Overview of ISO/RTO Demand Response Programs
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Panel Session on Demand Response under Smart Grid
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Trade Secret

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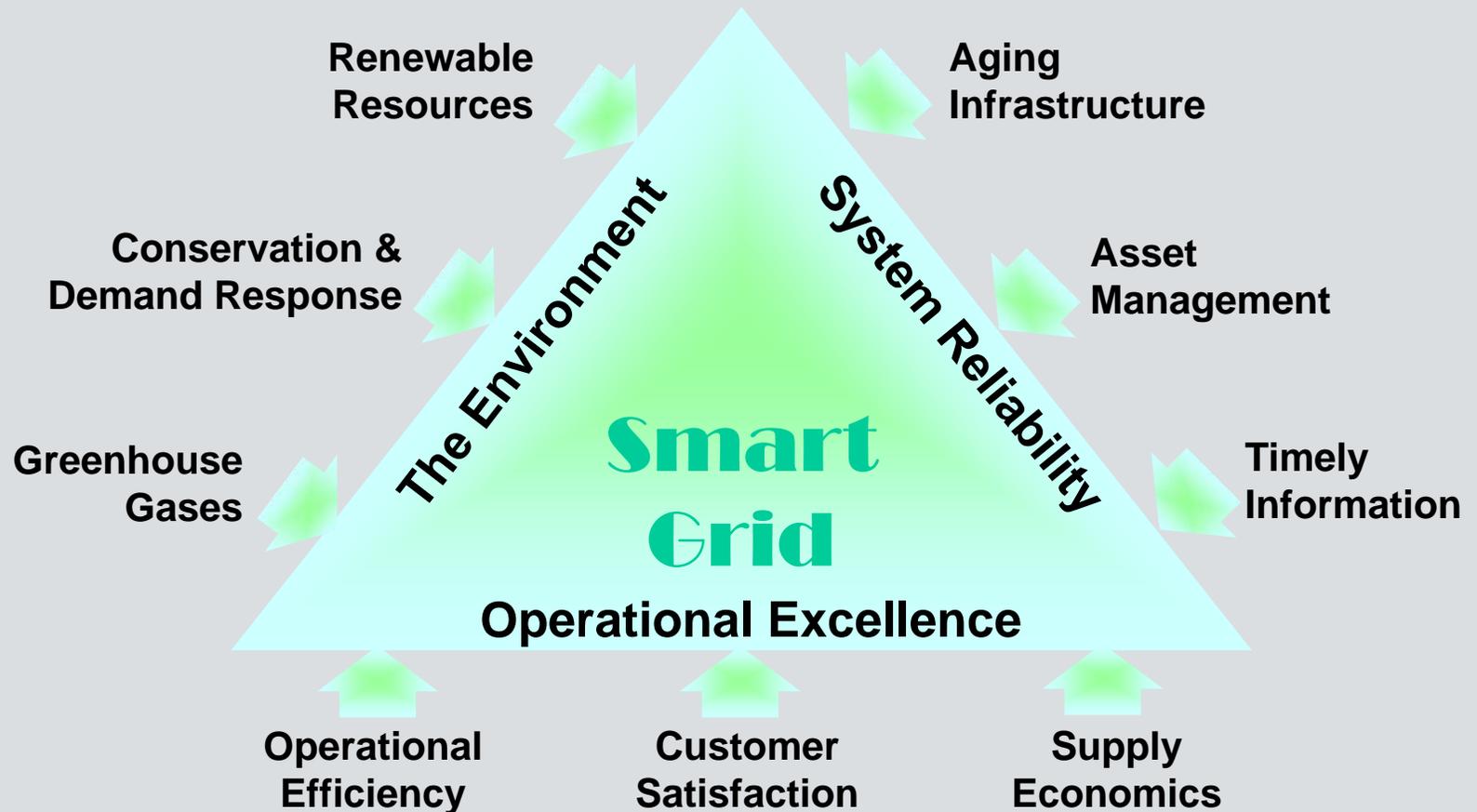
Panel Session on **Demand Response** in **ISO/RTO Markets** under **Smart Grid**

- Topics:
  - *Overview of Demand Response at different ISO/RTOs*
  - *Integrating Demand Response into Wholesale Electricity Markets*
  - *Effective Business Models for Demand Response under the Smart Grid paradigm*
  - *PG&E's Perspective on Demand Response under Smart Grid*
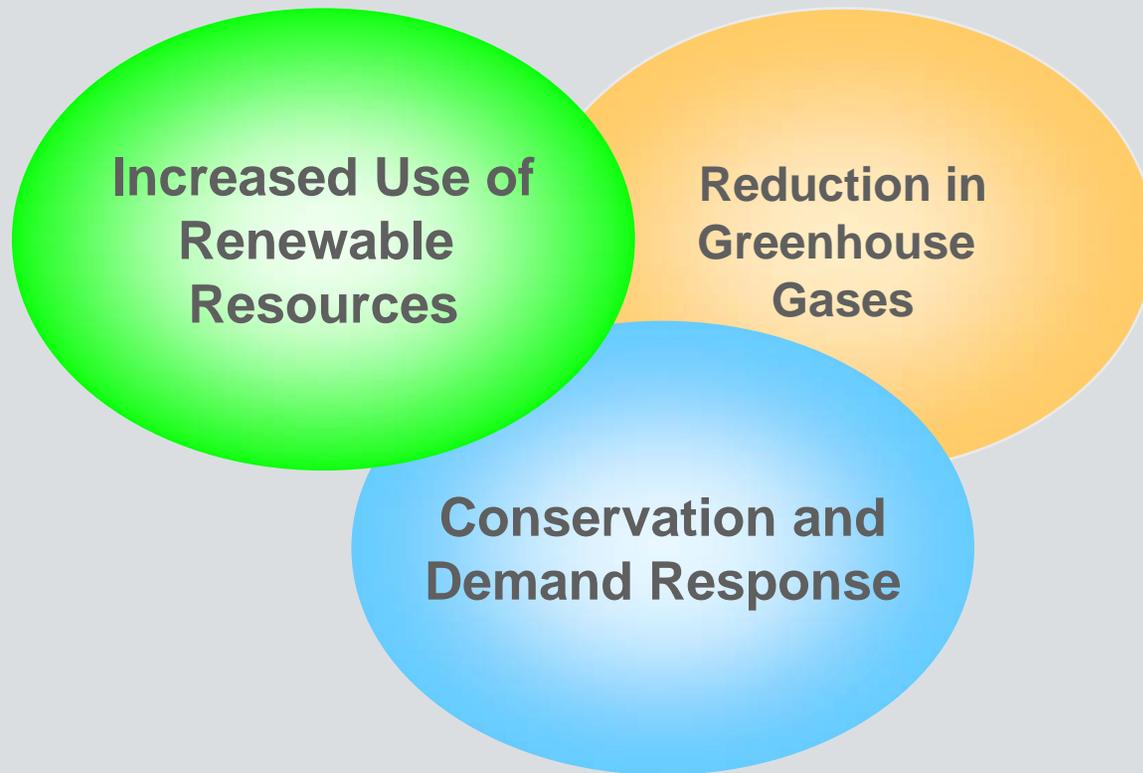 - *Smart Grid of the Future with Large Scale DR/DER Penetration*

Changing Industry:
New Emerging Business Environment

Renewable Resources

Aging Infrastructure

Conservation & Demand Response

The Environment

System Reliability

Asset Management

Greenhouse Gases

Smart Grid

Timely Information

Operational Excellence

Operational Efficiency

Customer Satisfaction

Supply Economics

The Environment

- Three Key Elements of Environmental Compliance

Increased Use of Renewable Resources

Reduction in Greenhouse Gases

Conservation and Demand Response

- They Impact Both Market and Power System Operations

Demand Response
FERC Order 719 - Oct 17 2008 Ruling Summary

- Rule aimed to strengthen competition in organized wholesale electric markets
- Seeks to Improve wholesale markets by establishing a more forceful role for Demand Response (DR)
- Directs RTO/ISOs to:
  - *Accept bids/offers from DR resources for Ancillary Services (A/S) comparable to any other A/S capable resources*
  - *Allow DR units to specify limits on frequency, duration, and the amount of their service in bids/offers to provide A/S*
  - *Eliminate, during system emergencies, charges to buyers for taking less electric energy than scheduled (current rule in some markets)*
  - *Permit aggregators to bid DR on behalf of retail customers directly into the market*
  - *Study and report on reforms needed to eliminate barriers to DR in energy markets*
  - *Assess, through pilot projects, the technical feasibility and value to the market of using A/S from small DR units*

Demand Response Classification

- Attributes of Demand Response Programs:
    - *Geographic Granularity:*
        - Retail
            - *Commercial & Industrial Customers*
            - *Small Consumers*
        - Wholesale:
            - *Node/Aggregated Node*
            - *Local Reliability Area*
            - *Demand Zones (Service Areas)*
    - *Trigger:*
        - Market-based: Demand adjustment in response to market signals
        - Reliability-based: Demand curtailment in the face of supply shortage or contingencies
    - *Dispatchability:*
        - Bidirectional response (demand reduction and increase)
        - Unidirectional response (demand reduction)

Demand Response Classification (Continued)

- Possible DR-based ISO/RTO Market Products:
  - *Capacity:*
    - ICAP
    - Unit Commitment
  - *Energy:*
    - Day-Ahead
    - Real-time
  - *Ancillary Services (Market-based DR with required Real-time Telemetry and Control):*
    - Contingency Reserves (Spinning Reserve; Supplemental/Non-Spinning Reserve)
    - Regulating Reserve

NYISO Demand Response Programs

- Existing Programs:
  - *Emergency Demand Response Program (EDRP)*
    - Voluntary load reduction during emergency conditions (Reliability-based)
    - Mostly large commercial and industrial consumers
    - Underlying Market Product: Real-time Energy
    - Compensated by NYISO when asked to curtail, and verified to have performed (higher of $500/MWh or the zonal real-time LBMP)
  - *ICAP Special Case Resources (SCR)*
    - Load reduction during emergency conditions (Reliability-based)
    - Mostly large commercial and industrial consumers
    - Underlying Market Product: ICAP
    - Compensated as ICAP for agreeing to curtail
    - Must perform when asked
  - *Day-Ahead Demand Response Programs (DADRP)*
    - Load reduction bid into Day-head market as "Negawatts"
    - Paid day-ahead Energy clearing price if cleared
    - Underlying Market Product: Day-Ahead Energy
- New: Demand-Side Ancillary Service Program (DSASP)

PJM Demand Response Programs

- DR Products: Energy, Capacity, Synchronized Reserve, Regulation
- DR Participation in Energy Markets:
  - *Economic Load Response:*
    - Providers: Agent PJM members, Curtailment Service Providers (CSPs)
    - Trigger: Curtail consumption when LMP $\geq$ $75/MWh
  - *Energy dispatched out of DR sold as Capacity or Ancillary Services (paid Real-time LMP)*
- DR Participation in Capacity Market:
  - *Providers: LSEs and CSPs*
  - *Capacity Credit for MW of Load Response*

PJM Demand Response Programs (Continued)

- DR Participation in Synchronized Reserve Market:
  - *DR must be able to provide metering data at no less than 1 minute scan rate*
  - *DR participation in Synchronized Reserve market is limited to 25% of the Synchronized Reserve requirement in each zone*
  - *Mandatory training requirements for CSPs bidding DR in Synchronized Reserve market*
- DR Participation in Regulation Market:
  - *DR bidding Regulation must meet all real-time telemetry requirements like a generator*
  - *DR participation in Regulation market is limited to 25% of the Regulation requirement*
  - *Mandatory training requirements for CSPs bidding DR in the Regulation market*

ISO-NE Demand Response Programs

- Real-time Demand Response (RDR) Programs:
  - *Mandatory Energy Reduction*
  - *Trigger: Extreme Emergency Operating Conditions (Operating Procedure #4)*
  - *Minimum Reduction: 100 kW*
  - *Sub-programs based on Notification Time:*
    - 30-minute DR Program
    - 2-hour DR Program
  - *Compensation:*
    - Max. of Real-time Load Zone LMP or $500/MWh
    - Capacity Credit
- Real-time Price Response (RPR) Programs:
  - *Voluntary Energy Reduction*
  - *Compensation: Greater of Real-time Zonal LMP or $100/MWh (no Capacity Credit)*

ISO-NE Demand Response Programs (Continued)

- Day-Ahead Load Response Program:
  - *Optional Program available to resources participating in RDR and RPR programs*
  - *Minimum Reduction: 100 kW*
  - *Bid Price: Min. ($50/MWh); Max ($1,000/MWh)*
  - *Cleared as part of Day-Ahead Market*
  - *Compensation: Greater of Day-ahead Zonal Price or Bid Price (no Capacity Credit)*

- DR Eligible to Participate in the Forward Capacity Market:
  - *Real-time DR Programs (RDR)*
  - *Energy Efficiency Programs*
  - *Load Management Programs*
  - *Distributed Generation Programs*

Midwest ISO Demand Response Programs

- DR under ASM Market:
  - *Demand Response Resource Type I (DRR Type I)*
  - *Demand Response Resource Type II (DRR Type II)*
- Demand Response Resource Type I (DDR Type I):
  - *Physical interruptible load under Midwest ISO command*
  - *May supply Energy or Contingency Reserve, but not Regulation*
  - *Can be committed (ON or OFF) but not dispatched*
  - *Can be committed for Energy or cleared for Contingency Reserve, but not both at the same time*
  - *Cannot set Energy LMP, but can set Ancillary Service MCP.*
  - *Can offer Targeted Demand Reduction (MW), shut down cost ($) and hourly curtailment cost ($/hr), but no Energy ($/MWh) curve; can also offer Contingency Reserve ($/MW/hr)*
  - *Eligible for RSG / make-whole payment subject to performance*
  - *Can offer in Day-ahead, RAC and Real-time markets*
- Demand Response Resource Type II (DRR Type II):
  - *Behind the meter generation or controllable load under Midwest ISO command to supply Energy, Contingency Reserve, or Regulation*
  - *Committable and dispatchable, like a generator*

SPP Demand Response Programs

- Current (EIS) Market Enhancements Under Consideration:
  - *Variable Dispatch Demand Response (VDDR):*
    - Offered and deployed like a generator (5 minute dispatch)
    - Requires real-time telemetry like a generator
    - Paid higher of LIP or Offer Price
  - *Block Dispatch Demand Response (BDDR):*
    - Fixed MW blocks at a price
    - Hourly Dispatch
    - After-the-fact interval metering required
  - *Geographical Granularity: Each DR resource must be completely within an existing Load Settlement Point*
- Future Markets:
  - *DR able to participate in Day-Ahead, Reliability Unit Commitment, and Ancillary Services markets*
  - *No Capacity Market planned at this time*

ERCOT Demand Response Programs

- Voluntary Load Response:
  - *Self directed*
  - *Decision to reduce consumption from scheduled or anticipated load in response to prices*
- Qualified Balancing Energy Up Load (BUL):
  - *Directed by ERCOT*
  - *Services Provided:*
    - Up-Balancing Energy Service
    - Down-Balancing Energy Service
  - *Compensation:*
    - Market-Clearing Price for Ancillary Service (MCPC)
    - Market-Clearing price for Energy (MCPE) if dispatched
- Load acting as a Resource" (LaaR):
  - *Similar telemetry and dispatchability requirements as a generator*
  - *Services Provided:*
    - Responsive Reserve Service
    - Non-Spinning Reserve Service
    - Replacement Reserve Service
  - *Compensation;*
    - Market-Clearing Price for Ancillary Service (MCPC)
    - Market-Clearing price for Energy (MCPE) if dispatched

CAISO Demand Response Programs

- Types of Demand Response Programs in MRTU Release 1:
  - *Emergency Demand Response:*
    - Reliability-based
    - Geographical Granularity: Load Aggregation Point (LAP)
    - Triggered by LSEs based on out-of-market conditions
    - Announced to CAISO before close of the Day-Ahead market
    - CAISO reduces RUC procurement target accordingly
    - May not provide Ancillary Services
    - will not bid in to be curtailed in the Real-Time Market
  - *Participating Load DR:*
    - Modeled as a pair of resources (Custom Load; Pseudo Generator)
    - Market-based
    - Must execute Participating Load Agreement with CAISO
    - Must respond to CAISO dispatch instructions
    - Types:
      - *Pumping Load associated with Pump Storage*
      - *Single Pumping or Non-pumping Load*
      - *Aggregated Pumping and Non-pumping Load*
    - Geographical Granularity: Custom Load Aggregation Point (CLAP)
    - May participate in Energy and Non-Spinning Reserve Markets
    - Requires telemetry to participate in Non-spinning Reserve market

CAISO Demand Response Programs Continued

- Extension of Demand Response Programs MRTU:
  - *Proxy Demand Resource (PDR):*
    - To be implemented shortly (a few months) after MRTU Release 1
    - Geographical Granularity: Within Local Capacity Area (CRR sub-LAP, Node, or a CLAP)
    - Market-based
    - Product offered:
      - *Primarily Energy market*
      - *Possibly Non-Spinning Reserve market*
  - *Dispatchable Demand Resource (DDR):*
    - To be implemented in MAP (a year after MRTU release 1)
    - Replaces Release 1 Participating Load (single resource)
    - Market-based
    - Must execute Participating Load Agreement with CAISO
    - Must respond to CAISO dispatch instructions
    - Geographical Granularity: Custom Load Aggregation Point (CLAP)
    - May participate in Energy and Non-Spinning Reserve Markets
    - Requires telemetry to participate in Non-spinning Reserve market

Questions?

THANK YOU

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