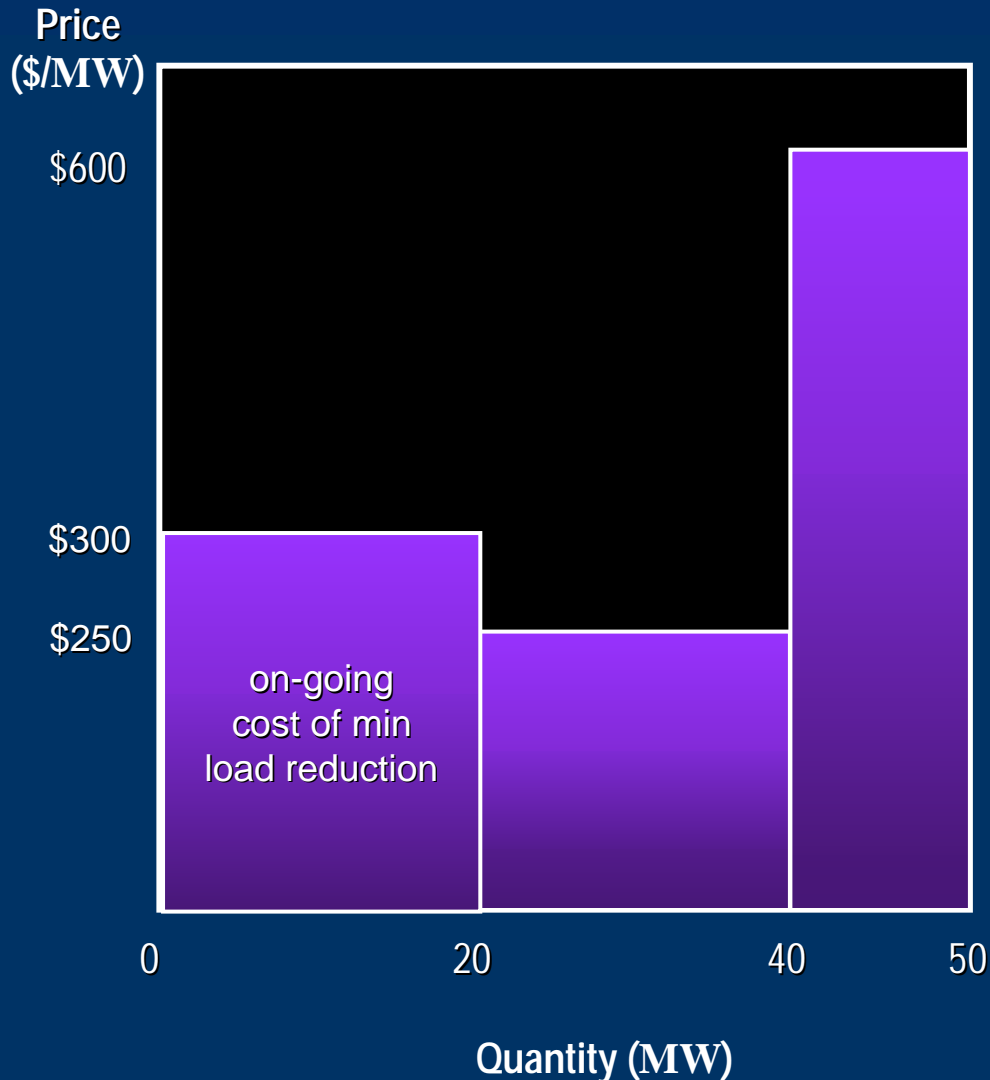
$$\$3,000 - \$3,300 = -\$300 \text{ (pays IMO)}$$

## Production Cost Guarantee

A guarantee that the participant will be kept whole to the costs associated with the day ahead schedule



# PCG - Price Responsive Load



## 50 MW Load Offers Demand Response:

- Fixed cost to reduce consumption of \$5,000
- On going cost of minimum 20 MW load reduction (to 30 MW) of \$6,000/hr
- Minimum downtime is 4 hours,
- The incremental price for a MW of reduction
  - 20 to 40 MW is \$250
  - 40 to 50 MW is \$600

## PCG - Price Responsive Load

- DAM Schedule is 30 MW consumption
- Cost to drop consumption from 50 MW to 30 MW is:  
\$5,000 (one time) + \$6,000 per hour
- Minimum downtime is 4 hours  
 $\$5,000 + 4 \times \$6,000 = \$29,000$

PCG ensures savings based on DAM price will be at least \$29,000 if a cut is scheduled

## PCG – Price Responsive Load

### DAM Prices:

Hour 1 = \$200, Hour 2 = \$200

Hour 3 = \$150, Hour 4 = \$150

Savings from a 20 MW cut for four hours =

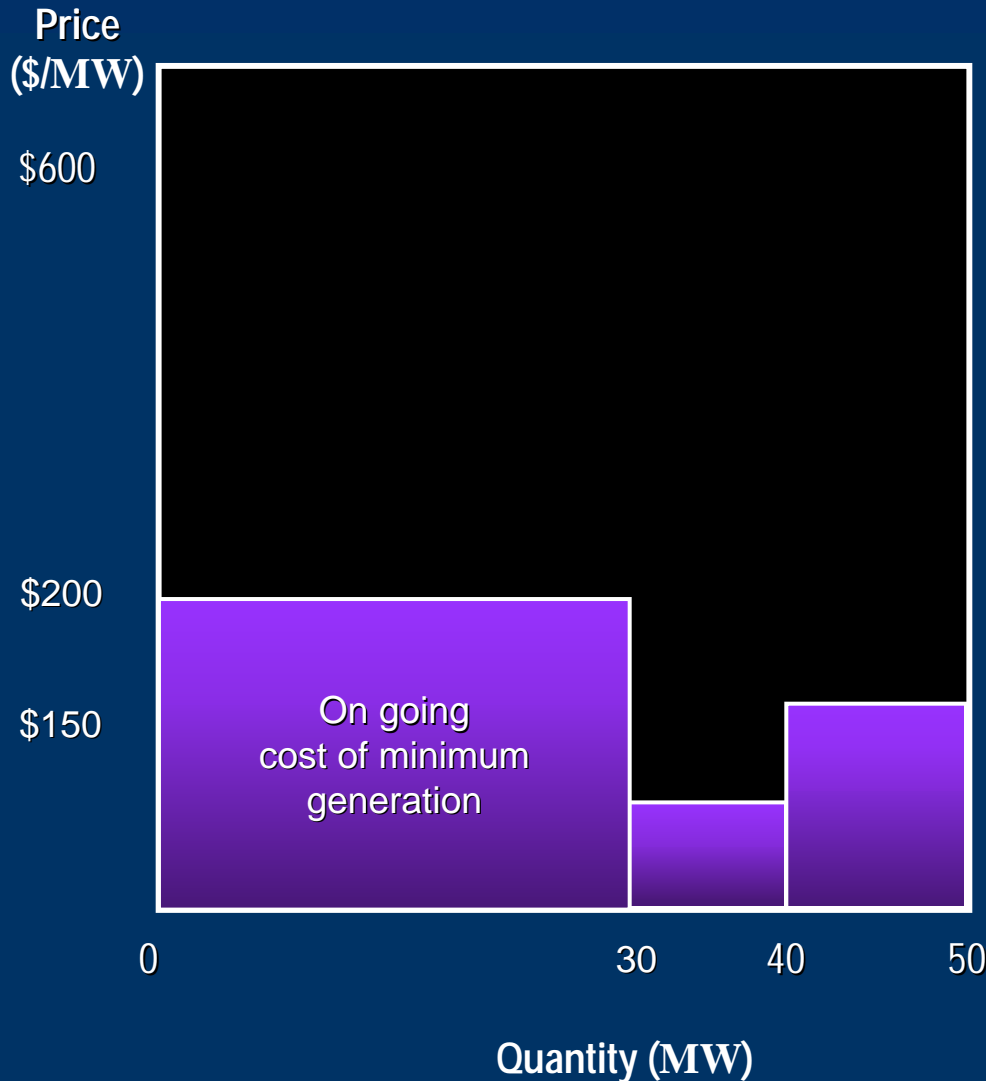
$\$200 \times 20\text{MW} + \$200 \times 20\text{MW} +$

$\$150 \times 20\text{MW} + \$150 \times 20\text{MW} = \$14,000$

$\text{PCG} = \$29,000 - \$14,000 = \$15,000$



# PCG – Generator



- Minimum output is 30 MW
- Start up cost to min gen is \$10,000
- On going cost of minimum generation is \$6,000/hr
- Minimum runtime is 4 hours
- The incremental price per MW above min is
  - 30 to 40 MW: \$100
  - 40 to 50 MW: \$150



## PCG - Generator

- Cost to start up and get to minimum output \$10,000 (one time) + \$6,000 per hour
- Schedule is for 6 hours at 50 MW
- PCG will ensure recover of costs associated with schedule
- $10,000 + 6 \times 6,000 + 6 \times 10 \times 100 + 6 \times 10 \times 150 = \$61,000$

## PCG – Generator

### DAM Prices:

Hour 1 = \$300, Hour 2 = \$200 Hour 3 = \$200,  
Hour 4 = \$200, Hour 5 = \$150 Hour 6 = \$200

Revenue for a 50 MW schedule for six hours =  
 $\$300 \times 50\text{MW} + \$200 \times 50\text{MW} + \$200 \times 50\text{MW} +$   
 $\$200 \times 50\text{MW} + \$150 \times 50 + \$200 \times 50 = \$62,500$

PCG = (minimum cost + incremental) - revenue  
= \$61,000 - \$62,500 = NO PCG

# Features of DAM

## Imports/Exports Scheduled Day Ahead

- Imports and exports can receive financially binding schedules and prices in the DAM
- Imports can receive a Production Cost Guarantee payment
- Day-ahead intertie schedules are expected to fail less frequently:
  - Importers/exporters have more time to complete tagging and firm up transactions
- Alignment with markets in neighbouring jurisdictions, allowing a consistent approach

# Features of DAM

## **Virtual Transactions – no energy actually consumed or supplied**

Participants can take a position in DAM which will be settled compared to the real-time price

# Two-Settlement System

- Settlement based on net position due to activity in the DAM and activity in the real-time market
  - $Q_{DA}(P_{DA} - P_{RT}) + Q_{RT}P_{RT}$
  - $Q_{RT}$  equals zero for virtual, therefore
    - $Q_{DA}(P_{DA} - P_{RT})$

# Features of DAM

## Virtual Transactions

- E.g., DAM price is \$100, RT price is \$110
- DAM schedule sells 100 MW, no real-time generation
- Because real-time price is \$10 higher, participant will pay the IMO  
 $\$10 \times 100 \text{ MW} = \$1,000$
- Allows participants to hedge price difference, drives the DAM price closer to the expected real-time price

# Features of DAM

## Virtual Transactions

- E.g., DAM price is \$100, RT price is \$110
- DAM schedule BUYS 100 MW, no real-time consumption
- Because real-time price is \$10 higher, participant will be paid  
 $\$10 \times 100 \text{ MW} = \$1,000$
- Allows participants to hedge price difference, results drive the DAM price closer to the expected real-time price

## Features of DAM

# Commits resources to satisfy forecast load and OR requirements

Day Ahead Bid Load = 1000 MW

IMO Forecast for reliability = 1800 MW

DAM will financially commit sufficient energy supply for 1800 MW

# IMO Commits to Forecast

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# IMO Commits to Forecast

- 1,000 MW bid into DAM
- 1,800 MW forecast load
  
- Gen A at 500
- Gen B at 470
- Gen C at 30
- DAM Price = \$65, RTEEM Price = \$100

# IMO Commits to Forecast

- 1,000 MW bid into DAM, PLUS 800 MW of Virtual Load
- Total Load Bid into DAM is 1800 MW
- 1,800 MW forecast load
- Gen A at 500
- Gen B at 500
- Gen C at 500
- Gen D at 300
- DAM Price = \$100, RTEEM Price = \$100



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# How Can I Participate?





# DAM Energy Market

## PHYSICAL SUPPLIERS

Dispatchable Generators

Non-dispatchable Generators

Importers

## PHYSICAL CONSUMERS

Price Responsive Loads

Price Sensitive Loads

Exporters

## VIRTUAL SUPPLIERS

Virtual Offers

## VIRTUAL CONSUMERS

Virtual Bids

# DAM Participation

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# Price Sensitive Load

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# Generator

- Dispatchable generators offer into DAM as price responsive generators
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- Non-dispatchable generators submit to DAM as now:
  - Self-schedulers submit schedules
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# Virtual Trader

- Must post prudential with IMO to cover trading limits (Loads must supply prudential as well)
- Can buy or sell energy
- Cannot sell OR



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# Costs





# DAM Costs

- PCG to meet bid load is recovered from all loads as uplift
- Additional PCG cost to meet forecast load will be allocated to those who incurred the cost i.e. load not bid into DAM



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# How Can I Learn More?



# DAM – Next Steps

- Review high level design Strawman
- Review detailed design proposals
- Review market rules proposals
- Comment to IMO
- Take the upcoming 1 day DAM training

# DAM Information

- A one day training session is coming in the fall
- IMO web under consultation-MEP-DAM
- Email [DAM@theIMO.com](mailto:DAM@theIMO.com)
- MEP Consultation (905) 403 6931



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# DAM Summary





# Summary of DAM

- Imports/exports are scheduled Day Ahead
- Transmission Rights settled on DAM prices
- Multi-part bids and offers allowing for recovery of fixed costs
- Financially commits resources to satisfy forecast load and OR requirements
- Production Cost Guarantee
- Virtual transactions

# Summary of DAM

- Provide price certainty in advance of real-time
- Provide greater operational certainty in advance of real-time
- Increase demand responsiveness to price
- Improved reliability
- Improved efficiency



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