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NYISO Stakeholder Forum

DER Integration into Wholesale Markets

September 22, 2016

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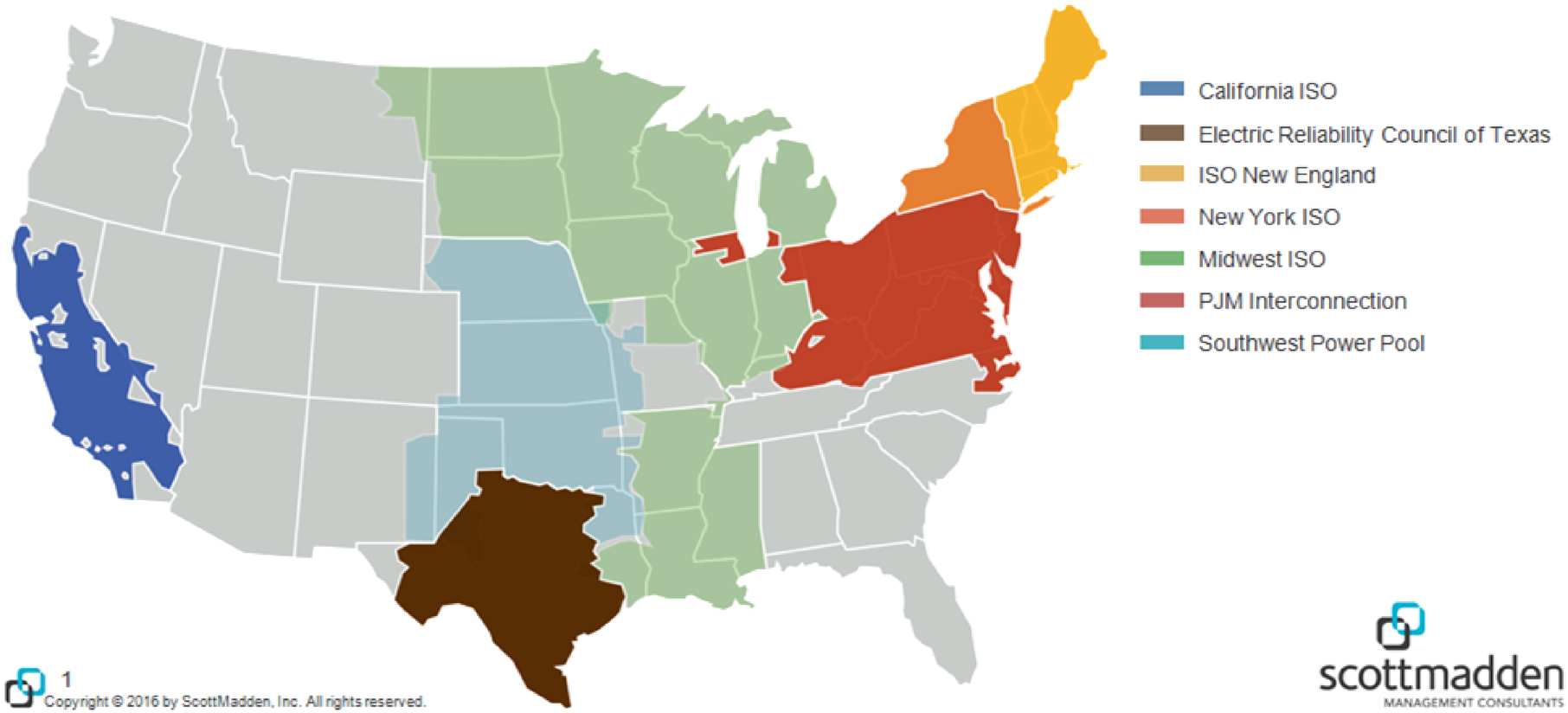
U.S. ISO / RTO Landscape

- Grid operators across the country, especially those with both highly deregulated state environments and with strong DER penetration rates, are wrestling with both the challenges and opportunities of DER
- Unique market, regulatory and technical infrastructures mean that each is pursuing a different approach and timeline



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Types of Resources

Type of Resource	Wholesale (In Front of the Meter)	Behind the Meter
Demand Response	• Long history of integration into market as load modifier and capacity resource	• Aggregation growing
Energy Efficiency	• Load modifier • Treated as capacity resource in some markets	• N/A
DG (dispatchable)	• Access to wholesale markets as generator	• Dispatched in some markets; in others load modifying only • Aggregation growing
DG (non-dispatchable)	• Access to wholesale markets as generator	• Generally serves as load modifier • Limited aggregation
Storage	• May participate in various markets (capacity, reserve, etc) • Myriad pilots	• May be resource or load modifier • Aggregation growing

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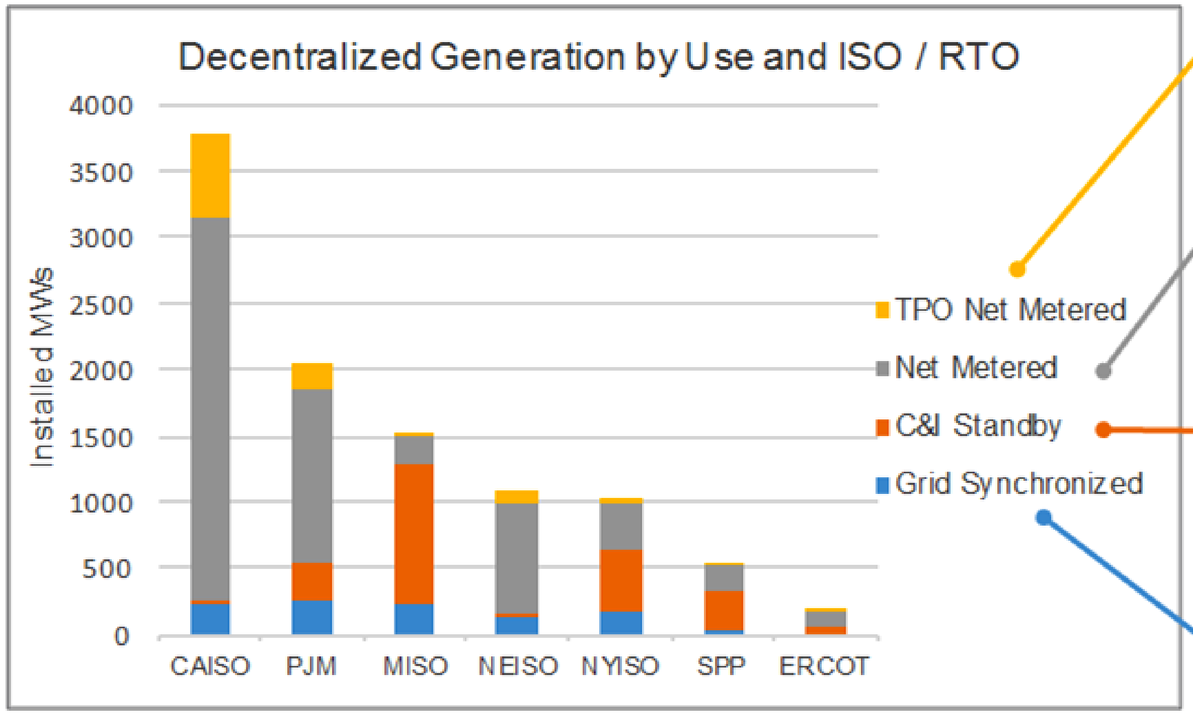
Decentralized Generation



Third-party owned net metered systems

Refers to generators that are less than 2 MW in capacity with a net-metering agreement

Commercial and industrial generators (< 1 MW) not connected nor synchronized to the grid

Includes all commercial and industrial generators (< 1 MW) that are grid connected and grid synchronized

*Figures are from 2014, the most recent data available. ISO data is calculated by adding data from participating states and is illustrative of the 2014 DG totals.

3 Sources: EIA, ScottMadden Analysis

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Challenges in Integrating Behind-the-Meter Resources

- Metering infrastructure (or lack thereof)
- Visibility of assets
- Verification of performance
- Dispatchability (reliability and economic)
- Availability for wholesale and retail needs (economic and reliability)
- Accounted for as load modifying resource, capacity or energy resource?

While these challenges are not insurmountable, they need to be considered as we integrate BTM resources into wholesale markets

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DER Integration Status

ISO new england

Background

- Has pursued integration of demand response into wholesale markets for many years
- 600 MW of active DR and 1,900 MW of EE through capacity market
- Plan to integrate DR into all markets in 2018 (energy, capacity, operating reserve)

Status of DER Integration to Wholesale Markets

- Aggregation for DR; tariff does not yet include rules that facilitate the aggregation of DERs when classified as generators
- BTM PV does not participate in the wholesale market though it is included in forecasts
- BTM storage is load modifying; typically doesn't participate in market

Other Observations

- Grid modernization efforts are underway (e.g., MA) but AMI not fully deployed
- Revised operating procedures effective 9/19/16 for generators and other resources

Resources	BTM DER
DR	Aggregated
DG – Disp.	Load modifying
DG – Non-Disp.	Incorporated into forecasting
Storage	Load modifying (demand resource)

Sources: EIA, ScottMadden Analysis; http://foresternetwork.com/daily/energy/energy-storage-solutions-latest/recent-progress-in-isorto-territories-march-der-aggregation-towards-reaching-comprehensive-wholesale-value/;

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DER Integration Status

Background

- PJM has long history of DR and EE participation in wholesale market

Status of DER Integration to Wholesale Markets

- Aggregation of demand resources enabled by Curtailment Service Provider
- BTM distributed solar amounts to roughly 3 GW (2016); incorporated into forecasting
- Tariff allows storage to serve as a capacity resource but it requires more rule clarity related to injection rights
  - Behind the meter injections are not allowed
- Retail BTM generation can participate as load modifying resource if dispatchable by PJM

Other Observations

- Has recently set new rules regarding capacity performance to push for enhanced integration of these resources

Resources	BTM DER
DR	Aggregated (CSP)
DG – Disp.	Load modifying (if dispatchable by PJM)
DG – Non-Disp.	Incorporated into forecasting
Storage	Load modifying, demand resource

Sources: EIA, ScottMadden Analysis; www.pjm.com; http://foresternetwork.com/daily/energy/energy-storage-solutions-latest/recent-progress-in-isorto-territories-march-der-aggregation-towards-reaching-comprehensive-wholesale-value/; http://sepa51.org/phaseII/OBoyle_51stState_Addendum.pdf; https://www.snl.com/InteractiveX/article.aspx?ID=36625286; "Seasonal Resources & Resource Aggregation under CP", PJM, April 2016

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DER Integration Status

California ISO

Background

- Combination of high DER penetration, active state policy making, and proactive regulatory mandates
- Multiple DER and DR pilots completed or under way and retail DR programs well established

Status of DER Integration to Wholesale Markets

- Two auctions completed to date under Demand Response Auction Mechanism (DRAM)
- Bifurcation of load modifying and supply side DR expected in 2018

Other Observations

- DER defined as "Any resource with a first point of interconnection to a Utility Distribution Company or a Metered Subsystem"

Resources	BTM DER
DR	Aggregated by Scheduling Coordinator
DG – Disp.	Aggregated by Scheduling Coordinator
DG – Non-Disp.	Aggregated by Scheduling Coordinator
Storage	Aggregated by Scheduling Coordinator

Sources: EIA, ScottMadden Analysis; St. John, California DRAM: Companies Say Utilities Fell Short on Distributed Energy Auction, GTM:, August 2016; https://www.caiso.com/Documents/DraftFinalProposal_ExpandedMetering_TelemetryOptionsPhase2_DistributedEnergyResourceProvider.pdf

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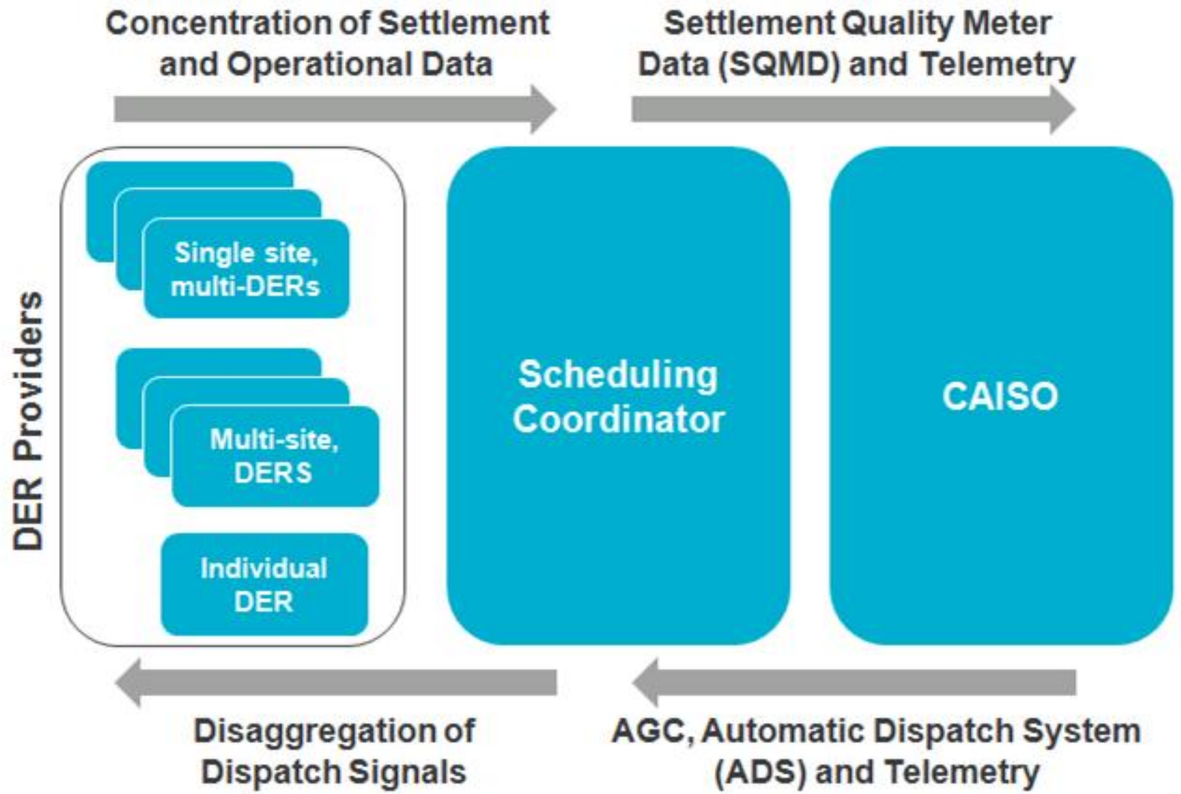
CAISO Approach to Market Bidding of Aggregated DER

CAISO has proposed, and FERC has approved, the aggregation of DER by a third party for bidding into wholesale markets.

Interaction Between Aggregated DER and CAISO



This approach enables a third party to aggregate BTM DER and bid them into the ISO

8 Source: Expanded Metering and Telemetry Options Phase 2: Distributed Energy Resource Provider, 6/10/15, pg. 24.

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Level of Integration into Wholesale Market

Factors such as DER penetration, public policy mandates, technical infrastructure and regulatory environment each contribute to the degree of BTM DER integration across the country.

	ISONE	PJM	NYISO*	CAISO
DR	Aggregation	Aggregation (CSP)	Aggregation	Aggregation (SC)
DG – Disp.	Load modifying	Load modifying (if dispatchable)	Aggregation	Aggregation (SC)
DG – Non-Disp.	Incorporated into forecasting	Incorporated into forecasting	Load modifier	Aggregation (SC)
Storage	Load modifying (demand resource)	Load modifying (demand resource)	Aggregation	Aggregation (SC)

* Draft roadmap
** May also be part of BTM NG program

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Other RTOs

ISO / RTO	Summary	Challenges and Opportunities
ercot	■ Limited DER penetration in IOU territories (greater in munis/coops) ■ Considering a proposal for DERs to participate in wholesale markets ■ Commission considering alternative ratemaking mechanisms for DER (will report out Jan 2017)	■ Full retail deregulation in IOU service territories leaves DER development to retail providers
MISO	■ Regulatory limitations across its 15-state territory; some state rules preventing aggregated DER being bid into wholesale markets ■ Restructuring its capacity market to increase DER aggregation opportunities	Examples of market rule limitations: ■ 5 MW minimum to participate in energy and frequency regulation markets ■ Aggregations must be tied to a single Commercial Pricing Node or physically located in one Local Balancing Area in order to access markets
SPP Southwest Power Pool	■ Slower growth of DER due primarily to deregulated energy markets in 3/4 of the states	

Sources: https://foresternetwork.com/daily/energy/energy-storage-solutions-latest/recent-progress-in-isorto-territories-march-der-aggregation-towards-reaching-comprehensive-wholesale-value/; http://www.betterenergy.org/blog/integrating-clean-distributed-energy-resources-der-electric-grid-requires-update-market-rules; http://www.utilitydive.com/news/how-aggregated-ders-are-becoming-the-new-demand-response/422725/ Source:

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