

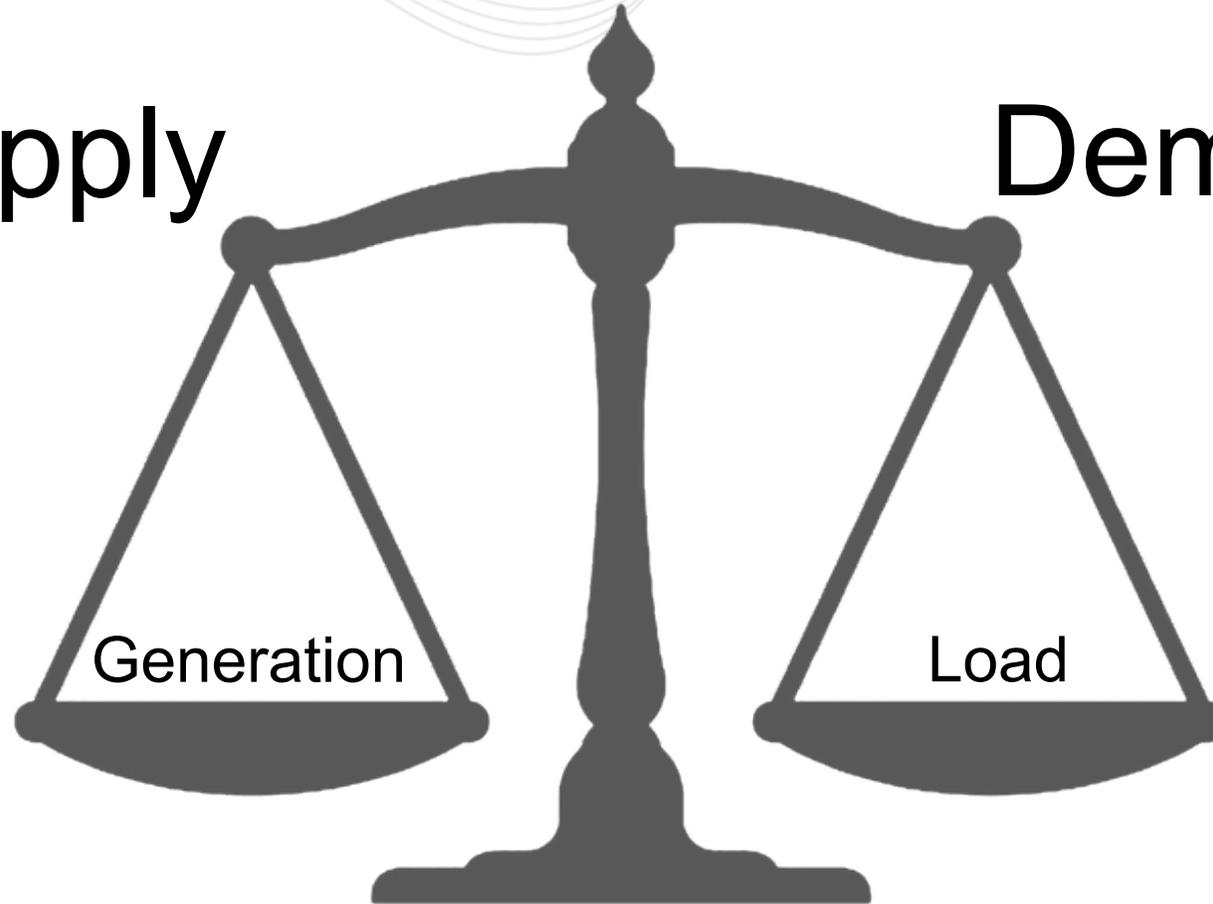
Where and How Much? MW responsibilities of supply

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DISRS
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MW

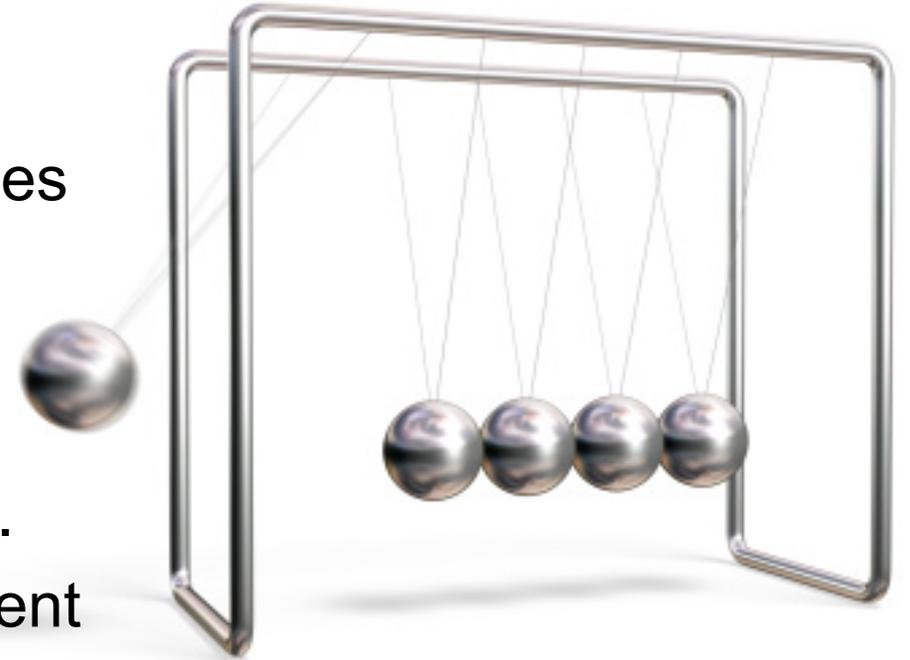
Supply

Demand

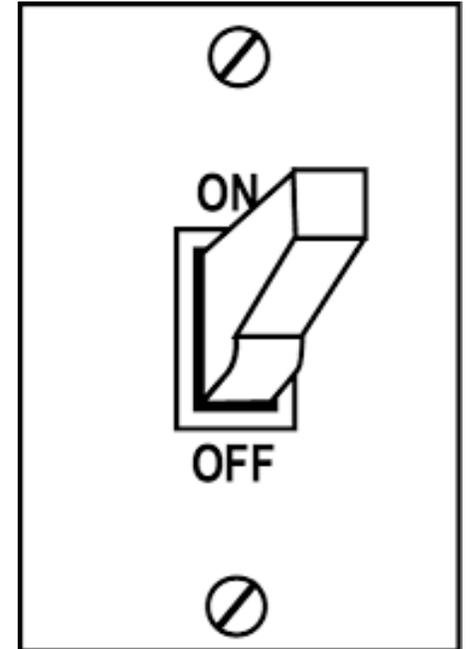


- Frequency
- Regulation
- Reserves
- Constraints
- Capacity Obligation
- Outage Reporting
- Performance
- Disclose Capability
- Follow a Schedule

- Supply and demand are balanced
- Power is delivered respecting all constraints
- Congestion is translated into economic incentives for both supply and demand
- A lack of supply certainty requires additional products like regulation, reserves, and capacity.
- A lack of constraint certainty requires less efficient control, bound at lower percentages and less economically transparent.



- Demand operates independent of ACE
- Demand ignores constraints (locational value)
- Demand largely ignores minute-to-minute economics
- Load shed is an absolute last resort only
- “Do Not Inject” is commonly enforced to differentiate demand from supply
- Demand that can follow a dispatch is generally marketed as supply (DR)



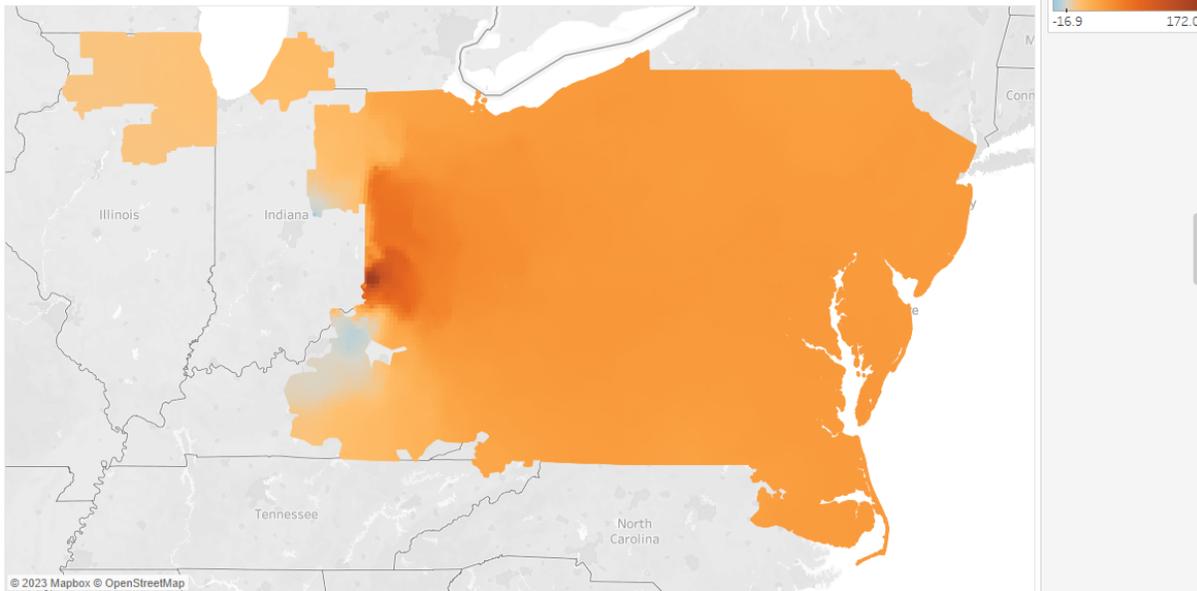
- Supply follows commitment decisions
 - Supply notifies of outages and reduction
 - Supply re-dispatches around constraints
 - Supply responds to minute-to-minute economics
-
- Although there are exceptions, they are generally excluded from full participation like self scheduled, energy or regulation only, etc
 - PJM ensures adequate supply obligations through the capacity market

- Supply is not perfect, faults and unexpected interruptions are unavoidable
- Reserve market procures appropriate safety margins for this uncertainty
- Regulation market responds to even more quickly to energy imbalance

- Increases in supply risk come with added costs in regulation, reserve, capacity, and other ancillary services.
- Capacity risk may ultimately lead to not meeting peak demand

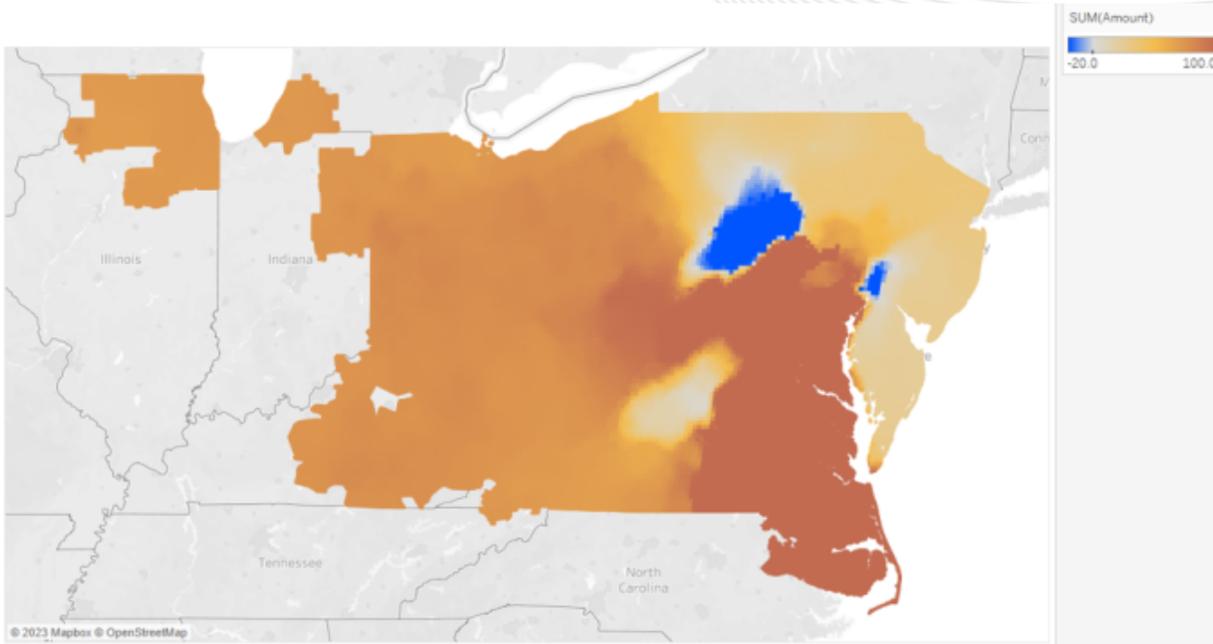
- Control means understanding current and potential impact to a constraint.
- Constraints have three components:
 1. Electrical Proximity to Constraint (Distribution Factors)
 2. Amount of Energy (MW) actual and possible
 3. Resource's Loss Contribution (gen to load deliverability ratio)
- Energy dispatch is priced through these factors. Capacity is procured to deliver sufficient energy dispatch.
- Transmission equipment must be protected from catastrophic failure, even including load shed if there is no available control.

Sheet 1



- Note gradient, not just regional price differences.
- Indiana, Kentucky, Western Ohio all have gradients.

- Single constraint
- Price gradient over small-ish area



- Note the gradients, not just the regional price differences.
- Pennsylvania, Maryland, Ohio, Delaware, West Virginia, and Virginia all have gradients.

- Significant Congestion, typical North/South issues
- 4 binding constraints

- Reducing Load in response to ACE, price, or other factors is certainly control and should be encouraged.
- Non-controllable Generation does lower prices and help prevent load shed.
- These types of responses are captured in ancillary services and demand response products, paid for by load.
- Capacity is still required in proportion to the total load with an explicit energy and reserve market obligation.

- Supply has an expected variability captured by capacity factor and requiring a supporting amount of regulation and reserves.
- Demand has very little exposure to minute-to-minute pricing, frequency control, or manual dispatch instruction.
- Changing the balance of responsibility between supply and demand is possible would be a much larger change than 2222.
- Constraint control requires specific information, specific response.
- Supply side products, aggregations or otherwise, must maintain “where and how much” at the very minimum.

- Aggregations ≥ 100 KW are permissible
- Must share the same primary transmission node (WHERE)
- Capacity market participation includes real-time telemetry requirements (HOW MUCH)
- Metering of individual resources for settlements

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