Demand Response 101

Workshop

May 10, 2024

Background

MISO DEMAND RESOURCES

- MISO's market mechanisms provide opportunities and incentives for full participation
- Multiple options are available
- Ongoing reform efforts will enhance participation requirements and enable reclassification of resources into appropriate categories to improve operational availability and reliable grid operations

Purpose

Purpose - Provide an overview of the current demand response provisions and rules . This workshop should help MISO and its stakeholders to effectively collaborate on the reform efforts that are underway at the Resource Adequacy Subcommittee (RASC) and Market Subcommittee (MSC)*.

Stakeholders should be able to answer the following questions:

- How does a company or organization register demand response?
- What are the various types of demand resources?
- What kinds of information will they need to provide or prepare?
- What kinds of requirements are faced by demand resources that wish to participate in the various markets?
- How is a demand resource's "output" measured and verified?
- How are payments and penalties determined?

*Reform proposals that are being discussed at RASC and MSC are not within the scope of today's discussion

Outline

1. PRINCIPLES AND REQUIREMENTS
2. MARKET ACTIVITIES
3. DEMAND RESPONSE TYPES
4. MARKET PARTICIPANT VIEW & POTENTIAL BARRIERS TO PARTICIPATION
5. CHALLENGES

1 Principles & Requirements

Framework For Robust and Competitive Markets

- Markets work best when there is a *vigorous* and *voluntary* participation by both buyers and sellers
  - Competition results in lower prices
  - Sellers will build if there's an opportunity to earn a return commensurate with the risks
- Competitive markets are efficient
  - Maximizing consumer welfare
  - Economic allocation of scarce resources
  - Production at lowest cost

Demand Response: MISO Market Philosophy

- Open wholesale energy market where market participants can buy or sell energy in fair, efficient, and non-discriminatory markets, while providing reliable grid operation

- Demand response can:
    - Reduce the need for new generating capacity
    - Address real-time reliability challenges
    - Mitigate peak prices and peak volatility
    - Limit supplier market power

Demand Response: MISO Market Philosophy

- MISO market structures seek to provide opportunities for demand to participate on a *comparable* basis as supply-side resources
  - Ability to make consumption decisions based on the *value* of energy consumed compared to the prevailing market price
    - Demand-side
  - Ability to monetize the value of flexibility that can be offered to dynamically balance market supply and demand
    - Supply-side

A Market Rather Than A Program

- MISO currently has no demand-side "*programs*"; MISO conducts markets that support reliable grid operation, where demand response can compete
- "Program" as used in some jurisdictions typically refers to *temporary* initiatives to promote a certain activity or action
- "Program" may also provide payments for participation
  - Funded by charges socialized across some/all market participants
- MISO's approach is to provide *market* mechanisms that provide opportunities and incentives for full participation
- States, utilities and retail providers in the MISO footprint do have demand "programs"

FERC Order 719

- On April 28, 2009, MISO submitted a compliance filing that responded to Order 719 requirements related to:
  - Ancillary services provided by DRRs
  - Eliminating deviation charges during system emergencies
  - Price formation during periods of operating reserve shortage
  - Reporting of barriers to comparable treatment of DRRs
  - Long-term power contracting
  - Market monitoring
- On October 2, 2009, MISO submitted a second compliance filing that presented its proposal for facilitating ARC participation

Aggregators of Retail Customers (ARCs) Tariff 38.6

- Aggregators of Retail Customers (ARCs) are market participants that combine the abilities of one or more retail customers to "provide" electricity in the wholesale markets
  - Demand Response Resources (DRR and DR) "provide" energy by reducing the amount of electricity purchased from the grid
  - Behind-the-meter generation supplies energy, typically to meet in part the electric load requirements of the end-use customer
- ARCs can combine customers, but only under certain circumstances
  - All customers receive service within a single LBA and a single LSE
  - The relevant electric retail regulatory authority (RERRA) must allow customer participation (either directly or implicitly)
- An example of an ARC might be a business entity that combines several large retail businesses, each of which is able to turn off lighting in certain areas of their buildings
- ARC registration instructions are included in BPM-001

FERC Order 745

Each ISO/RTO that has a tariff provision permitting demand response resources to participate as a resource in the energy market by reducing consumption of electric energy from their expected levels in response to price signals must:

A. **Pay to those demand response resources the market price for energy for these reductions** when these demand response resources have the capability to balance supply and demand and when payment of the market price for energy to these resources is cost-effective as determined by a net benefits test accepted by the Commission;

B. **Allocate the costs associated with demand response compensation proportionally to all entities** that purchase from the relevant energy market in the area(s) where the demand response reduces the market price for energy at the time when the demand response resource is committed or dispatched.

2 Market Activities

MISO can employ demand response to…

…reduce loads when values to end-use customers are less than the costs of serving those loads

Economic Demand Response (Energy)

…provide regulating, contingency or ramp reserves

Operating Reserves Demand Response

…substitute for generating capacity

Planning Resources Demand Response

…reduce demand during system emergencies

Emergency Demand Response

Brief Look at Energy and Ancillary Services Products

Six Products for Day-Ahead, Real-Time Energy and Ancillary Services Markets

Energy	Regulating Reserve	Spinning Reserve	Supplemental Reserve	Ramp Capability Product	Short-Term Reserve
• Demand bids and resource offers in day-ahead • Resource offers in real-time	• Allows the system operator to physically balance supply and demand on real-time basis	• Provides energy to meet demand in the event of an unexpected loss of a generation or transmission resource	• Same as spinning reserve, but can be from online or offline resources	• Prepositions resources for availability in subsequent intervals	• Rampable Capacity provided by eligible Resources available to be converted to Energy within 30 minutes

Demand Response Participation: Day-Ahead

- **Day-ahead** energy & OR markets: *Demand response* design elements
  - Fixed Demand Bid: LSEs indicate an amount to be purchased, regardless of price
    - ~85% of daily market demand – price-taker
  - Price Response Demand (PRD): LSEs submit "physical" or "virtual" PRD bids to manage price risk
    - ~15% of daily market demand
  - Demand Response Resources Type I: Evaluated and cleared based on offer components, including start, notification, minimum run times and availability offers
    - May clear Energy OR Contingency Reserves
  - Demand Response Resources Type II: Treated in nearly all respects like generation; evaluated and cleared based on offer components, including start, notification, minimum run times and availability offers
    - May clear Energy and Operating Reserve products simultaneously
  - Value in submitting DRR offer instead of a price responsive demand (PRD) bid is that MISO will respect the DRRs operational characteristics

Demand Response Participation: Real-Time

- **Real-time** energy & OR markets: *Demand response* design elements
  - Price Responsive Demand (PRD) – LSEs cannot submit PRD in this market
    - Manage exposure to volatile prices by responding to RT clearing prices
  - Demand Response Resources Type I – Can be committed based upon economics
    - Deployed to a target demand reduction level
    - Contingency reserves that are cleared are only expected to interrupt if/when deployed by MISO
  - Demand Response Resources Type II – Can be dispatched based upon economics, in the same manner as generation resources

Demand Response Participation: Capacity

- **Capacity** market: *Demand response* design elements
  - DRR-Type I & II eligible to qualify as Capacity Resources – Module E-1 69A.3.1.b
  - Load Modifying Resources (LMRs) – Module E-1 69.A.3.3

Demand Response Participation: Emergency

- **Emergency service**s: *Demand response* design elements
  - Schedule 30: Emergency Demand Response (EDR) resources created to enable more demand resources to help the system during emergency conditions, without necessarily qualifying for the more involved options

3 Demand Resource Types

Categories of Demand Resources

- Demand resource terminology can be confusing
  - Several categories use similar words; e.g., demand resources, demand response resources
  - Not necessarily exclusive definitions; e.g., an LMR can also provide EDR service
  - Same words used both generically and specifically (per Tariff); e.g., demand resource and Demand Resource; btmg (generic behind-the-meter-generation) and BTMG (behind-the-meter-generation participating as an LMR)
- Classification ultimately depends on two questions:
  - **Physical capabilities of the resource**
    - Can the resource perform at varying levels of power/energy?
    - Metering
  - **Responsibilities the resource operator is willing to accept**
    - Will the resource be available during a system emergency?

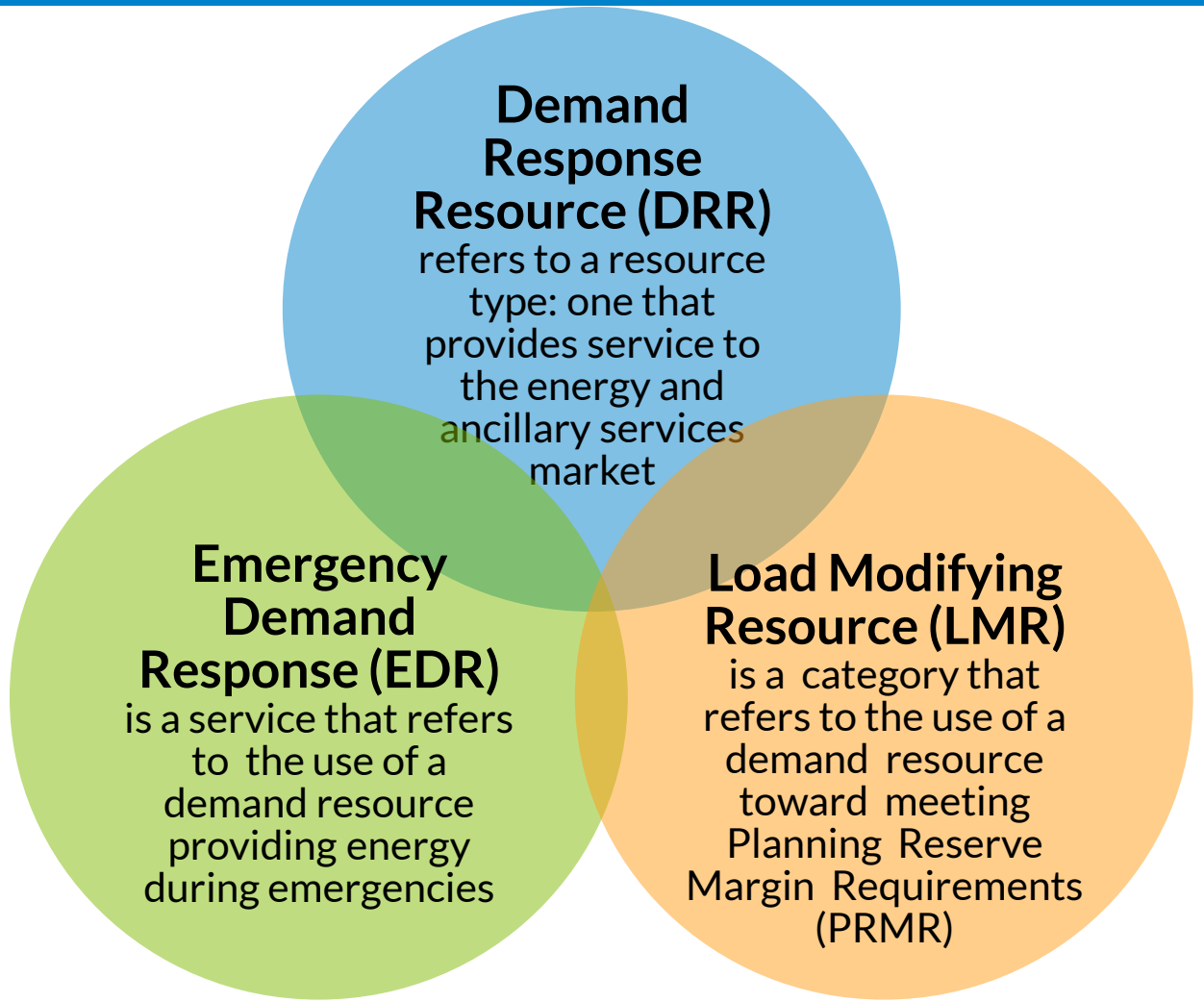
LMR: Load Modifying Resource EDR: Emergency Demand Response BTMG: Behind the Meter Generation

Tariff Definitions

From Module A

- **Behind the Meter Generation (BTMG):**
  - Generation resources used to serve wholesale or retail load located behind a CPNode that are not included in the Transmission Provider's Set-point Instructions and in some cases can also be deliverable to Load located within the Transmission Provider Region using either Network Integration, Point-To-Point Transmission Service or transmission service pursuant to a Grandfathered Agreement. These resources have an obligation to be made available during Emergencies.
- **Demand Resource (DR):**
  - Interruptible Load or Direct Control Load Management and other resources that can reduce Demand during Emergencies.
- **Emergency Demand Response (EDR):**
  - The commitment and dispatch of Load reductions, Behind the Meter Generation Resources and other Demand Resources during an Emergency, in accordance with Schedule 30.
- **Demand Response Resource (DRR)-Type I:**
  - Resource owned by a single Load Serving Entity, or an ARC within the MISO BAA and that (i) is registered to participate in the Energy and Operating Reserve Markets, (ii) that is capable of supplying a specific quantity of Energy, Contingency Reserve or Capacity … through Behind the Meter Generation and/or controllable Load, (iii) is capable of complying with the Transmission Provider's instructions, and (iv) has the appropriate metering equipment installed.
- **Demand Response Resource (DRR)-Type II:**
  - Resource owned by a single Load Serving Entity, or an ARC within the MISO BAA and that (i) is registered to participate in the Energy and Operating Reserve Markets, (ii) is capable of supplying a range of Energy, Operating Reserve, Up Ramp Capability and/or Down Ramp Capability...through Behind-The-Meter generation and/or controllable Load, (iii) is capable of complying with Transmission Provider's Setpoint Instructions and (iv) has the appropriate metering equipment installed.
- **Load Modifying Resource (LMR):**
  - A Demand Resource or Behind the Meter Generation Resource.

Resources, Categories, Services



DRR – Type I

- Capable of supplying a specific quantity of energy to the market through physical load interruption
- Is an "on/off" resource; provides 0 MW (no demand reduction) or a target demand reduction amount
- Can provide spinning or supplemental reserves, if qualified
  - Not capable of providing regulation or ramp capability product
- Can be included in MISO Transmission Expansion Planning (MTEP) long-term capacity planning
- Can be counted towards Resource Adequacy Requirements (RAR)
- Has a "must offer" requirement if it registers to qualify as a capacity resource
  - "Must offer" – must make its capacity available to the DA market or the various RAC processes

DRR – Type II

- Capable of supplying energy to the market through behind-the-meter generation or controllable load
- Can be committed and dispatched in the same way as a generation resource
  - Requires ICCP data, if regulation qualified
  - Can provide regulation, spinning, supplemental reserves and ramp capability product, if qualified
- Can be included in the MTEP (long-term) capacity planning
- Can be counted towards Resource Adequacy Requirements (RAR)
- Has a “must offer” requirement if it registers to qualify as a capacity resource
  - “Must offer” – must make its capacity available to the DA market or the various RAC processes

Load Modifying Resource (LMR)

- LMRs are a category of demand resources created for resources that either cannot or do not wish to qualify as capacity resources, but *do* wish to be considered as planning resources and thus can help satisfy Planning Reserve Margin Requirements (PRMR)
  - DRR can qualify as an LMR or as a capacity resource
  - Both Demand Resources and Behind-the-Meter Generation may qualify as an LMR
- LMRs *must* make themselves available to the system during emergency conditions but are not required to at any other time
  - LMRs can optionally dual-register as emergency Demand Response

Load Modifying Resource (LMR)

To be qualified as an LMR, a resource must satisfy the following requirements:

- May be claimed by only 1 Market Participant
- ≥ 100 kW (grouping allowed)
- Able to be scheduled within 6 hours (start up time ≤ 6 hours)
- Able to achieve the target level provided during registration
- Maintain target level for 4 continuous hours
- Able to respond at least 5 times in the summer and winter, 3 times in the fall and spring
- Response is an obligation during emergencies
- Cannot be "netted" against LSE's forecast demand in RAR; must be converted into Zonal Resource Credits
- Submit hourly availability in MWs in the DSRI
    - Additional documentation may be required for LMRs with less than 9 months availability or notification times greater than 2 hours

Emergency Demand Response (EDR)

- EDRs were created to enable more demand resources to help the system during emergency conditions without necessarily qualifying for the more involved categories (Schedule 30)
- EDR resources submit information describing their costs incurred to reduce load (provide energy) during an emergency event
  - As submitted, an EDR resource is then *required* to respond during an emergency
  - EDR can change its offer and availability day-by-day
- An LMR can dual-register as an EDR

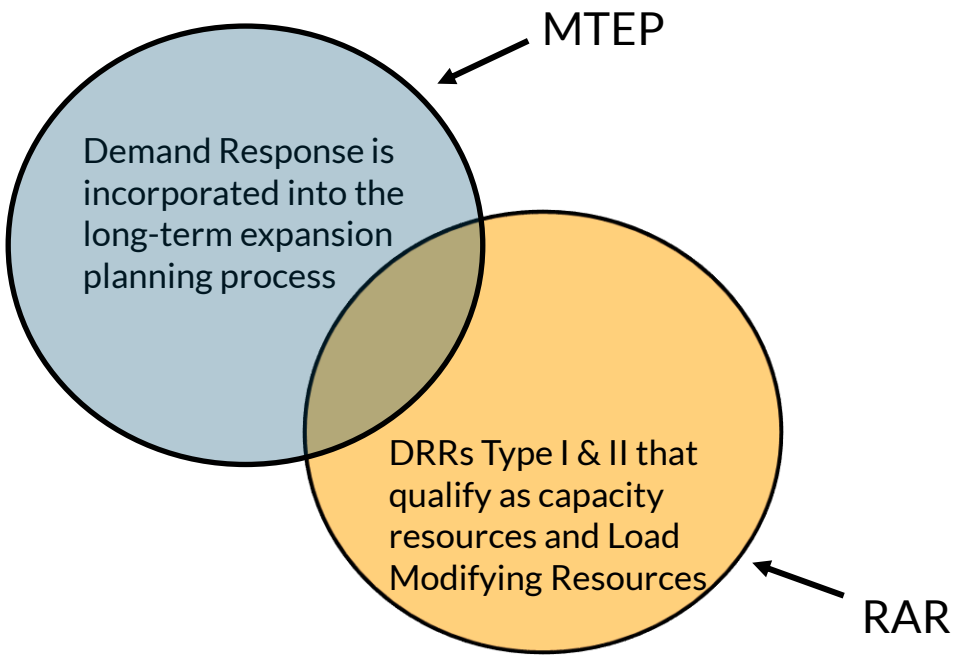
Resource Participation Summary

Resource \ Product	Energy	Regulation Reserve	Other Reserves	Module E (ZRC)	Emergency Energy
DRR Type I	Can/Must*		Can	Can	Can
DRR Type II	Can/Must*	Can	Can	Can	Can
DR - LMR				Can	Must
BTMG - LMR				Can	Must
EDR					Can

* DRR Type I and DRR Type II resources are required to offer into Day-Ahead Energy Market if they clear the MISO PRA (Capacity Market)

Demand Response as a Planning Resource

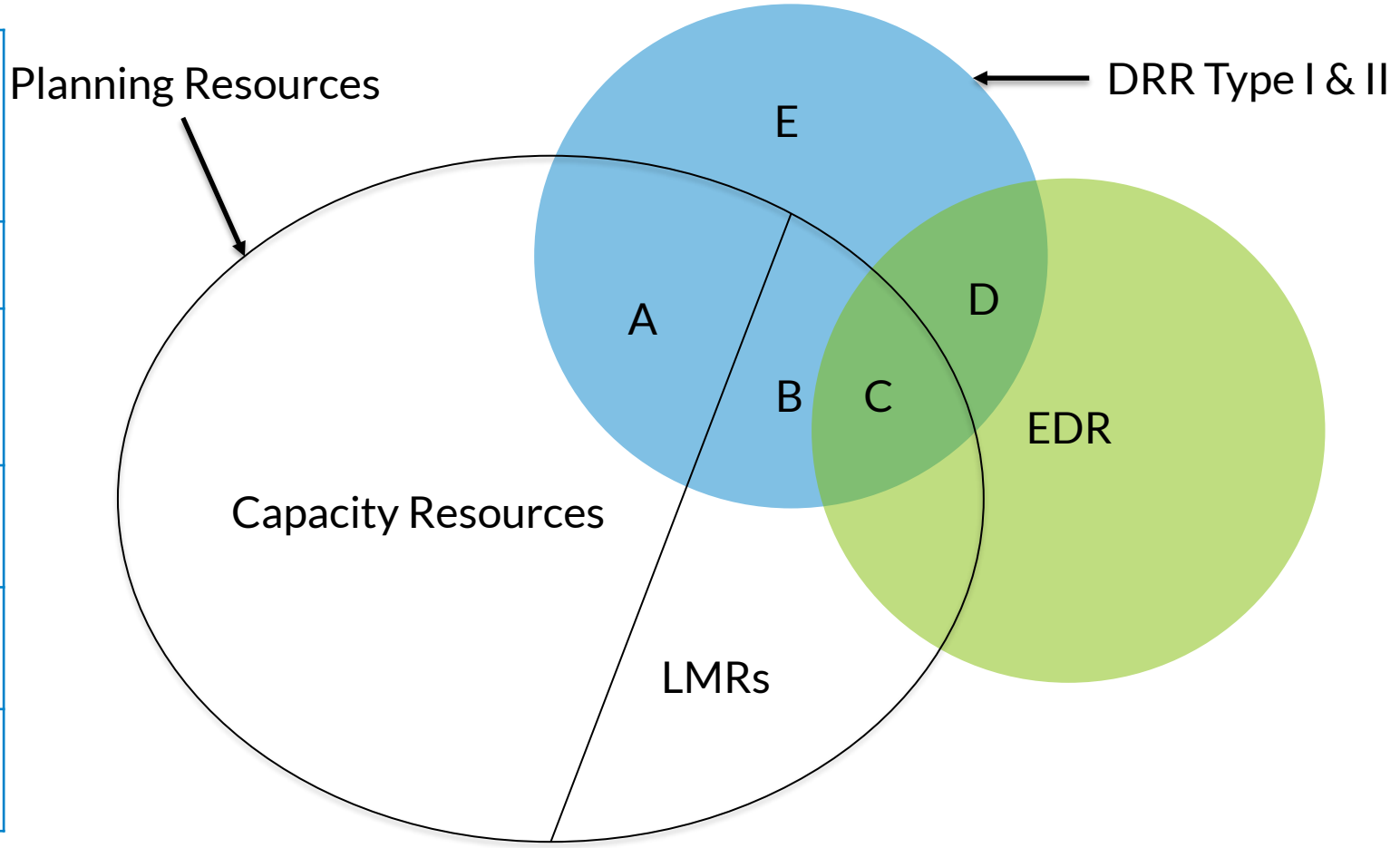
MISO Transmission Expansion Plan (MTEP) Compared with Resource Adequacy Requirements (RAR): *The Question of the Time Horizon for Resources*



- **"In" MTEP, but outside of RAR**
  - With its longer horizon, 5-10 years, MTEP might include generic or in-development resources not included in RAR
- **"In" RAR, but outside of MTEP**
  - While some RAR-qualified demand resources may be included in MTEP studies, it is possible that some will not
    - Very recent resources might now exist that were not available for MTEP analysis (developed and activated between the MTEP horizon and the planning year)
    - Some examples would include solar panel roofs, certain Smart Grid efforts or other renewable energy concepts

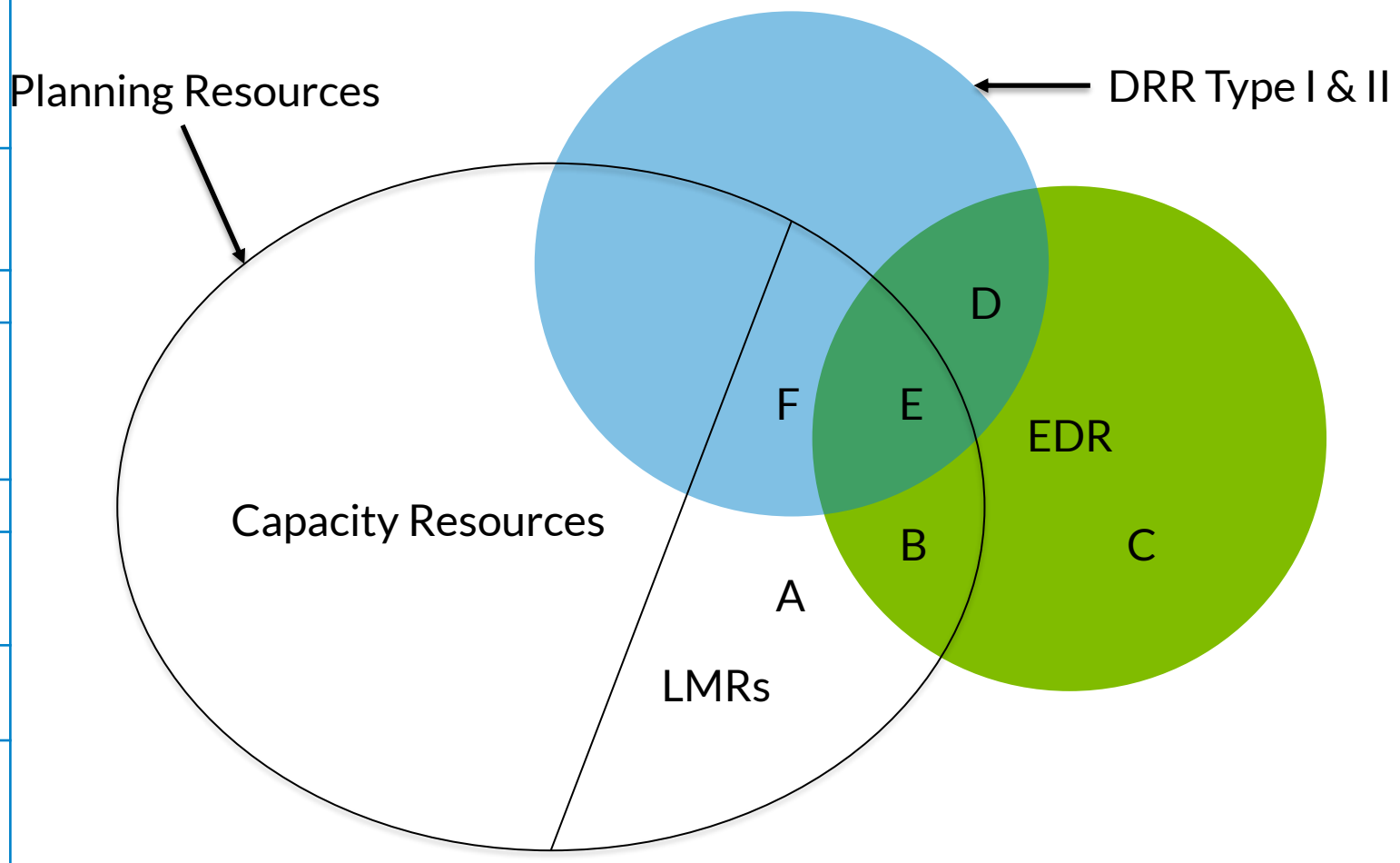
Resource Adequacy Requirements: Demand Response Resources (Type I and II)

DRR Type I & II	• DRR offer into energy market and relevant ancillary services. • "Must offer" requirement determined by type of capacity participation desired. • May also register as an EDR and/or LMR
A	• Receives capacity credits • "Must offer" required
B	DRR dual-registered as an LMR • Receives capacity credits • No "must offer" requirement • Required for emergencies only
C	DRR also registered as both LMR and EDR • Same as B, can also receive energy payments for emergency response
D	DRR dual-registered as an EDR • No capacity credits • Voluntary self-schedule emergency
E	No capacity credits • No "must offer" or emergency service required



Emergency Demand Response resources: to LMR or Not to LMR

LMR	• Qualify for Zonal Resource Credits (ZRCs) • As LMR, they are "price takers" during an emergency • May be some challenges related to retail regulatory treatment
EDR	• No capacity credits • Voluntary self-schedule emergency • Receive energy payments for emergency response
A	• LMR Only
B	LMR dual-registered as an EDR • No "must offer" requirement • Required for emergencies only • Receives energy payment for emergency response
C	• EDR Only
D	EDR dual-registered as a DRR • No capacity credits • Voluntary self-schedule emergency
E	DRR also registered as both LMR and EDR • Same as B, may also participate in the market
F	LMR dual-registered as a DRR • Receives capacity credits • No "must offer" requirement • Required for emergencies only



Payments Available Under Participation Regimes

Demand Response Resource

- Energy (LMP) possibly including make-whole payments
- Operating reserves (MCP)
- Planning resources (ACP)

Emergency Demand Response

- Emergency energy only
- Payment is greater than
  - LMP* energy
  - Production costs (shut-down costs + curtailment offer * energy); i.e., make-whole

Load Modifying Resource

- Capacity payments only (ACP)
- Can be dual-registered as an EDR or DRR and offer appropriately to obtain other payments

Comparison of DRR & LMR in the Models

Network Model		Commercial Model
• Represented as controllable load or btmg • Must be at least 1 MW	**DRR Type I**	• Modeled with a DRRNODE1 CPNode
• The load and generator combination is represented by a single equivalent generator • Must be at least 1 MW	**DRR Type II**	• Modeled with a DRRNODE2 CPNode
• Represented through regular load • Must be at least 0.1 MW	**BTMG**	• Represented through regular load
• Represented through regular load • Must be at least 0.1 MW	**DR LMR**	• Represented through regular load

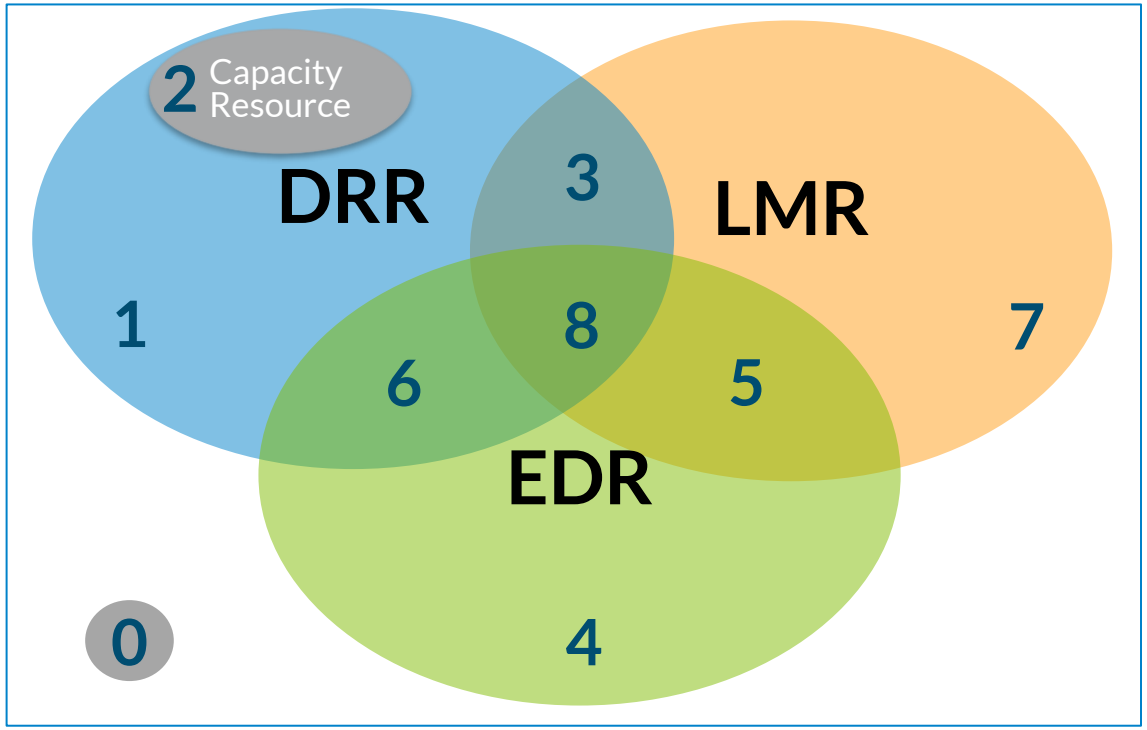
Note: 1) Refer to the Level 100 and Level 200 training courses and BPM-010 for a more detailed understanding of network and commercial modeling for all types of resources
2) All DRR dual-registered as an LMR is modeled as the appropriate DRR type

Market Design Elements

	DRR-Type I	DRR-Type II	LMR	EDR
DR Type	btmg / BTMG / (Interruptible/ curtailable) load	btmg / BTMG / Dispatchable load	BTMG / DR	BTMG / DR
Size/Impact	≥ 1 MW	≥ 1 MW	≥ 0.1 MW	≥ 0.1 MW
Real-Time Telemetry	No	Yes, for regulation service	No	No
In-Network Model	Through load	As gen	Through load	Through load
In-Commercial Model	Yes	Yes	Through load	Through load
Treatment in DART	0 or Target demand reduction amount	Dispatchable	N/A	N/A
Aggregation in DART	Single LBA and single LSE	Single EPNode	N/A	N/A
Capacity Payment	Eligible	Eligible	Eligible	N/A

Demand Resource Registration Options

Many options are available for demand response registration as a supply-side resource



#	Comments/Notes
0	Not MISO registered
1	There is no DRR "must offer" requirement since there are no capacity credits
2	Uncommon approach for DRR; resource "must offer" in Energy & AS markets
3	LMR receives capacity credits and resource can optionally offer into the Energy & AS markets
4	EDR only; no capacity credits or "must offer" requirement
5	LMR that optionally provides an EDR offer for emergency energy
6	Similar to "1" but can optionally participate in emergencies
7	LMR only; not involved in Energy and AS markets
8	Similar to "5" but can optionally participate in Energy & AS markets

4 Market Participant View & Potential Barriers to Participation

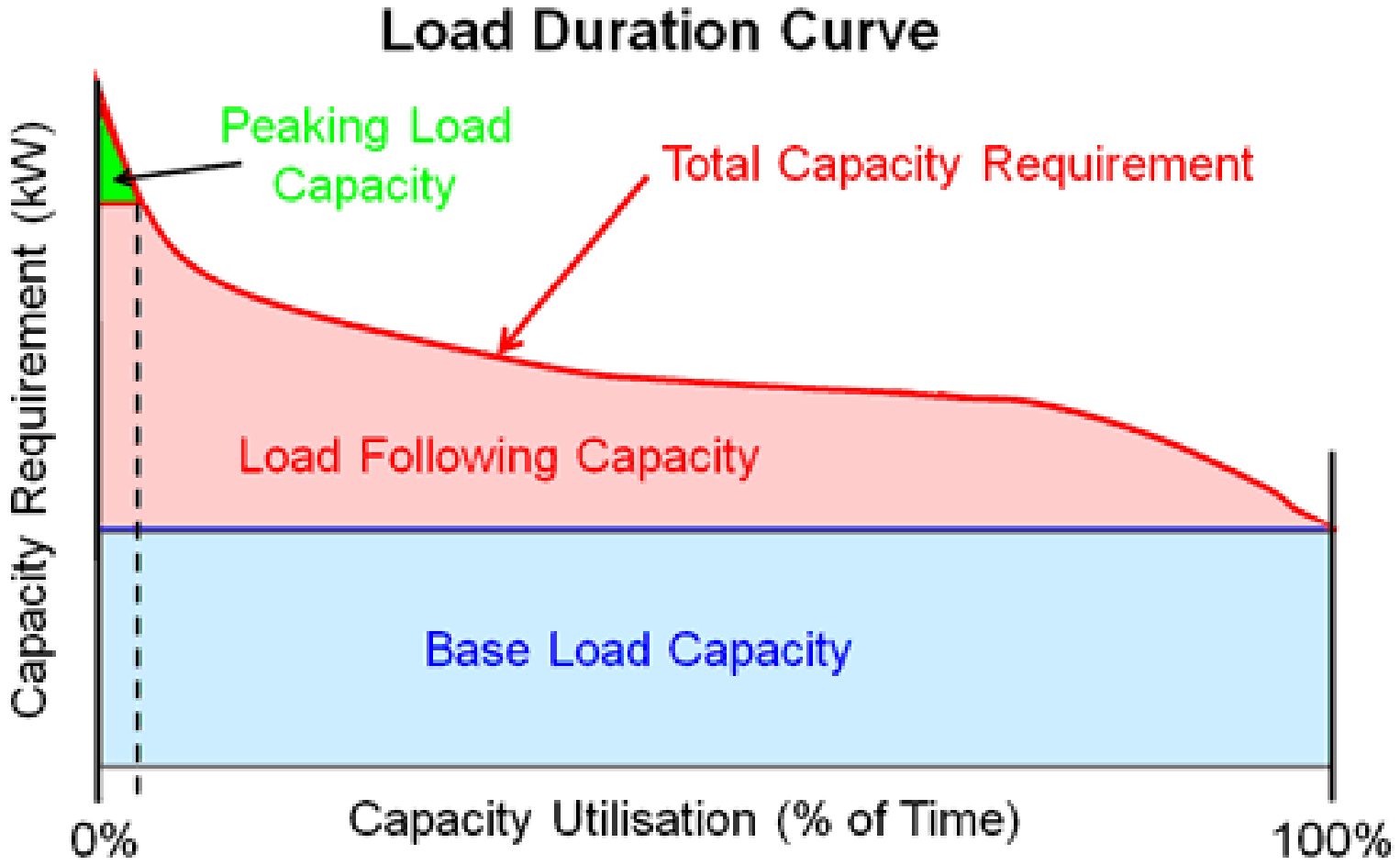
Market Participant's View

Energy	Not MP's business model *Does have ability to specify operating constraints*
Operating Reserves	Probably best opportunity in Energy & Operating Reserve markets
Capacity	May be part of business model
Emergency Energy	Offer cap $3500 + shutdown costs

Value to Capacity Market

A Resource Adequacy mechanism should:

- Ensure enough resources available across the entire load forecast duration curve
- Support reliable grid operation in an efficient manner
- Increased renewables and less excess capacity results in the margin being smaller during off-peak times, Demand Response meeting RAR must address



Requirements For Participation

Energy	Cannot specify price responsive demand (PRD) in real-time market
Operating Reserves	• Regulation: > 1 MW, location limited to 1 EPNode • Spin: > 1 MW, capped at 40% of total Spin, 1 LBA and 1 LSE • Supplemental: > 1 MW, 1 LBA and 1 LSE • Ramp Capability: only DRR II can provide
Capacity	Varies based on mechanism
Emergency Energy	Offer cap $3500 + shutdown costs

Order 719

RERRA approval for ARC participation, in addition

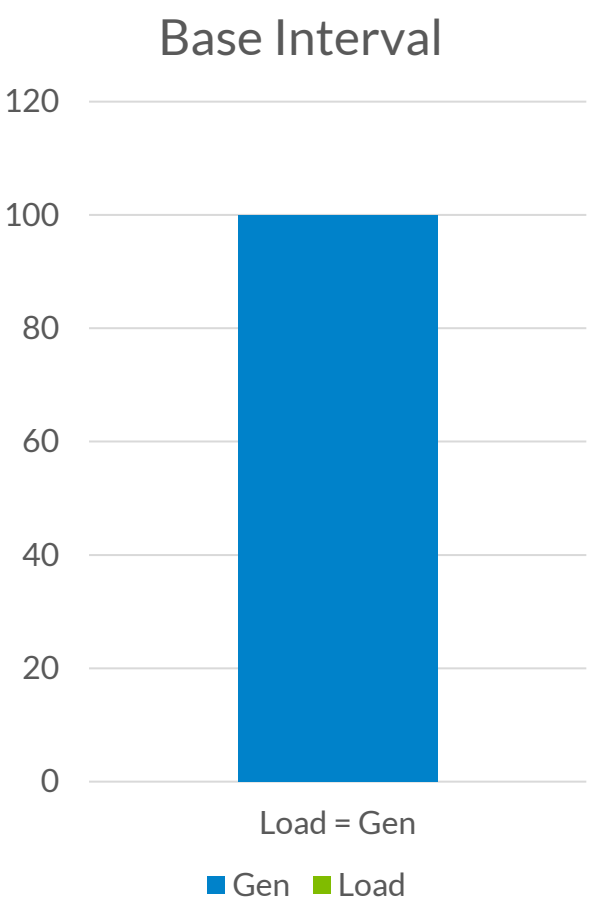
- Allow multi-part operating reserve offer curves for DRRs
- Introduce maximum daily regulation and contingency reserve deployment limits for DRRs
- Remove the Host Load Zone requirement for DRR-Type II

Order 745

DRR compensation and cost allocation

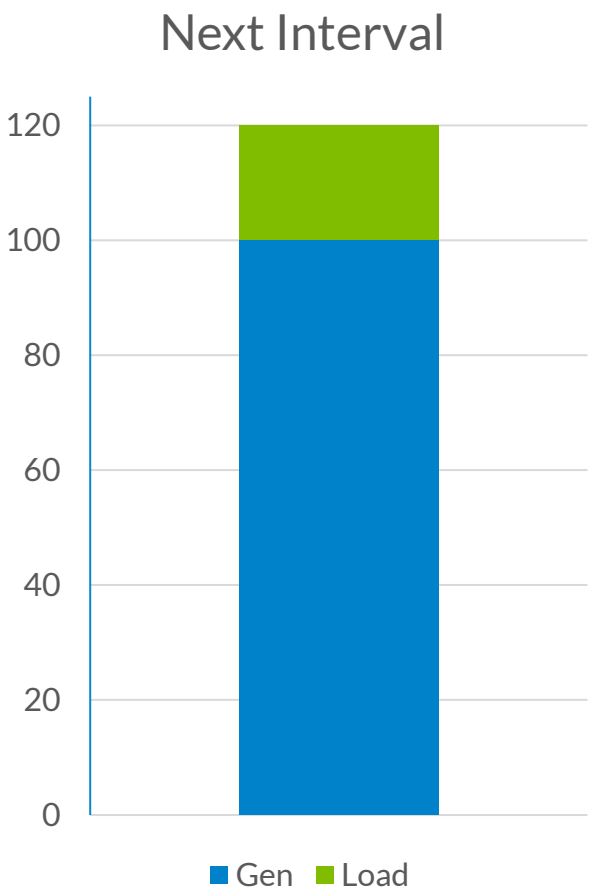
- Credit LMP for economic energy when LMP > NBPT
  - NBPT: Price at which reductions in LMP from implementing demand response results in a reduction in the total amount consumers pay for resources greater than the money spent acquiring those DRRs at LMP
    - NBPT: point at which energy supply curve becomes inelastic
    - Calculated monthly
- Double payment results in missing money problem

Missing Money Problem



Load = Gen = 100 MW
LMP = $20

Result:
- Energy balance achieved
- Revenue neutrality achieved



Expected load = 120 MW
Gen = 100 MW
LMP = $30
Load (DRR) dispatched down 20 MW to achieve energy balance

Result:
- Energy balance achieved
  - Actual load = Gen = 100
- Revenue neutrality NOT achieved
  - Actual load charged $30 * 100 = $3000
  - Gen credited $30 * 100 = $3000
  - DRR credited $30 * 20 = $600
- Where does $600 come from?

Which MP(s) gets charged the $600?

Depends on LMP and NBPT

- If LMP < NBPT: LSE serving load receives the charge
- If LMP ≥ NBPT: Buyers in Real-Time Energy Market receive the charge

In either case, these uplift charges are incurred to market participants for MISO to remain revenue neutral

- Not a problem when demand resources are relatively small compared to the size of the market. Increased penetration of demand response as a supply resource may result in unsustainable uplift charges
    - Uplift charges create a non-transparent market and degrades market efficiency
- Potentially contributes to less demand response being available in the market due to lost revenues and payments, i.e., double payment

5 Challenges

Registration Challanges

Many of the current challenges revolve around ARC registration, including, but not limited to:

- Names and addresses of end-use customers
- EPNode & CPNode identification
- Avoiding double counting
- Information sharing protocols
- Timeliness
- Entire registration submission process

Settlement Challenges

Most of the current challenges revolve around M&V procedures (measurement & verification), including but not limited to:

How to observe the counterfactual consumption level?

- Adverse selection problem
- Moral hazard problem

Attachment TT (consumption baselines)

- Metered generation baseline (BTMG)
- Meter before/meter after
- Firm service level
- Calculated baseline
  - 10 in 10
  - With symmetric adjustment
  - With weather adjustment
- Direct load control baseline
- Custom baseline

Performance Evaluation Type

- **Firm Service Level:** A performance evaluation methodology based solely on a Demand Resource's ability to reduce to a specified level of electricity demand, regardless of its electricity consumption or demand at deployment.
- **Meter Before/ Meter After:** A performance evaluation methodology where electricity consumption or demand over a prescribed period of time prior to deployment is compared to similar readings during the sustained response period.
- **Baseline Type-I:** A Baseline performance evaluation methodology based on a Demand Resource's historical interval meter data which may also include other variables such as weather and calendar data.
    - Symmetric or weather sensitive adjustments allowed
- **Baseline Type-II:** A baseline performance evaluation methodology that uses statistical sampling to estimate the electricity consumption of an aggregated Demand Resource where interval metering is not available on the entire population.
- **Metering Generator Output:** A performance evaluation methodology, used when a generation asset is located behind the Demand Resource's revenue meter, in which the demand reduction value is based on the output of the generation asset.

Appendix

Additional Resources

- Attachment TT
- Demand Response BPM-026
- Demand Response Fact Sheet
- Market Participation Overview
- Net Benefits Methodology
- Net Benefits Price Threshold Monthly Values
- LMR Reform (Discussion ongoing at RASC)
- Demand Response Rule Changes (Discussion ongoing at MSC)

Acronyms

ACP	Auction Clearing Price
ARC	Aggregator of Retail Customers
AS	Ancillary Services
BPM	Business Practices Manual
BTMG	Behind the Meter Generation
CPNode	Commercial Pricing Node
DADS	Demand Response Availability Data System
DR	Demand Resource
DRR	Demand Response Resource
DSRI	Demand Side Resource Interface
EDR	Emergency Demand Response
EDRI	Emergency Demand Response Initiative
EEA(1, 2, 3)	NERC Energy Emergency Alert levels
EOP	Emergency Operations Procedures
EPNode	Elemental Pricing Node
FERC	Federal Energy Regulatory Commission
GADS	Generating Availability Data System
IMM	Independent Market Monitor
LBA	Local Balancing Authority
LMP	Locational Marginal Price

LMR	Load Modifying Resource
LSE	Load Serving Entity
MCP	Market Clearing Price
MECT	Module E Capacity Tracking tool
Module E-1	MISO EMT module regarding Resource Adequacy
MP	Market Participant
MTEP	MISO Transmission Expansion Planning
NAESB	North American Energy Standards Board
NBPT	Net Benefits Price Threshold
NERC	North American Electric Reliability Corporation
OR	Operating Reserves
Power GADS	MISO GADS database
PRA	Planning Resource Auction
PRD	Price Responsive Demand
PRMR	Planning Reserve Margin Requirement
RA	Resource Adequacy
RAC	Reliability Assessment Commitment
RAR	Resource Adequacy Requirement
RASC	Resource Adequacy Subcommittee
RSG	Revenue Sufficiency Guarantee
ZRC	Zonal Resource Credit