

White Paper

Alternative Aggregated DER Participation Methods for US Grids Are Still Needed

FERC Order 2222 Is a Good First Step, but Additional Work Remains

Published 4Q 2023

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Executive Summary

1



DER Adoption Is Increasing

Adoption of distributed energy resources (DER) in the US is rising in all business segments. Customers are increasingly adopting DER to achieve cost savings, improve their energy resilience, and lower emissions. These resources, which would already be connected to utility networks, can be essential sources of grid flexibility—particularly distributed solar plus energy storage, as well as EVs. When aggregated, DER can enable a distributed grid to integrate higher levels of renewable energy capacity without sacrificing reliability.

2



FERC Issued Order 2222 to Advance DER in Wholesale Markets

The Federal Energy Regulatory Commission (FERC) issued Order Number 2222 to enable and induce aggregated DER participation in the six wholesale markets under FERC's jurisdiction. Its intent is to effectively link wholesale and retail markets such that market operators can take advantage of aggregated DER to deliver grid services at the transmission level. In essence, the goal is to allow aggregated DER to compete alongside traditional generation sources.

3



Order 2222 Seems to Have Had a Mixed Impact So Far

Regional variations in compliance proposals and plans along with existing state-level regulations appear to create challenges for aggregated DER in wholesale markets. Demand response (DR) opt-outs, single-node aggregation restrictions, and restrictive dual participation methods are among the regulations creating challenges. To address these barriers, market operators could look to peer compliance plans for guidance. Despite challenges, FERC Order 2222 has gotten the conversation started around integrating aggregated DER into US wholesale markets.

4



Alternative Methods Are Needed to Integrate Aggregated DER

DER aggregators must continue to work to find alternative methods to showcase the value of aggregated DER, such as distribution-level programs or local flexibility markets, in areas where wholesale participation may not be as viable. US utilities can look to peers with active distribution-level programs or grid operators in countries outside the US for ideas and guidance. Ongoing engagement among market operators, utilities, DER aggregators, and regulators is required to fully integrate aggregated DER into US grid operations.

Introduction

At the time of its release, FERC Order Number 2222 was hailed as a game changer for DER.

- The order required the six regional wholesale market operators under FERC jurisdiction to develop new market frameworks to accommodate aggregated DER as a market participant.
- The order's intent was to enable aggregated DER portfolios to be compensated at the wholesale level for providing flexibility, thereby inducing market participation and allowing them to compete alongside traditional generation sources.

Customers in every segment are increasingly adopting DER for a variety of reasons other than potential opportunities for wholesale market revenue.

- FERC Order 2222 seeks to have grid operators leverage distributed capacity that is already coming online to provide essential grid services.
- These resources can lead to increased resilience, reduced emissions, and lower operational costs for the bulk power system.

In the 3 years since FERC Order 2222 was issued, however, its full impact seems to be more mixed.

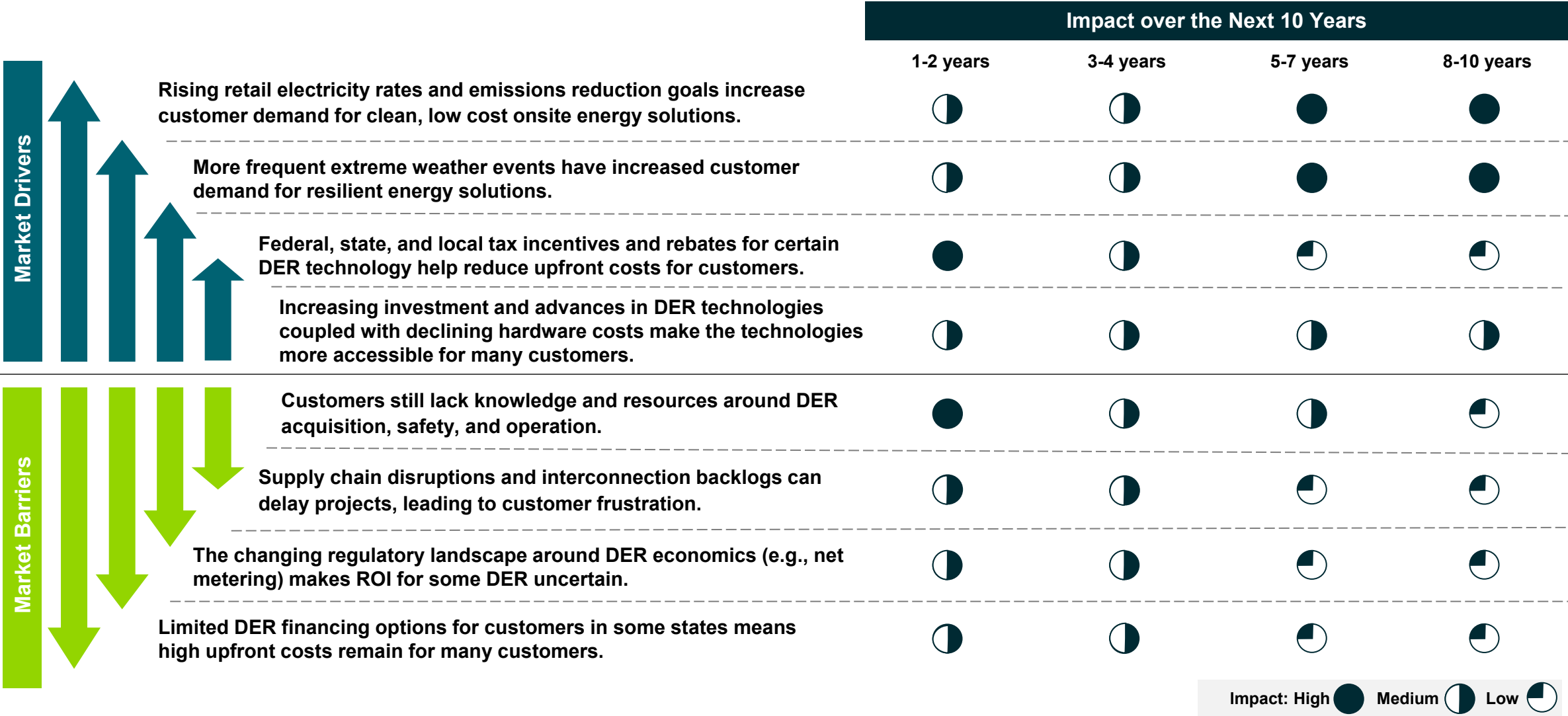
- Regional market operator compliance plans vary, partially due to the differences in resource constraints each operator faces, and because of existing state-level regulations relating to DER within each market territory.
- Together, these challenges, if not properly addressed, may derail the order's original goal.

Instead of viewing FERC Order 2222 as another regulation with which they must comply, regional market operators and state regulators should instead view it as an opportunity to further advance electricity markets in the US.

- With proper wholesale market frameworks and regulatory mechanisms in place, portfolios of aggregated DER can become critical sources of grid flexibility in the bulk power system.
- Until those frameworks are fully implemented, aggregated DER providers will need to continue to find alternative methods to showcase the value they can add to grid operations.

DER Adoption and Grid Service Potential

US DER Market Drivers and Barriers



DER Grid Service Potential

DER are diverse assets and can provide a multitude of grid services when aggregated.

Trends in US DER Adoption

- Customers are **increasingly adopting and interconnecting a wide range of DER** including rooftop solar PV systems, energy storage systems, smart thermostats, and EVs (along with associated charging infrastructure) for **multiple reasons**.
- As **more distributed solar PV capacity** is deployed, **managing intermittent generation with energy storage** has become critical to grid operations to avoid further exacerbation of the **duck curve**.
- **Breakthroughs** in AI, predictive analytics, and other **energy software technologies** are **facilitating the growth of DER** and making it **easier for grid operators to utilize these resources** in operations.
- Many **utilities** are **implementing time-of-use rates** for certain residential, commercial, and industrial customers.
- The **Inflation Reduction Act** will be critical in **driving market growth for several DER types** including distributed energy storage, EVs, heat pumps, and microgrids.
- The **reduction of export compensation** for excess solar electricity generated will also be a key factor in **driving the distributed energy storage** market.



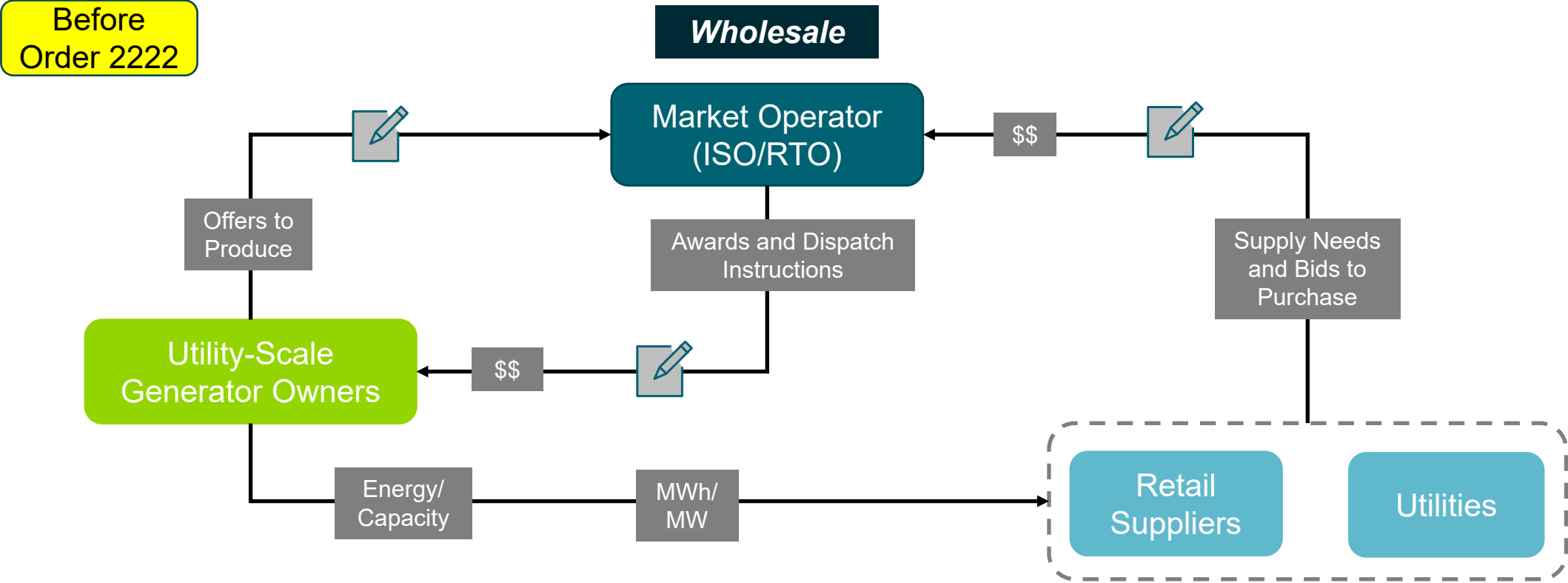
DER Grid Service Implications

- **DER aggregators** are **developing new business models** that require **no upfront capital** from the customer in exchange for the aggregator occasionally **using the asset to provide grid services** to a utility or wholesale market.
- **Aggregated DER** like distributed energy storage can be **used to provide localized grid services** like congestion management, leading to **reduced renewable curtailment** and **distribution upgrade deferrals**, which can prevent overbuilding of traditional infrastructure.
- **Residential, commercial, and industrial** customers may **investigate energy storage and other DER** to take advantage of **time-of-use rates** to shift load to **off-peak hours** without sacrificing comfort.
- Leveraging **aggregated DER** can also **reduce reliance on peaker plants**, leading to **lower operational costs** and **reduced emissions**.
- **Lithium ion batteries** of all sizes have already demonstrated they can be **critical resources** in wholesale **energy and ancillary service** markets.

US Wholesale Electricity Markets

US Wholesale Electricity Market Structure (Before)

Wholesale electricity markets have generally favored utility-scale resources connected to the transmission system.

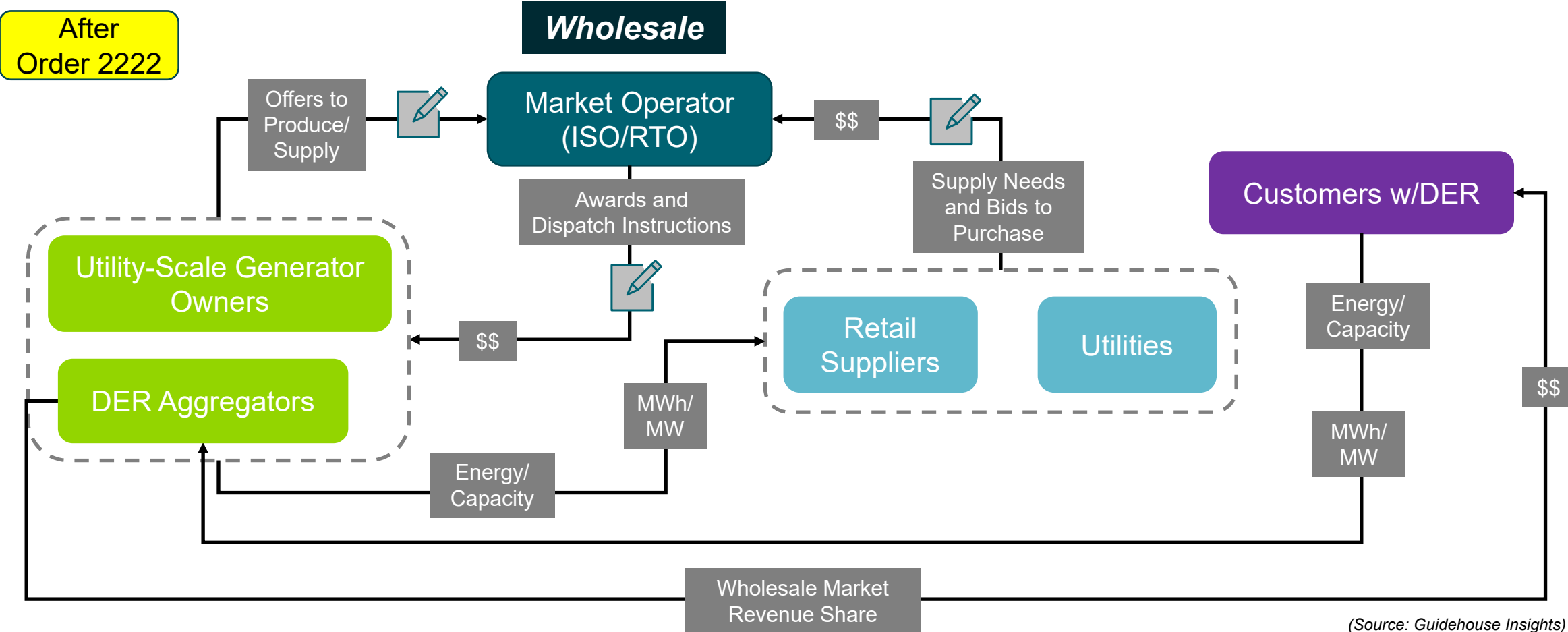


Select DER (energy storage and DR) were permitted to participate directly in wholesale markets prior to FERC Order 2222, but their impact has been limited and even restricted in some states.

(Source: Guidehouse Insights)

US Wholesale Electricity Market Structure (After)

FERC Order 2222 aims to make DER a source of bulk power grid services to enhance reliability, reduce operational costs, and create additional revenue streams for DER owners.





Regional Variance in Implementation Plans

Examples of Implementation Challenges for DER

To address challenges, market operators can look to peer compliance plans for ideas.

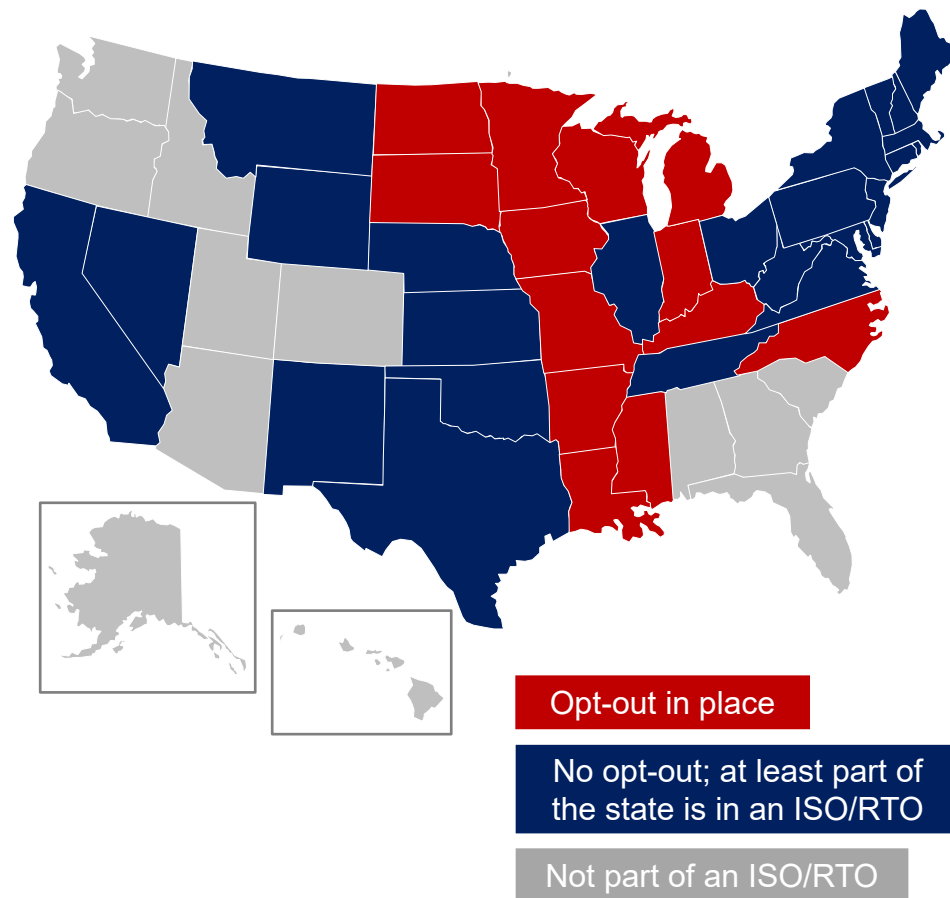
Challenge	Description	Example ISO/RTO
DR Opt-Out	States do not allow third-party DR aggregations (or direct end-customer DR capacity) to participate in the wholesale electricity market.	MISO*, SPP*, PJM*
Minimum Asset Size Requirements	Market operator specifies individual DER in an aggregation must meet minimum size requirements that may prevent some asset types from participating.	NYISO
Single-Node Aggregations	Market operator requires all DER assets in an aggregation be located within the same pricing node, potentially leading to difficulties in ensuring aggregations meet the 100 kW minimum bid size.	NYISO, MISO, SPP, PJM*
Restrictive Dual Participation Regulations	Market operator institutes requirements that effectively make it difficult or impossible for DER to participate in both wholesale aggregations and retail programs, even if the resources would be providing different services.	CAISO*, PJM*
Metering and Telemetry Requirements	Market operator requirements around metering and/or telemetry for individual DER in an aggregation are too costly or complex for certain asset types.	CAISO*, ISO-NE*
Far-Off Implementation Date	Target date for new aggregation frameworks to take effect is 2026 or later, which could slow momentum around DER aggregations in wholesale market operations.	MISO, SPP, ISO-NE*, PJM*

*Challenge is only present in select markets (e.g., energy, capacity, ancillary services), select states in an ISO/RTO territory, for select DER types, or for aggregations that meet specific criteria.

Demand Response Opt-Out

Third-party DR aggregations are essential to unlocking the full potential of aggregated DER.

- As allowed by FERC Order 719, 13 states within ISO/RTO territories restrict or fully prohibit participation of direct customer and/or third-party DR aggregators in wholesale markets.
 - This means a third-party (e.g., nonutility) DER aggregation created under the new FERC Order 2222 frameworks that includes DR could be prevented from participating in a wholesale market, even if it contains other resources for which states are not allowed to opt out (e.g., energy storage).
- DR is one of the lowest cost resources for grid operators and consumers.
 - Residential DER like rooftop solar and energy storage still have high upfront costs.
 - DR-enabling technologies like smart thermostats and communications modules for water heaters can be procured by customers at a relatively low cost.
- Michigan recently allowed third-party DR aggregations of commercial and industrial customers with at least 1 MW of load.
 - Other states, including Indiana, Minnesota, and Missouri, are looking into adjusting or removing the opt-out.
- FERC is also investigating the possibility of removing the opt-out.



(Source: Guidehouse Insights)

Restrictive Dual Participation Regulations

Some ISO/RTO plans to avoid double counting may prevent DER from participating altogether.

- There must be a way to ensure resources are not being double counted and receiving credit for providing the same service twice (or alternatively, resolving an issue with one resource caused by another resource within the same aggregation).
- Some DER, particularly residential, tend to favor retail programs in the current market structure because these programs generally offer higher compensation than wholesale services.
 - This means DER that provide energy through their utility net metering program, for example, cannot also be compensated for providing energy to the wholesale market.
 - These assets can still provide other grid services (e.g., capacity, ancillary services) to the bulk power system, and their participation in retail programs should not preclude them from serving in wholesale aggregations.

ISO/RTO	Description of Regulation	Implication for DER
CAISO	Requires aggregated DER to be available 24/7 for CAISO dispatch (exception made for DR resources).	Would make it impossible to participate in both wholesale and retail programs unless acting strictly as a DR resource (which may limit the effectiveness of DER aggregations).
PJM	Has a “must offer” requirement for resources participating in the capacity market, meaning they must also be available for the day-ahead energy market.	Could prevent net-metered resources from participating in the capacity market because the “must offer” requirement would lead to double counting through the energy market compensation.

Potentially Restrictive Dual Participation Regulations

ISO/RTO	Description of Regulation	Implication for DER
PJM	Requires non-net-metered resources that are colocated with net-metered resources to have a separate electric distribution company account number and separate meter if they are to provide wholesale services.	PJM states it does not think this is a very likely scenario, as enrollment in net-metering programs is generally established at the level of electric distribution company account number, meaning all technologies at a site are either enrolled or not enrolled. However, this regulation could create complications as more non-net-metered DER (e.g., energy storage systems, EVs and chargers) that are capable of providing wholesale services are adopted by customers with existing net-metered resources (e.g., rooftop solar).
MISO	Does not allow net-metered resources to provide wholesale energy to MISO markets (this is in accordance with FERC Order 2222, as those resources would be double compensated). However, MISO guidance on these resources providing other MISO services defers to retail regulatory authorities.	While these guidelines are not explicit restrictions, they are more general in nature, which could lead to issues in implementation (e.g., some resources being wrongfully excluded).
SPP	Requires an attestation from at least three distribution electric utilities or load-serving entities that DER resources enrolled in a retail program will not be providing the same service in the SPP wholesale markets before enrolling in wholesale aggregation.	While these guidelines are not explicit restrictions on certain resources, the process is more open-ended, which could lead to issues in implementation (e.g., cumbersome process to enroll assets in a DER aggregation).

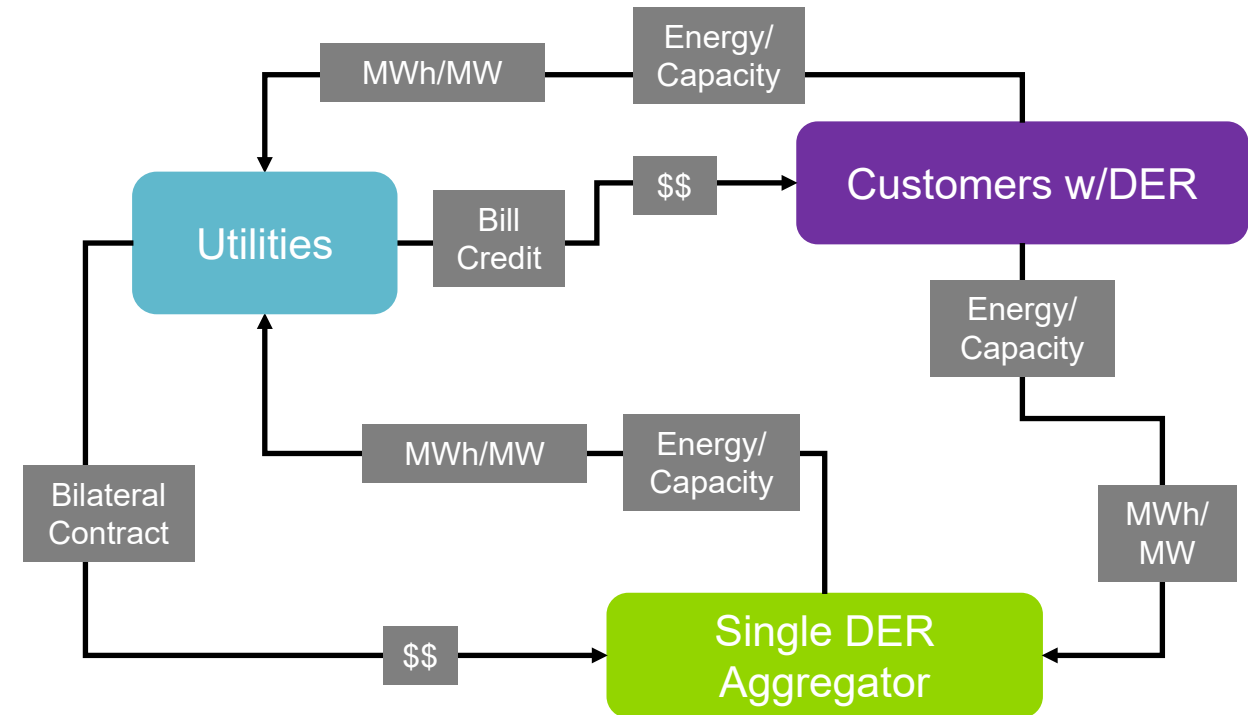
Alternative Aggregated DER Participation Methods

Bilateral Contracts and Retail Tariffs

Retail tariffs, beyond net metering, and bilateral contracts can enable more advanced use cases for aggregated DER where wholesale participation is not viable.

Current: Bilateral Contracts and Retail Tariffs

- **Bilateral contract:** An agreement between a DER aggregator and a distribution utility to provide grid services from aggregated DER.
 - The aggregator enrolls customers (and may also assist customers in getting DER installed) and dispatches their DER to ensure contract requirements are met.
 - The utility pays the aggregator for fulfilling contract requirements and provides a financial credit to customers that participated.
- **Retail tariff:** A distribution utility starts its own DER program whereby customer assets are used to provide grid services.
 - Customers enroll directly through the utility, and participating customers receive financial credits.
 - The utility procures a flexibility management platform (e.g., DERMS) to manage, control, and dispatch the DER.
- Many utilities around the US currently use these strategies to integrate DER like DR, energy storage, and EV charging into grid operations.
 - Examples of utilities with programs for energy storage: Con Edison, Hawaiian Electric, Green Mountain Power, Portland General Electric, Southern California Edison, PG&E, National Grid, Eversource.



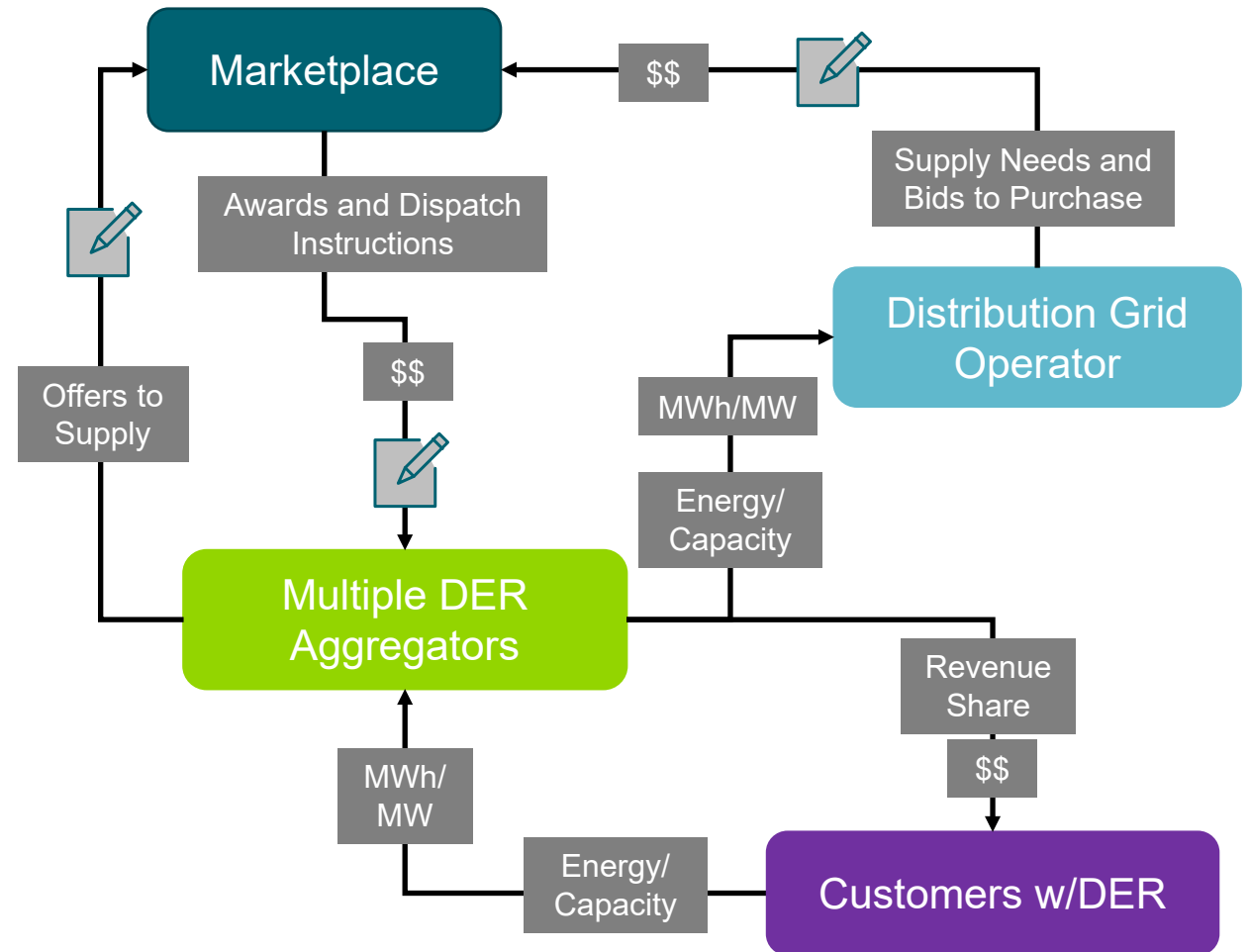
(Source: Guidehouse Insights)

Local Flexibility Markets

Local flexibility markets can facilitate competition among DER aggregators while maintaining grid reliability and lowering costs for operators and customers.

Potential Future: Distribution-Level Flexibility Markets

- Local flexibility market: Markets operating at specific points on the distribution grid to manage local grid operations.
 - An aggregator enrolls DER asset owners.
 - The aggregator submits bids to the marketplace to provide certain grid services in that specific section of the grid.
 - DER owners then receive a share of market revenue earned.
 - Because these markets operate at specific points on the distribution grid, DER are generally competing with other DER instead of utility-scale resources.
 - Geographically targeting grid issues increases the effect of aggregated DER participation.
- The concept has been deployed by numerous distribution companies in Canada and Europe and is gaining traction with utilities in the US.
 - Examples of distribution companies that have used local flexibility markets: UK Power Networks (UK), Linja AS (Norway), Jämtkraft Elnät (Sweden), Newmarket-Tay Power Distribution and Elexicon Energy (Canada), National Grid (New York, US).



(Source: Guidehouse Insights)

Conclusions and Recommendations

Key Conclusions and Recommendations



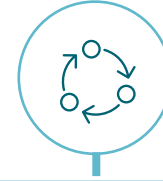
DER can be valuable sources of flexibility and resilience for power grids.

Customers across all segments are adopting DER for various reasons, meaning grid operators will have an increasingly large and diverse pool of additional tools available to them to maintain reliability. A grid that leverages DER can be more flexible and resilient, characteristics that are essential as generation from large-scale variable renewable resources increases.



Regional variations in compliance plans make the future of some DER unclear.

Certain aspects of ISO/RTO compliance frameworks may make it difficult or impossible for new DER aggregations to include some resource types, thus undermining the goal of FERC Order 2222. This could lead to widening disparities between ISOs/RTOs and more intense capacity shortfalls in some regions. A balance must be struck between facilitating the inclusion of DER in wholesale markets and acknowledging the resource limits of market operators and utilities.



FERC Order 2222 is a good first step for US wholesale markets.

Despite the challenges present in compliance plans, FERC Order 2222 represents a landmark rule that has gotten the conversation started in the US around integrating DER into wholesale operations. Extensive collaboration between market operators, regulators, utilities, and DER aggregators is still required to clarify uncertainties in current wholesale frameworks and fully integrate aggregated DER into all wholesale markets. To address challenges for DER, market operators should look to peer compliance plans for ideas.



Alternative methods for aggregated DER participation are still needed.

DER aggregators should continue to investigate alternative methods, such as distribution-level programs or local flexibility markets, to demonstrate how aggregated DER can provide grid services in those regions where wholesale participation is not as viable. US utilities should look to peers with active programs or grid operators in countries outside the US for guidance on setting up and deploying these types of initiatives.

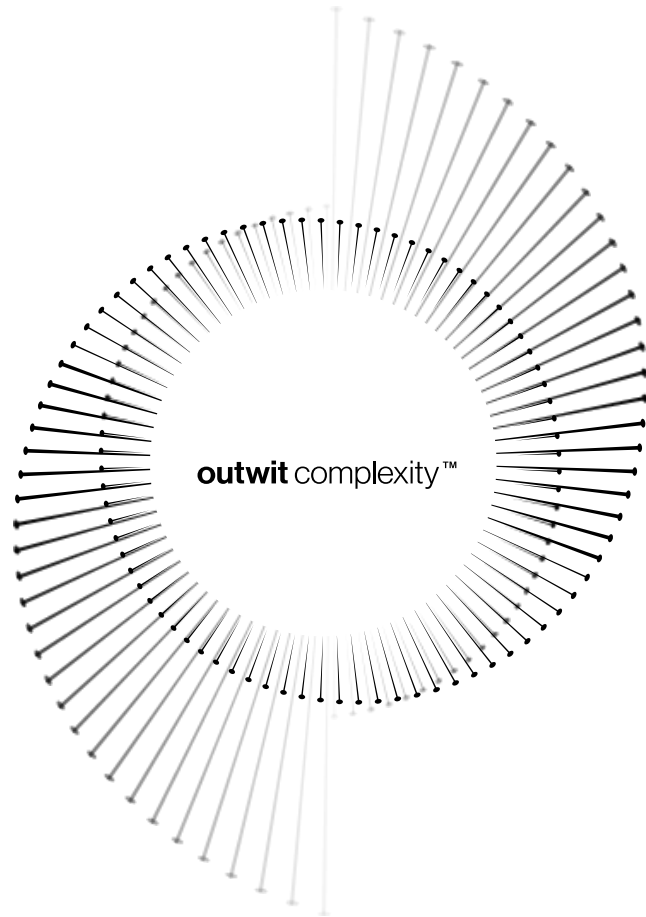
Abbreviations, Resources, and Contact

Acronyms and Abbreviations

- AI Artificial Intelligence
- CAISO California ISO
- DER Distributed Energy Resources
- DERMS DER Management System
- DR Demand Response
- EV Electric Vehicle
- FERC Federal Energy Regulatory Commission
- ISO Independent System Operator
- ISO-NE ISO New England
- kW Kilowatt
- MISO Midcontinent ISO
- MW Megawatt
- MWh Megawatt-Hour
- NYISO New York ISO
- PG&E Pacific Gas and Electric
- PJM Pennsylvania-New Jersey-Maryland Interconnection
- PV Photovoltaics
- ROI Return on Investment
- RTO Regional Transmission Organization
- SPP Southwest Power Pool
- UK United Kingdom
- US United States



Additional Resources



- Explore the Guidehouse Insights [Virtual Power Plants](#) page
- Read Industry Insights on the latest trends:
 - [*Retail Programs Are Critical for Residential Virtual Power Plants in the US*](#)
 - [*Overcome Interconnection Challenges by Exploiting FERC 2222 Quirk*](#)
 - [*Grid-Interactive Water Heaters Are Important VPP Resources*](#)
 - [*FERC Order 2222-B Affects VPP Market in the US*](#)
- Read related reports:
 - [*Residential Distributed Energy Resources and Flexibility*](#)
 - [*Business Model Innovations Can Drive Virtual Power Plant Growth*](#)
 - [*FERC Order 2222 Implementation Plans Create Risks, Challenges, and Opportunities for Market Players*](#)
 - [*FERC Order 2222: RTO Compliance Plans Reveal Regional Disparities in Distributed Energy Integration*](#)

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Note: Editing of this report was closed on December 6, 2023.

