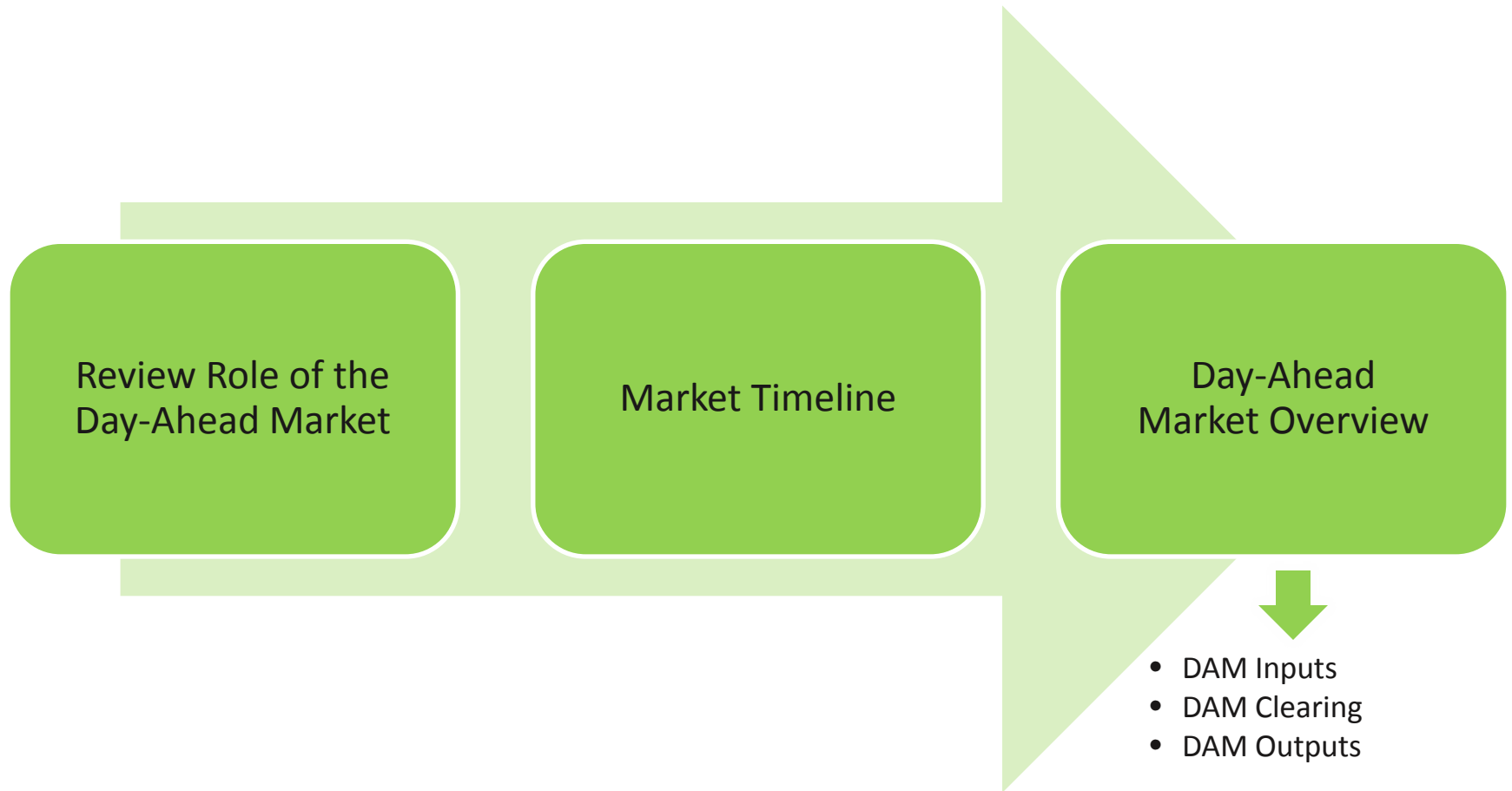


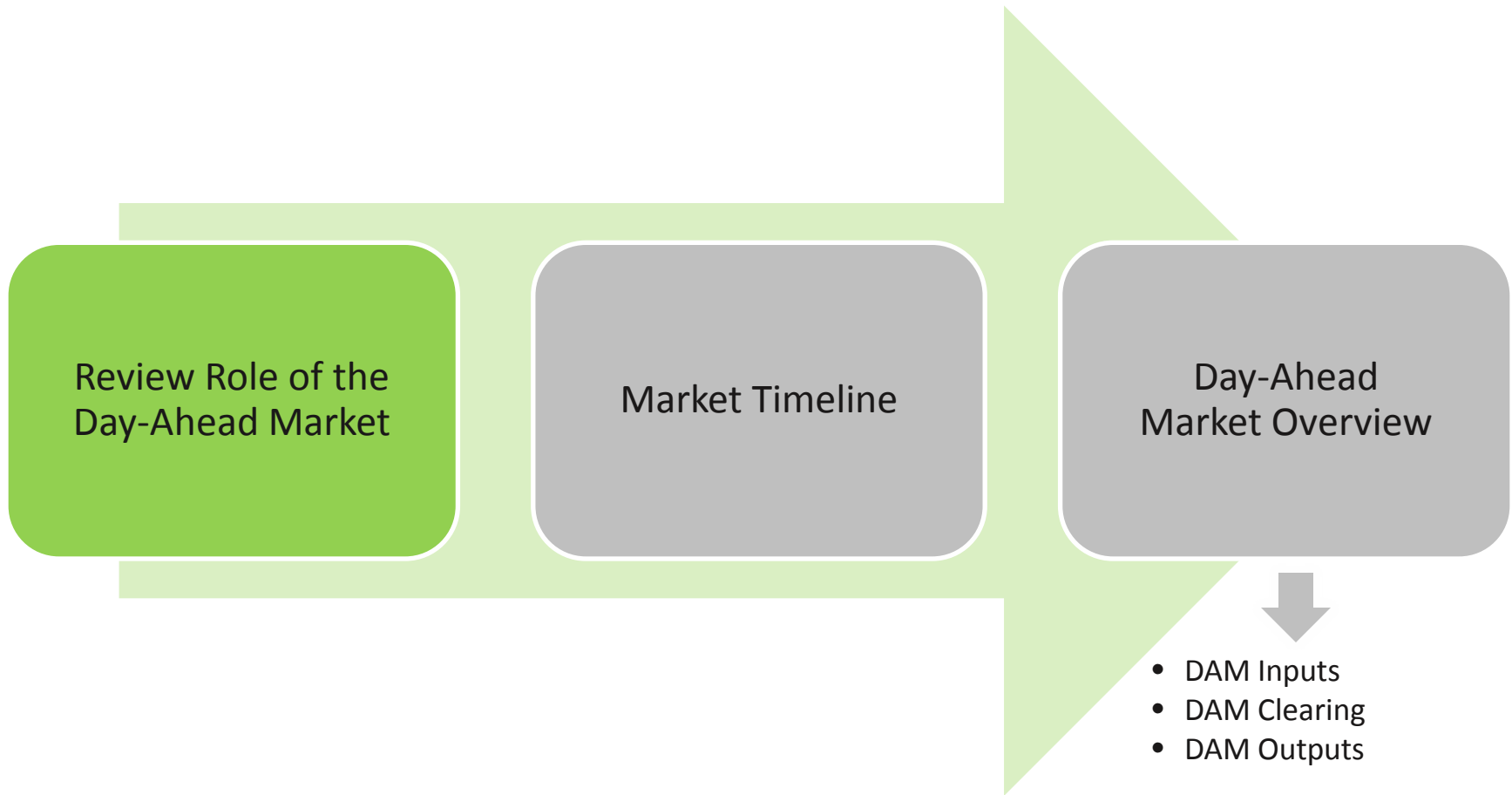
Day-Ahead Energy Market

David Turner

Hourly Market Operations

Topics Covered in this Module





Why a Day-Ahead Market (DAM)?

- A forward market to hedge against Real-Time (RT) price volatility
 - Allows Generation and Load Participants to secure Day-Ahead (DA) prices and reduce vulnerability to RT price fluctuations
 - Allows wholesale demand to participate in price determination
 - Provides a starting point for the initial unit commitment for the next operating day

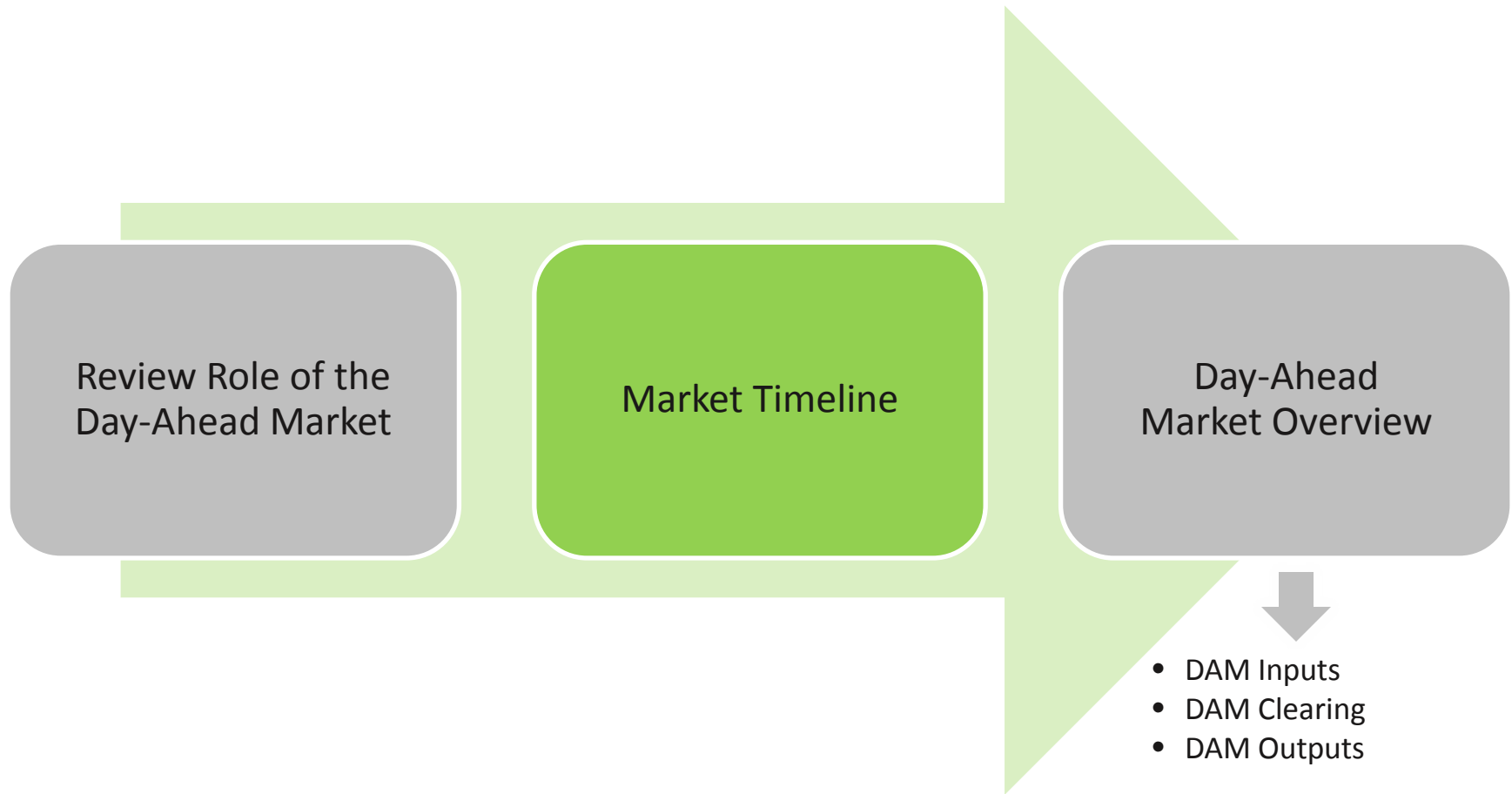
What is the Day-Ahead Market (DAM)?

- DA Energy Market enables Market Participants to purchase and sell energy at financially binding Day-Ahead Prices
 - DAM clearing based on submitted supply offers and demand bids.
 - Produces financially binding schedules for demand and generation.
 - Least-cost security-constrained unit commitment and dispatch.



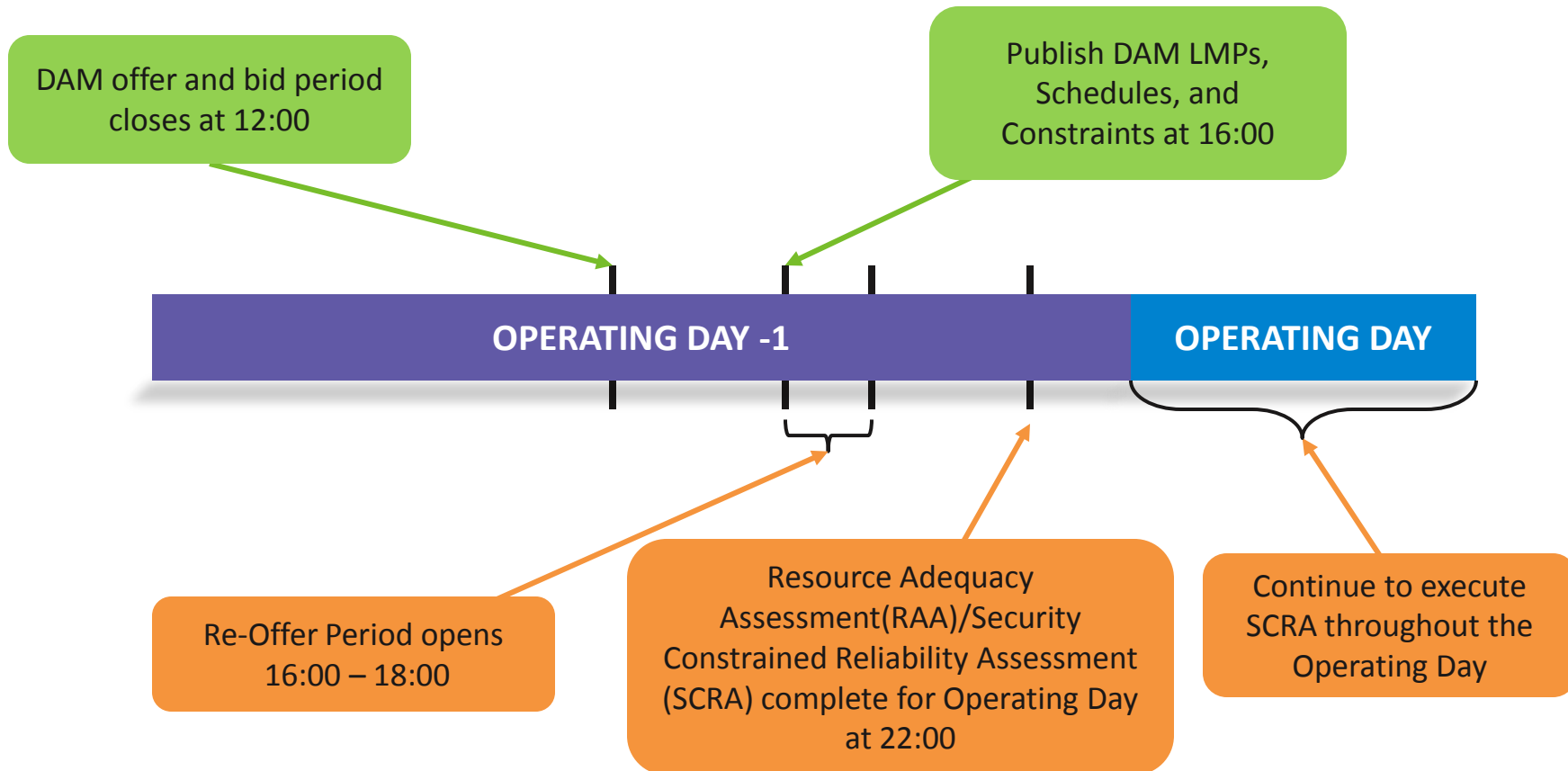
What is the Day-Ahead Market (DAM)? (cont.)

- Market Inputs – No later than noon (day before Operating Day); as early as 10 days prior
 - Demand bids
 - Decrement bids
 - Supply offers
 - Increment offers
 - Scheduling external transactions
- Clearing Outputs – 16:00 (before Operating Day)
 - Schedules for next Operating Day (Generation, Demand & External Transactions)
 - DA Hourly LMPs
 - Binding Constraints

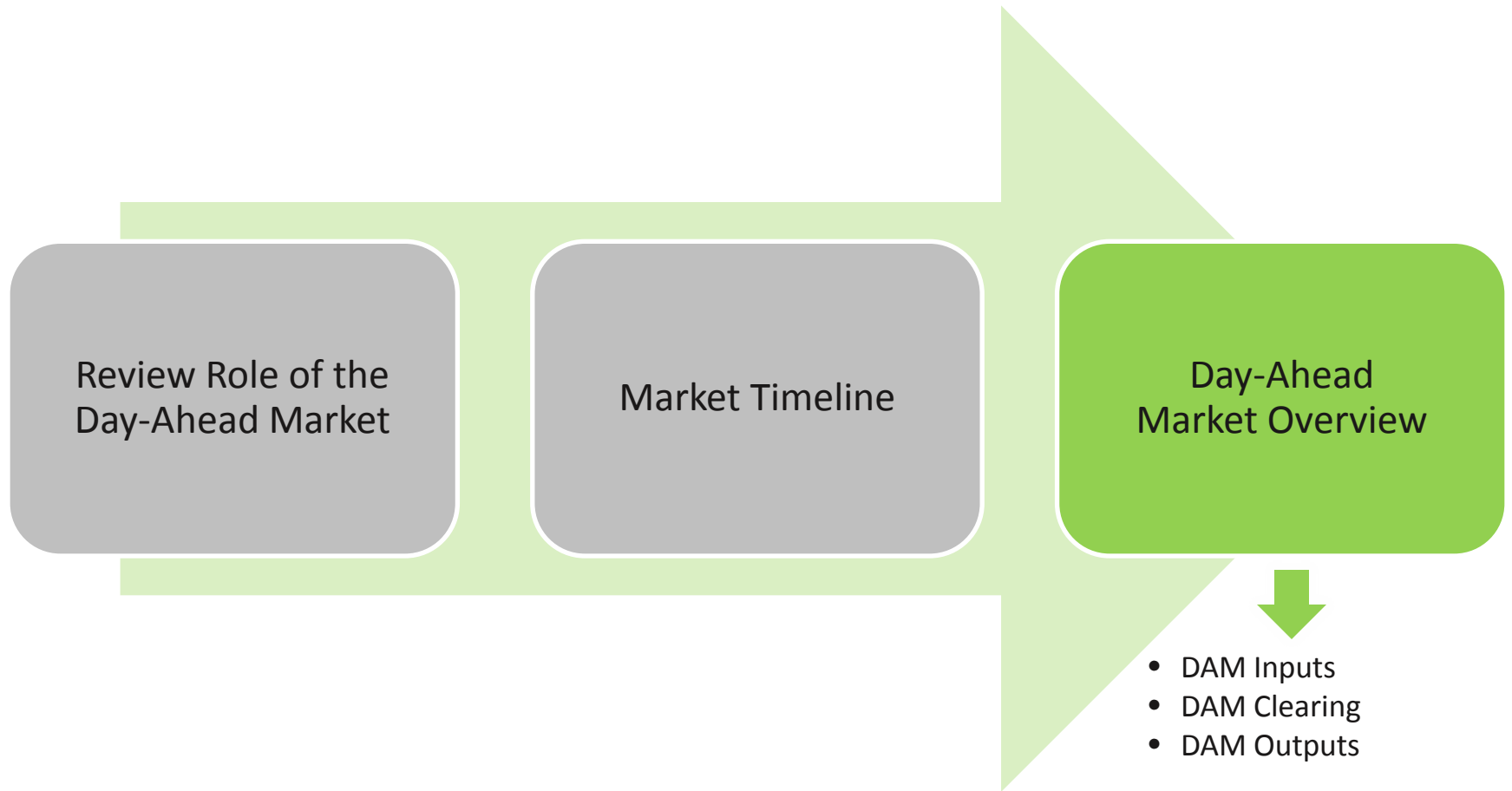


Market Timelines

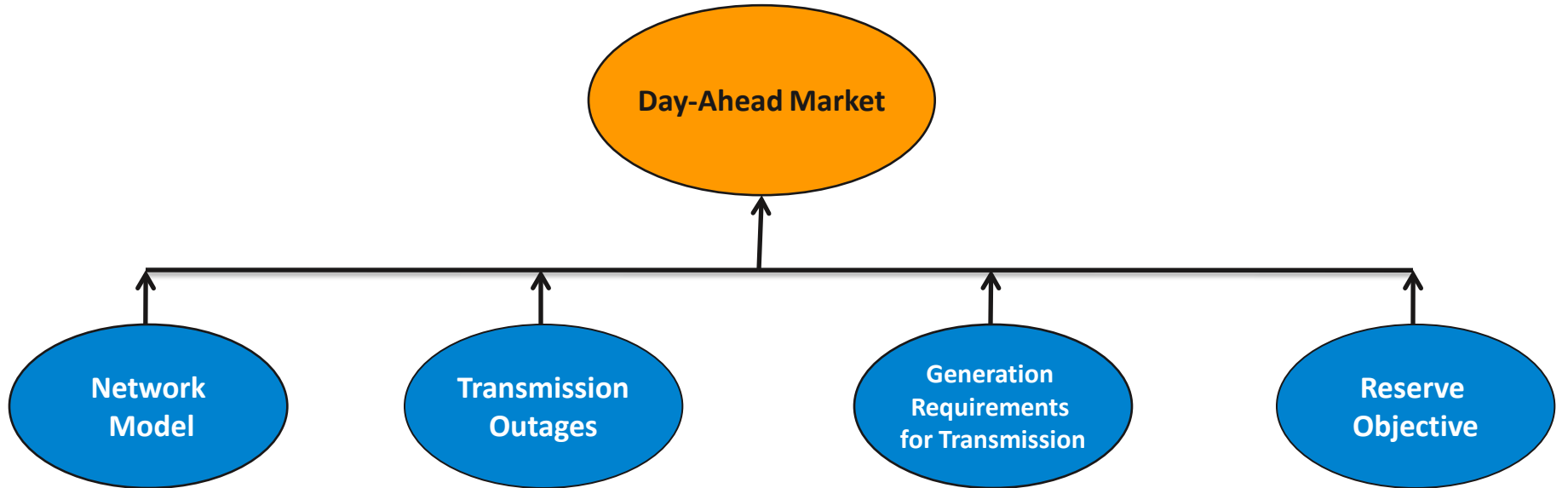
Day-Ahead Market (DAM)



Real-Time Market (RTM)



DAM Inputs at ISO



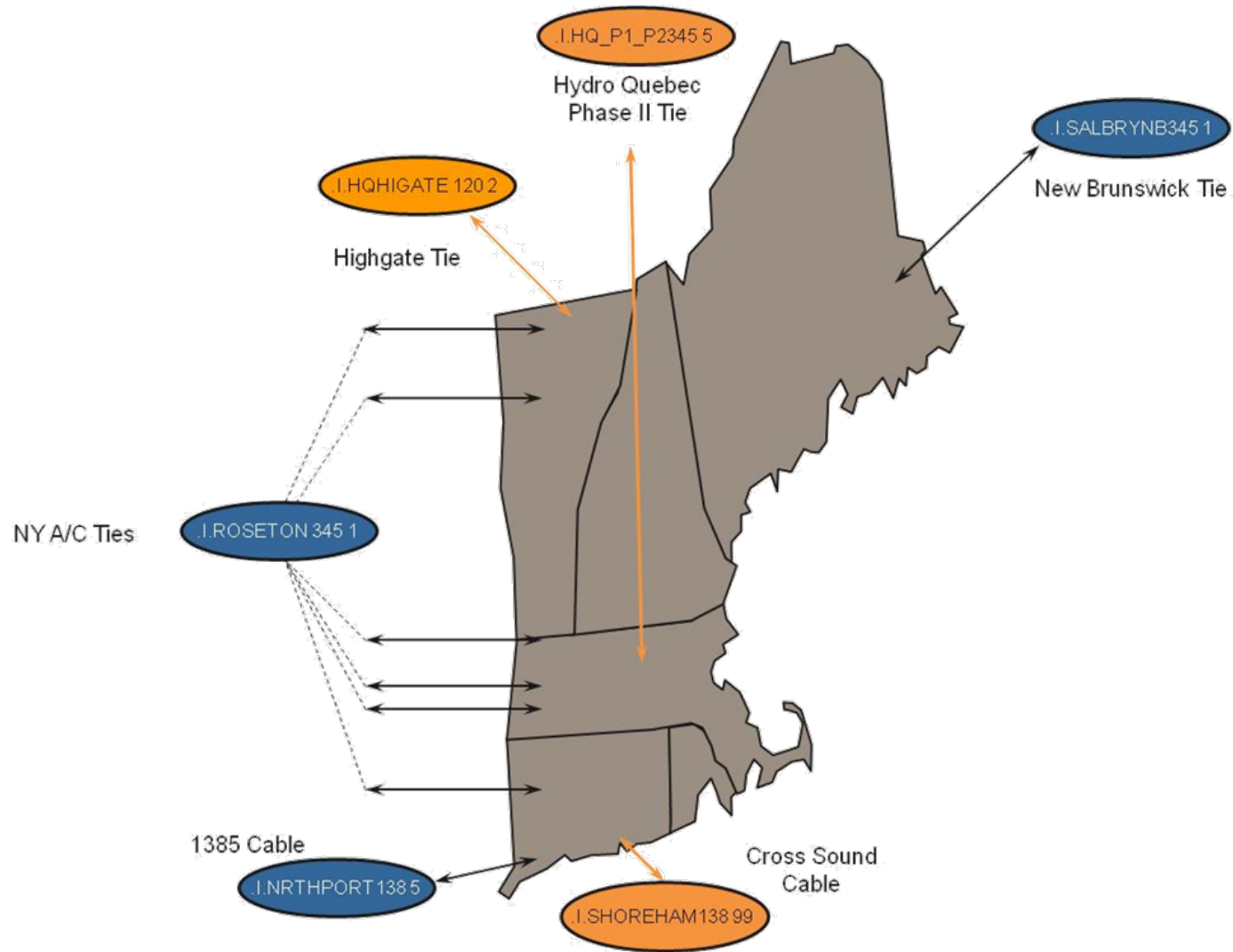
- Same model that is used in Real-Time
- Consists of transmission elements (breakers, lines, and transformers) with associated ratings and pricing locations (nodes)

- Approved transmission outages are modeled for the next day
- Devices (lines, breakers, and transformers) are verified for correct outage status and duration

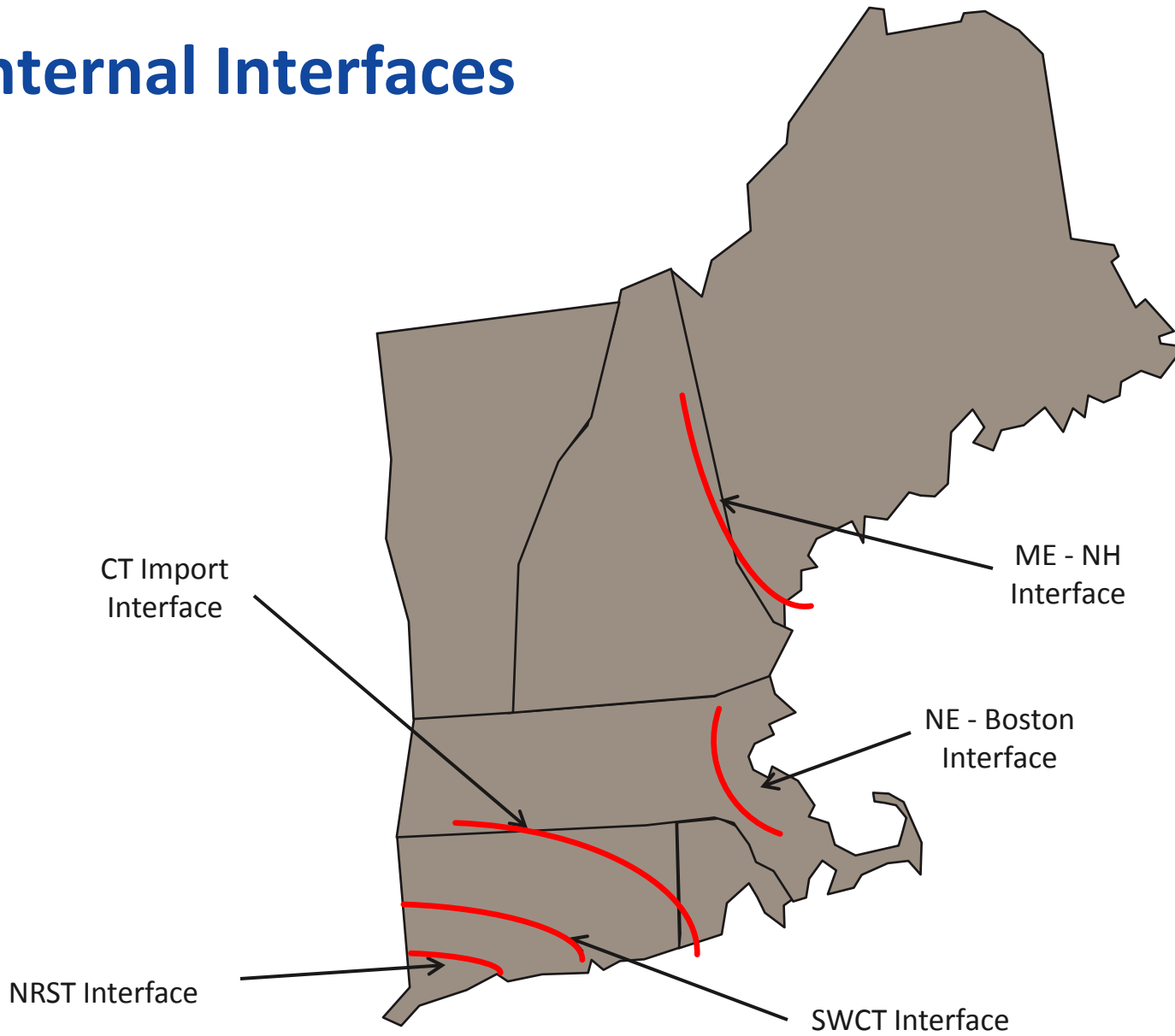
- Generation Requirements for Transmission (GRT) are limits for internal interfaces and external interfaces
- Includes double contingency limits for internal interfaces where applicable

- Ten-Minute Reserve
 - Sum of Ten-Minute Spinning Reserve (TMSR) and Ten-Minute Non-Spinning Reserve (TMNSR)
 - Requirement is 100% of 1st Contingency
- Thirty-Minute Operating Reserve
 - Requirement is 50% of 2nd Contingency
- ISO New England OP No. 8

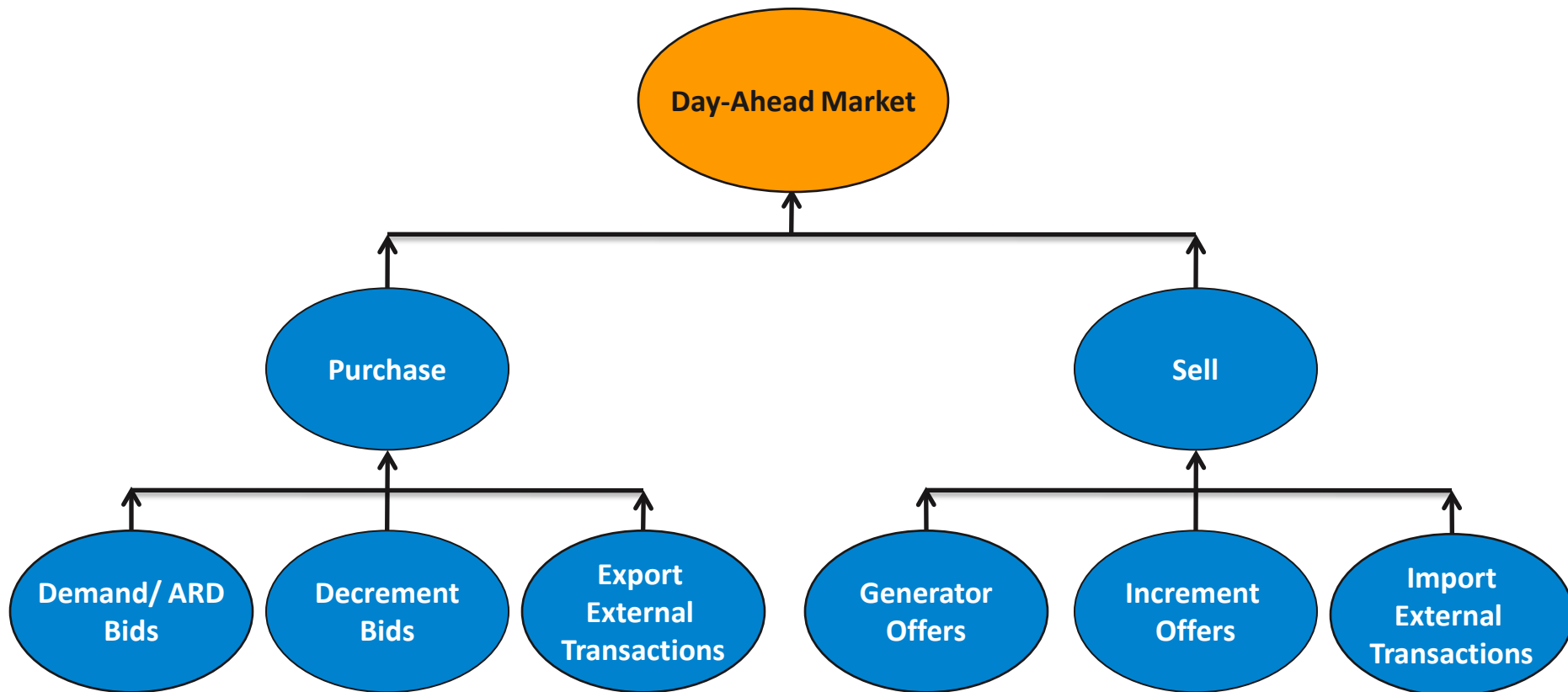
External Interfaces



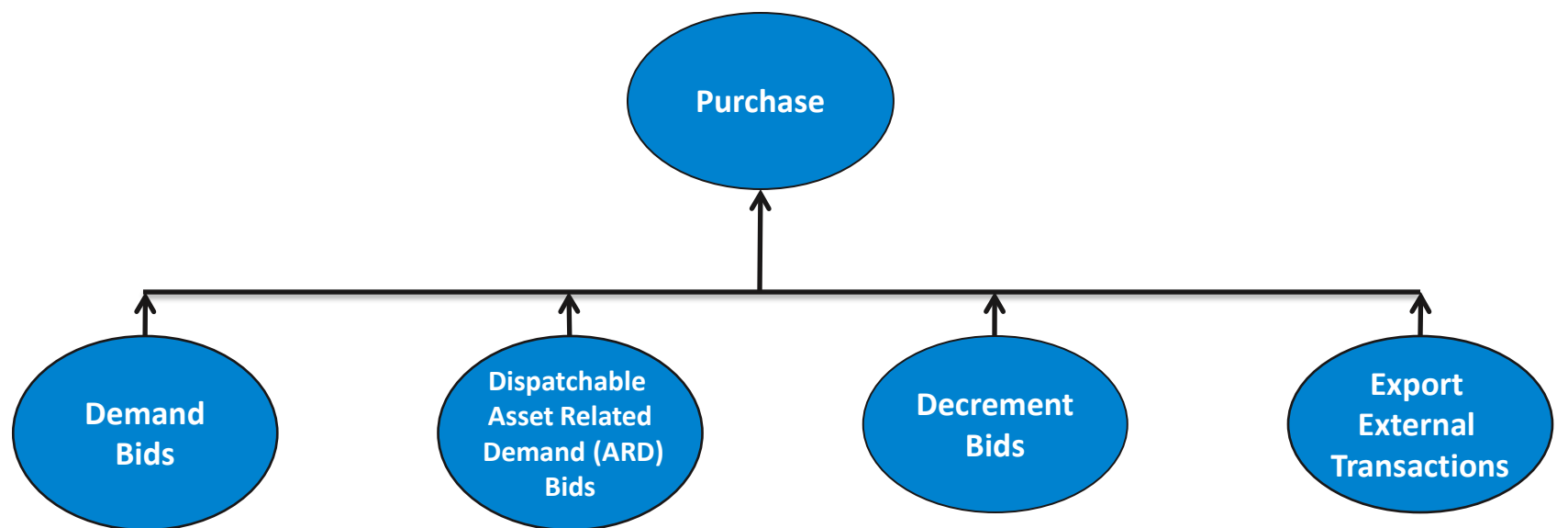
Internal Interfaces



DAM Participant Inputs



DAM Participant Inputs (cont.)



- Must be associated with physical load registered as a Load Asset
- Must submit to load zone
- Fixed or price sensitive
- Demand Bids distributed based on historical load weights

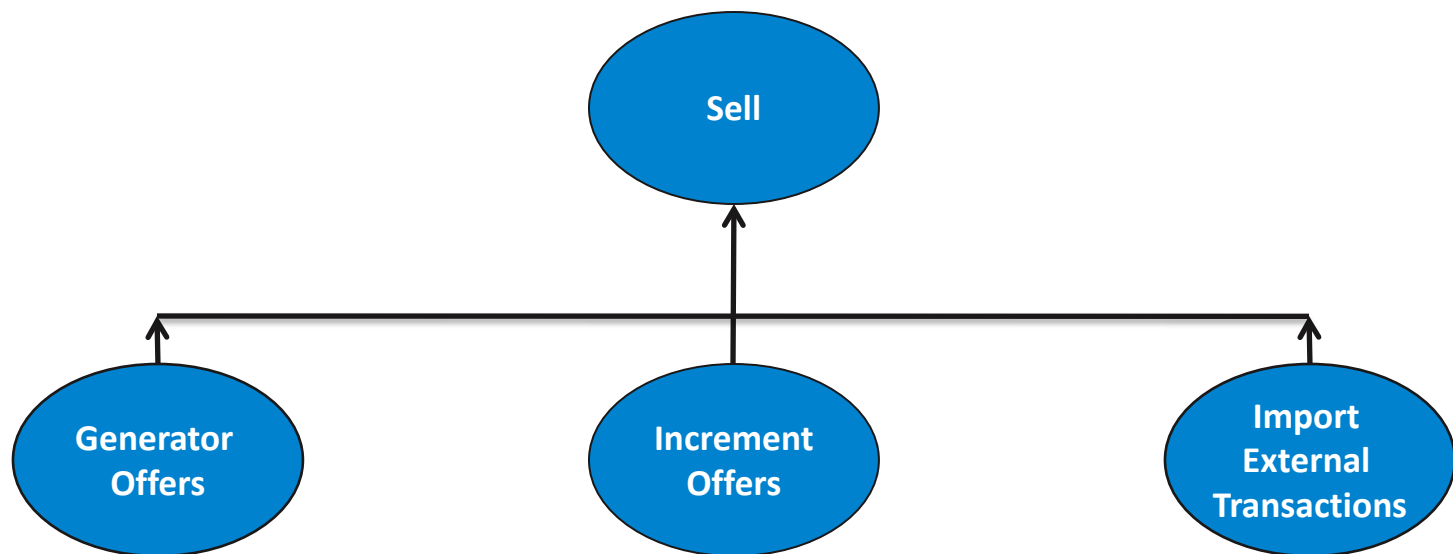
- Self-Scheduled or price sensitive
- Must submit to associated ARD node

- Financial tool to purchase energy in the DAM at a specific location
- May submit at any location for which an LMP is calculated (Hub, Load Zone or Node)
- The bids are **NOT** required to be associated with a physical load

- May only submit to external node
- Fixed or price sensitive

Price sensitive demand bids, decrement bids, and external transactions have a price cap of \$1,000 per MW and must be equal to or greater than \$0

DAM Participant Inputs (cont.)



- All Resources with a CSO must submit a Day- Ahead Schedule
- Must be associated with a physical generator that is registered as a generator asset
- Economic, Self-Scheduled, or Unavailable

- Financial tool to sell energy in the DAM at a specific location.
- May submit at any location for which an LMP is calculated (Hub, Load Zone or Node)
- The offers are **NOT** required to be associated with physical generation or load

- May only submit to external node
- Fixed or price sensitive

Generator offers, increment offers, and price sensitive external transactions have a price cap of \$1,000 per MW and must be equal to or greater than \$0

DAM Participant Inputs – Increment (INC)

- A quantity of MW offered to supply at a minimum price per block in the DA financially binding Market
 - M-35 “Increment Offer shall mean an offer to sell Energy at a specified Location in the Day-Ahead Energy Market. An accepted Increment Offer results in scheduled generation at the specified Location in the Day-Ahead Energy Market.”

DAM Participant Inputs – Increment (INC)

Example

- An INC for hour one (1) at the Hub with a price quantity pair of 50 MWh @ \$75/MW
 - If the DA LMP at the Hub is greater than or equal to \$75, then this INC would clear at this location in DA.
 - Cleared offer would then create a payment of the cleared MWs x the DA Hub LMP.
 - Assuming no other positions taken in RT, the lack of supply at the same location (Hub) in RT would create a deviation requiring the Participant to pay back at the RT price.

DAM Participant Inputs – Decrement (DEC)

- A quantity of MW bid to consume at a maximum price per block in the DA financially binding Market
 - M-35 “Decrement Bid shall mean a bid to purchase Energy at a specified Location in the Day-Ahead Energy Market, which is not associated with a physical load. An accepted Decrement Bid results in scheduled load at the specified Location in the Day-Ahead Energy Market.”

DAM Participant Inputs – Decrements

Example

- An DEC for hour one (1) at the Hub with a price quantity pair of 50 MW @ \$75/MW
 - If the DA LMP at the Hub is less than or equal to \$75, then this DEC would clear at this location in DA.
 - The cleared bid would then create a charge of the cleared MWs x the DA Hub LMP.
 - Assuming no other positions taken in RT, the lack of load at the same location (Hub) in RT would create a deviation and the Participant would receive a payment at the RT price.

Clearing of the Day-Ahead Market (DAM)

- DAM clearing based on Participant-submitted supply and demand
 - Clearing is based on least cost means of satisfying cleared demand and reserve requirements using a security constrained economic commitment and dispatch.
- DAM produces financially binding schedules for demand and generation.
 - Based on hourly Locational Marginal Pricing (LMP)
 - The cleared generation offer would create a payment of cleared MWs x DA price at the node
 - The cleared demand bid would create a charge of the cleared MWs x DA price at the zone

Clearing of the DAM (cont.)

- Least Cost Security Constrained Economic Dispatch
 - ISO New England, Market Rule 1
 - Section 1.10.8, ISO Responsibilities
 - (a) The ISO shall use its best efforts to determine (i) the least-cost means of satisfying hourly purchase requests for energy, the projected hourly requirements for Operating Reserve, Replacement Reserve and other ancillary services of the Participants, including the reliability requirements of the New England Control Area, of the Day-Ahead Energy Market

Clearing of the DAM (cont.)

- Least Cost Security Constrained Economic Dispatch
 - ISO New England Manual for Market Operations (Manual M-11)
 - Section 5.1, ISO Philosophy
 - The ISO scheduling philosophy in the Day-Ahead Energy Market is to schedule and Dispatch generation, Increment Offers and External Transaction purchases on a least cost, security-constrained basis (minimize Start-Up Fees, No-Load Fees and incremental Energy costs) to meet the aggregate cleared Demand Bids, cleared Decrement Bids, cleared External Transactions sales and Operating Reserve and Replacement Reserve requirements, while maintaining the reliability of the New England Control Area.

Clearing of the DAM

Software Applications

Resource Scheduling & Commitment (RSC)

Economic unit commitment based on submitted supply offers & demand bids and reserve objective

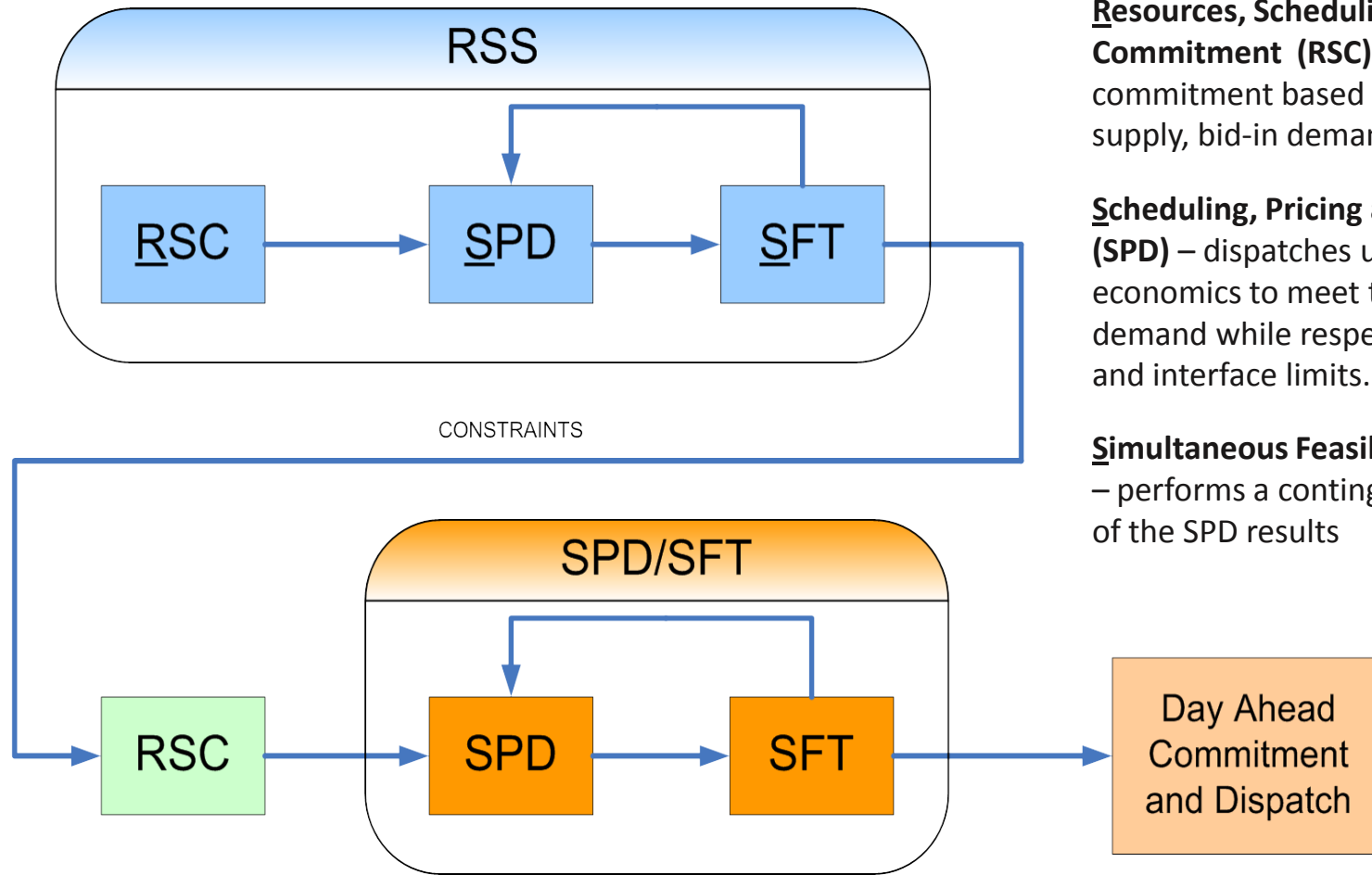
Scheduling, Pricing and Dispatch (SPD)

- Security constrained economic dispatch using the unit commitment produced by RSC
 - Respects line limits and interface limits
- Develops LMPs

Simultaneous Feasibility Test (SFT)

- Contingency analysis of SPD results
- Constraint sensitivities fed back to SPD for re-dispatch

Clearing of the DAM

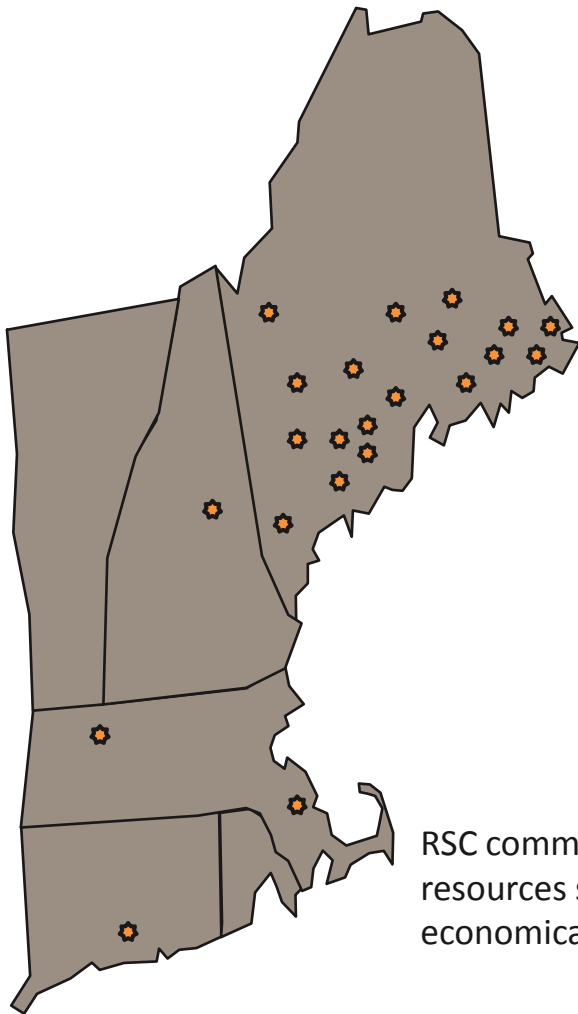


Resources, Scheduling and Commitment (RSC) – develops unit commitment based on offered supply, bid-in demand and reserves

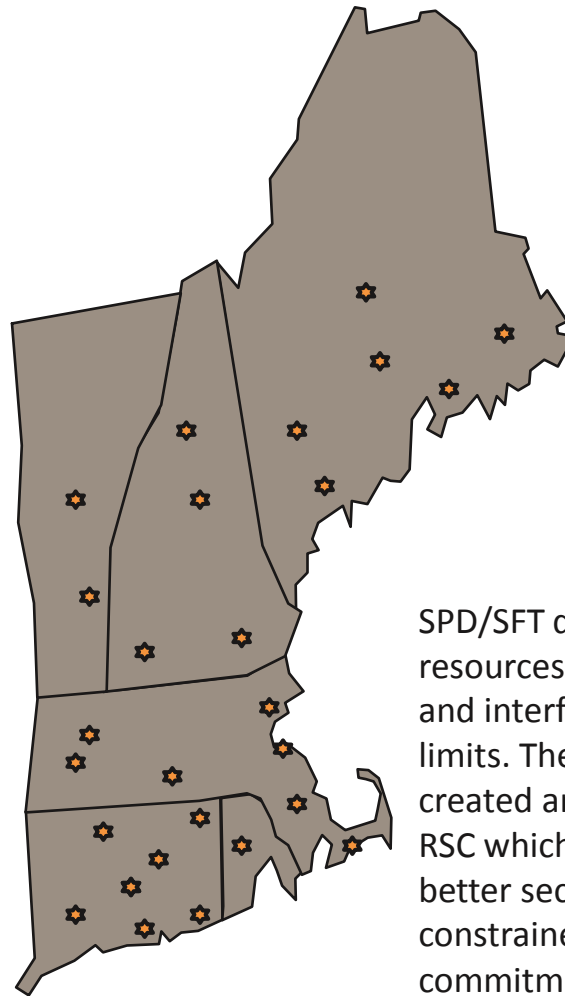
Scheduling, Pricing and Dispatch (SPD) – dispatches units in economics to meet the cleared demand while respecting the line and interface limits.

Simultaneous Feasibility Test (SFT) – performs a contingency analysis of the SPD results

Example: Clearing of the DAM

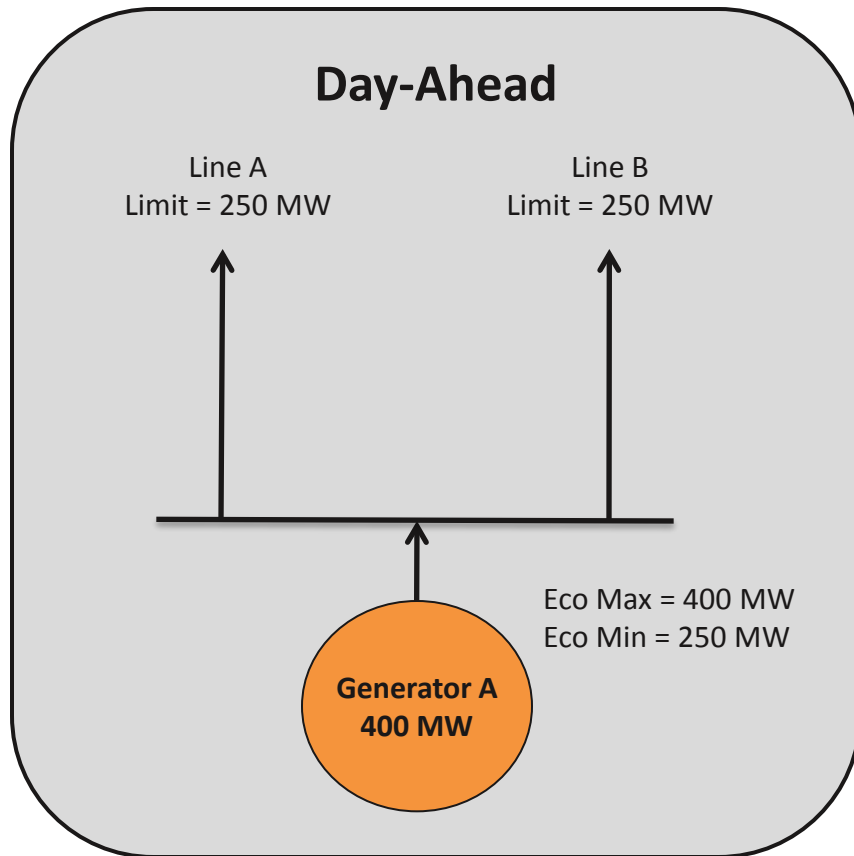


RSC commits resources strictly economically



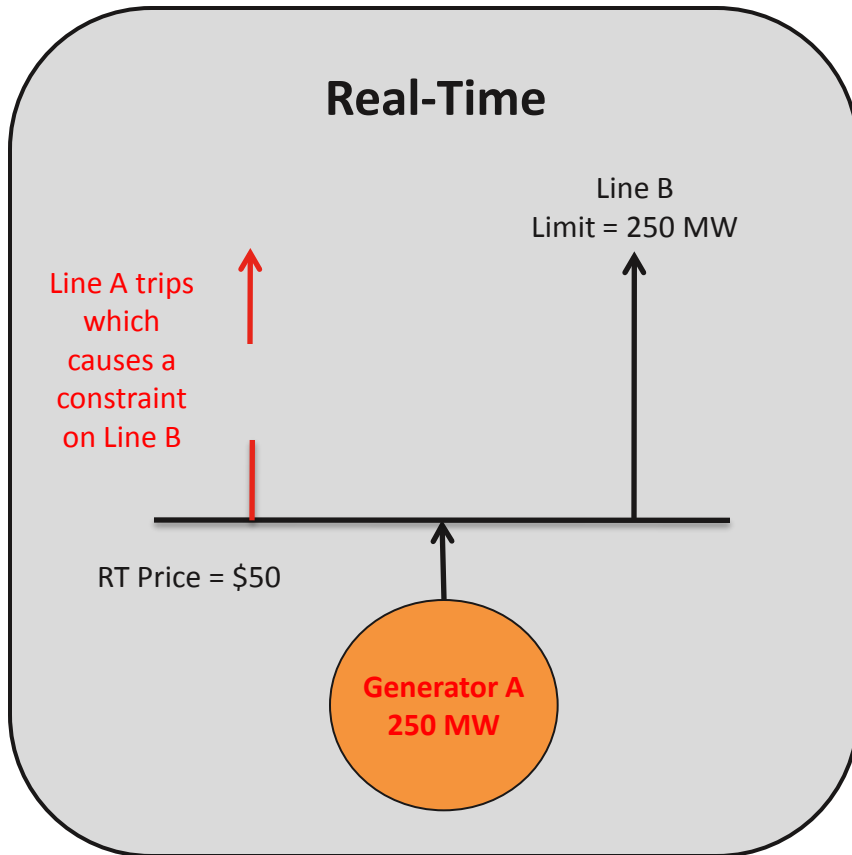
SPD/SFT dispatch the resources respecting line and interface limits. The constraints created are fed into a 2nd RSC which produces a better security constrained unit commitment.

Example: Benefits of DAM – Generator



- Generator A offered 400 MW @ \$50/MW
- Calculated LMP at Generator A pnode = \$75/MW
- Generator A dispatched to 400MW
- DAM Settlement:
 $400\text{MW} \times \$75/\text{MW} = \$30,000$ Payment

Example: Benefits of DAM – Generator

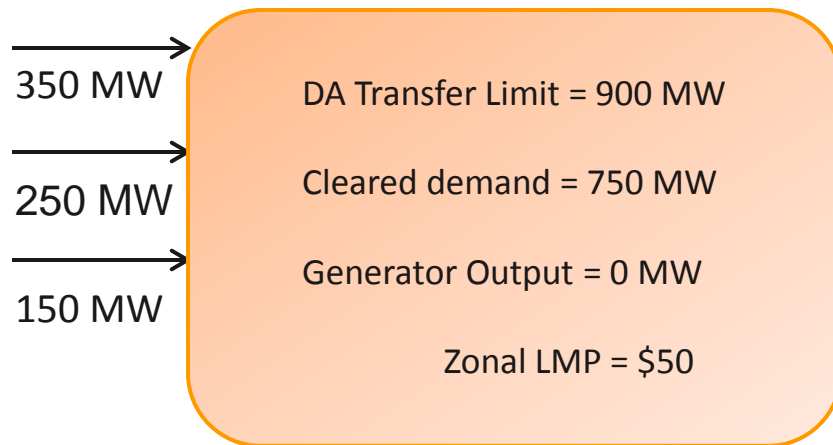


- Deviation (RT-DA):
 $250 \text{ MW} - 400 \text{ MW} = -150 \text{ MW}$
- RT Settlement:
 $-150 \text{ MW} \times \$50/\text{MW} = -\$7,500 \text{ Charge}$
- Net Settlement:
 $\$30,000(\text{DA}) - \$7,500(\text{RT}) = \$22,500$
- No DA commitment:
 $250 \text{ MW} \times \$50/\text{MW} = \$12,500$

The generator is re-dispatched to 250 MW in RT to respect limit for remaining line in service. The RT price at the generator will be lower due to the constraint and possibly negative depending on the severity. The generator pays back the deviation (150 MW) at the RT price (\$50/MW for this example based on offer).

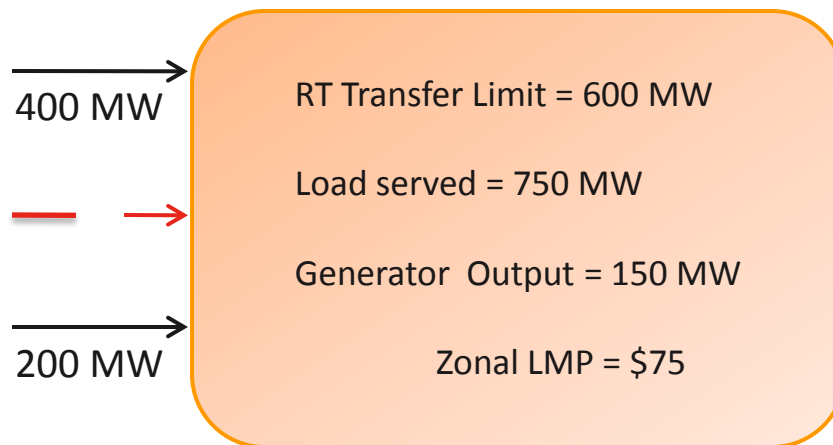
Example: Benefits of DAM – Demand

Day-Ahead



- Generator offered 175 MW @ \$75/MW
- DAM Settlement:
 $750 \text{ MW} \times \$50/\text{MW} = \$37,500 \text{ Charge}$

Real-Time



- Generator dispatched to 150 MW to serve load
- RT Settlement:
 - $150 \text{ MW} \times \$75/\text{MW} = \$11,250 \text{ Payment to Generator}$
 - No charge to load (demand) due clearing in DA
 - Payment to Generator withdrawn from the Congestion Revenue Fund

Outputs of the DAM

- ISO-NE Public website:

http://www.iso-ne.com/markets/hst_rpts/hstRpts.do?category=Hourly

- Day-Ahead LMPs
- Day-Ahead Constraints
- Hourly Day-Ahead Cleared Demand
 - Sums fixed demand, price sensitive demand, asset related demand, decrement bids, and increment offers
- During the operating day the LMP Map shows the Day-Ahead Zonal LMPs, cleared demand, and binding constraints for actual hour of the day. The LMP Map can be found at:

<http://www.iso-ne.com/portal/jsp/Impmap/Index.jsp>

Outputs of the DAM (cont.)

- Private (eMarket)
 - System Summary
 - Day-Ahead Demand
 - Day-Ahead Load Forecast
 - Day-Ahead Operating Reserve
 - Prices
 - Ability to select All PNODES, Unit PNODES, ARD PNODES External Interface PNODES, Zones, or Hub
 - Binding Constraints
 - Identifies whether base or contingency
 - Reactive Interface Limits
 - Internal interface limits and actual flow
 - Net Tie Schedules
 - Provides actual flows for the external interfaces

Outputs of the DAM (cont.)

- DAM schedules are an initial input to the Resource Adequacy Assessment (RAA).
 - Forecaster adds unit commitments for reliability and capacity.

Module Review: Topics Covered

