FERC Order 2222 Implementation: *Preparing the Distribution System for DER Participation in Wholesale Markets*

January 2022

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Table of Contents

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Background

- AEE and GridLab brought together utilities and AEE members to build consensus around key distribution system issues to facilitate DER participation in wholesale markets
- This summary lists key recommendations to help educate state commissions; inform FERC and RTO/ISO processes; and support state policies that increase DER value
- Four working groups formed to discuss: Interconnection and aggregation review; communications, controls, and coordination; dual participation; and investment recovery and cost causation

CAMPAIGN PARTICIPANTS

Other participants include: APS, Exelon, PECO, ComEd, Pepco, and BGE

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Broad Conclusions

- DER aggregation in wholesale electricity markets under Order 2222 presents unique opportunities and challenges
- Order 2222 implementation will be most successful for customers and grid reliability with active engagement from state utility regulators
- Existing processes and tools developed by states, distribution utilities, and stakeholders to support DER integration should be built on to facilitate Order 2222 implementation
- In the future, processes and tools adopted by states and utilities related to DER adoption and integration should anticipate participation in wholesale aggregations
- New requirements and investments to support Order 2222 implementation should be aligned with the services provided and scaled as participation increases where possible
- Processes, tools, and policies enacted to support Order 2222 implementation must set clear expectations of all participants
- Equitably addressing the potential incremental distribution-level costs of Order 2222 implementation requires identification of a range of potential costs and benefits
- State regulators could consider establishing dedicated forums to examine and address the complex distribution system issues identified in this report

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Interconnection and Aggregation Review

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Problem Statement

There appears to be a need for clarity around what an Aggregation Review process might be (and what, if any relationship it has to other processes)

Recommendations

- As EDCs establish an aggregation review process, they should utilize existing data from interconnection or ISO aggregation registration processes where possible to minimize the impact on all parties
- EDCs should work with RERRAs to modify existing distribution interconnection processes to include an option to indicate if a DER is intended to be included in an aggregation
- EDCs should distinguish aggregation review processes for different use cases and penetration levels
- DER aggregators should share ISO/RTO aggregation registration data with EDCs wherever possible and make best efforts to share any updates that take place on a regular basis
- ISO/RTOs should maintain up-to-date records accessible to EDCs on aggregations
- RERRA have an important role to play in approving tariffs, aggregation review processes, relevant cost recovery, adjustments to distribution interconnection, and potentially resolving any disputes that may arise

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Interconnection and Aggregation Review Recommendations
(Continued)

- Requirements in the aggregation review process and any necessary impact studies should align with expected dispatch of the aggregation and any restrictions should be transparent for all parties
- Any new/modified processes need to be feasible for EDCs of varying degrees of sophistication
- All parties should expect that these processes will evolve as DER penetrations increase and/or EDC operations become more complex

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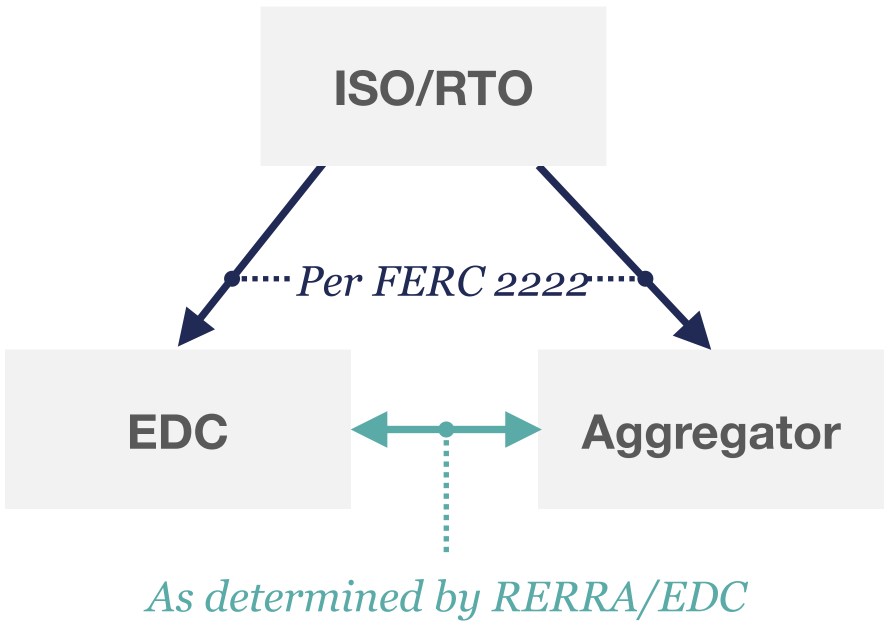

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Communications, Controls, and Coordination

Problem Statement

FERC order 2222 requires unprecedented coordination between the RTO/ISO, aggregator, and EDC. Existing tools and processes do not provide the functionality needed to enable the required coordination

Recommendations

- Do not assume a complete solution will be implemented immediately; follow a “crawl, walk, run” approach. Start with least regrets deployments
- At the early stage, scrutinize whether additional investments in communications, monitoring and controls above what the RTO/ISO and the interconnection procedures will require are necessary
- Consider if there are simple and lower cost approaches for fostering coordination, controls and visibility between EDCs and aggregators
- The functions of controls and monitoring are distinct, and these terms should not be used synonymously; distinct requirements should be developed.
- Requirements on controls, coordination, and monitoring for various types of DERs can be very different

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Communications, Controls, and Coordination Recommendations

(Continued)

- DER installations should leverage autonomous control features that have been adopted as standards, such as IEEE 1547
- For distribution overrides, there may be two levels of overrides:
  - **Soft override** where aggregator can act based on early notice from EDC
  - **Hard override** where EDC directly curtails or interrupts DER for safety and/or reliability purposes
- The need for hard vs. soft overrides will depend on circumstances and degree of coordination between EDC and aggregator
  - Soft overrides will be the preferred option in non-real time applications and demand response
  - Hard overrides will be a last resort where system reliability or safety is at risk
- Level of automation (i.e., machine-to-machine) vs. manual communication will depend on level of complexity, existing tools at the EDC/aggregator, DER penetrations, and/or grid topology
- Setting clear expectations and open communications between EDCs and aggregators on drivers and likely conditions that lead to distribution overrides will benefit all parties

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Communications, Controls, and Coordination Recommendations
(Continued)

- EDCs alerting aggregators prior to bidding windows and aggregators adapting bidding behavior to expected conditions from EDC could help to alleviate the need for hard overrides
- Support foundational EDC actions that bring greater visibility into the distribution system (such as linking AMI with SCADA and/or ADMS); these can be part of broader grid modernization efforts
- The EDC functions of planning and operations are distinct. Any proposed hardware/software investment should be understood in the context of how they support these distinct functions, and how the EDC plans to institutionalize these new procedures and the feasibility of doing so vis-à-vis current planning and operations
- For small DER applications (especially residential demand response), access to AMI data has been a barrier; consider frameworks that reduce friction for aggregators to access AMI data and/or create systems that don't require aggregators to access AMI data by coordinating the data exchange between the EDC and ISO/RTO
- Low friction aggregator access to relevant meter data for settlement purposes and low friction utility access to relevant metering and controls data for planning, operation and settlement purposes need to be specified and mandated by applicable RTO/ISO tariffs and/or state jurisdictional tariffs in order to scale DERs in wholesale markets

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Dual Participation

Problem Statement

Order No. 2222 requires all RTOs/ISOs to provide aggregated DERs with access to wholesale markets. Enabling dual participation will require thoughtful construction of both RTO/ISO-level market rules and state-level programs, reasonable oversight, & appropriate compensation for participating resources

Recommendations

- Load forecasting reconstitution practices exist today for wholesale demand response in markets such as NYISO and ISO-NE; other grid operators can leverage these existing practices for DERs
- RERRAs should establish a process through which the utility can identify where duplicate compensation may occur and RERRAs should develop appropriate mechanisms to prevent duplicate compensation (e.g., eligibility criteria in the aggregation enrollment and review, including ways to operationalize those criteria)
- Consideration of, and accounting for, instances of dual participation where a DER's capability may be split to provide more than one distinct wholesale or retail service in a given interval

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Dual Participation Recommendations

(Continued)

- ISO/RTO participation models for joint ownership may be an example of how dual participation could be structured
- New York utilities' CSRP and DLRP tariffs provide useful models for preventing double compensation of energy
- DER Aggregators should update the DERA's operational status to the ISO/RTO to appropriately reflect any retail activities and/or obligations of DERs that comprise the DERA that impact resource availability for wholesale services and potential dual participation
- Retail tariffs and contracts should have guidelines for governing DER dual participation (such as identifying incompatible wholesale market services), with consideration for both normal and emergency operations at the bulk- and distribution-system levels
- RERRAs should proactively collaborate with utilities, DERs, Aggregators, and RTOs/ISOs to develop dual participation rules that are transparent and accommodate DER capabilities while preventing those issues outlined earlier in this document
- RERRAs should recognize that on-site metering will be necessary to facilitate wholesale participation and/or participation in retail programs

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Investment Recovery and Cost Causation

Problem Statement
Implementation of Order No. 2222 will result in incremental distribution level costs

Recommendations
Consider the following potential cost categories when evaluating utility investments that relate to Order No. 2222

1. **Interconnection Studies & Upgrade Costs**
2. **Utility Review of DERA Registration Requests**
3. **Day-to-Day Utility Management of DERs**
4. **Investments to Increase or Maintain Hosting Capacity**
5. **Wholesale Market Access Charge**

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Recommended Considerations by Which to Evaluate Proposed Investments[1]

1. Identify costs required to enable DERs sited on the distribution system to participate in wholesale markets

2. Identify relevant benefits of enabling DER penetration in wholesale markets

3. Avoid duplication of DER benefits in benefit cost analysis

4. Establish an objectively quantifiable basis for measuring, quantifying, and allocating relevant identified benefits and costs

5. Equitably allocate costs between retail customers, DERs, and aggregators, taking into consideration of applicable benefits and consideration of implications of any cost shifts to retail customers

[1] These principles are focused on costs incurred at the distribution level; costs incurred by RTOs/ISOs are expected to be recovered through existing RTO/ISO cost recovery mechanisms.

Table of Contents

Background

- AEE and GridLab brought together utilities and AEE members to build consensus around key distribution system issues to facilitate DER participation in wholesale markets
- This summary lists key recommendations to help educate state commissions; inform FERC and RTO/ISO processes; and support state policies that increase DER value
- Four working groups formed to discuss: Interconnection and aggregation review; communications, controls, and coordination; dual participation; and investment recovery and cost causation

CAMPAIGN PARTICIPANTS

Microsoft, DTE, greenlots (A Member of the Shell Group), CLEAResult, ecobee, Dominion Energy, Google, Xcel Energy, RECURVE, CPower, Portland General Electric, SIP, uplight, enel x, ORACLE, Walmart, GridLAB, Advanced Energy Economy

Other participants include: APS, Exelon, PECO, ComEd, Pepco, and BGE

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Problem/ Opportunity Statement

- FERC Order No. 2222 presents an opportunity to ensure that Distributed Energy Resource (DER) have an opportunity to participate in wholesale markets on a level playing field with other resources. Success depends on:
  - Unprecedented collaboration between RTOs/ISOs, distribution utilities, DER aggregators, and state regulators working through challenging issues in a short timeframe
  - Distribution utilities' systems and capabilities to facilitate wholesale market participation, and addressing compatibility of retail programs for DER that enable wholesale market participation
  - Maintaining system reliability and maximizing the ability of wholesale market pathways for delivering grid services from DERs
- There were few effective venues for distribution utilities and DER providers to collaborate on compliance plans and implementation challenges outside of RTO/ISO stakeholder processes. AEE assembled this collaborative to consider distribution system impacts, retail programs and policies, and other state-level regulatory actions that could facilitate participation of DERs in wholesale markets

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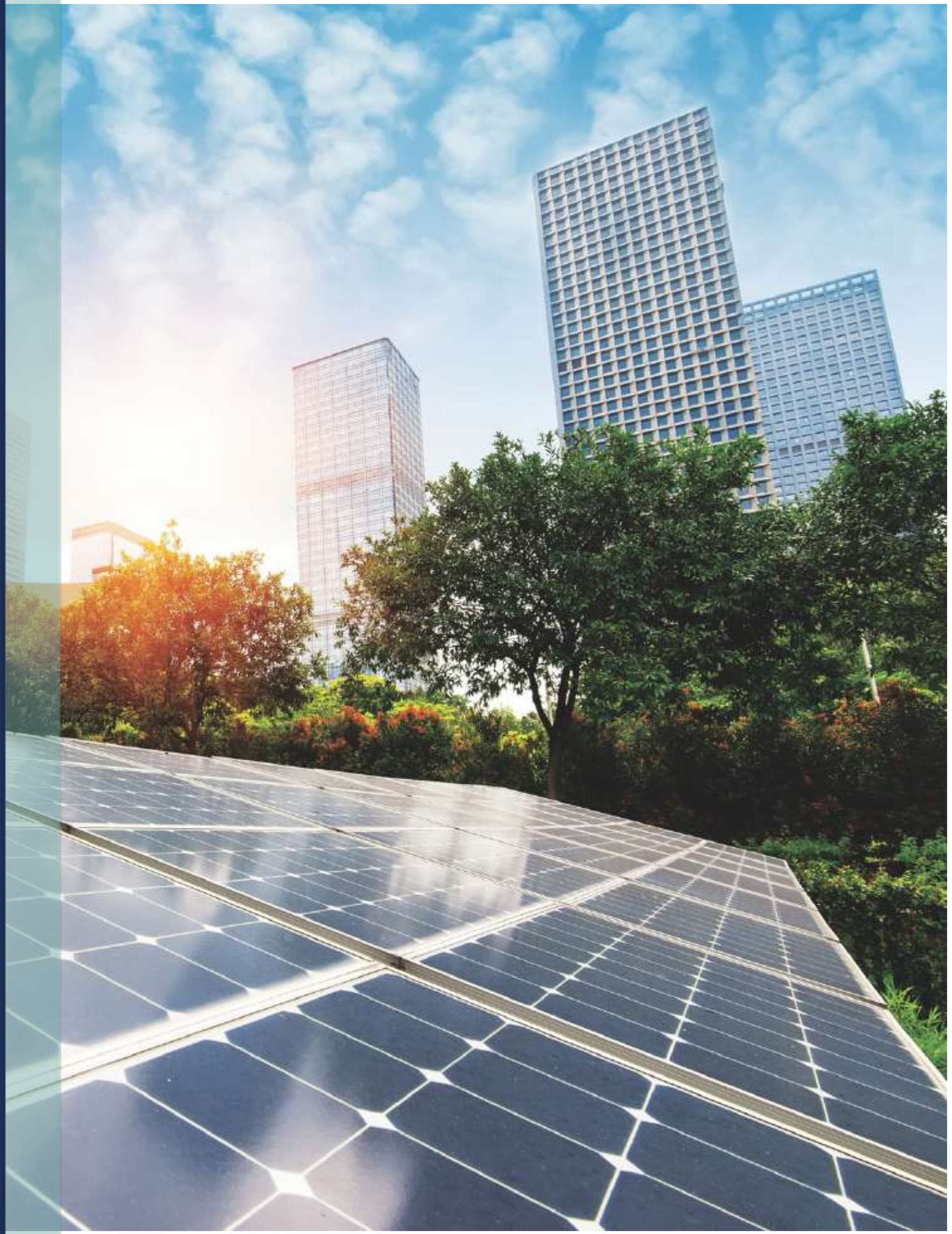
Vision of Success

DER aggregators, distribution utilities, RTOs/ISOs, and utility customers may benefit from increased DER participation in wholesale markets, for example:

- **DER Aggregators:** Order 2222 opens new opportunities to earn revenue from wholesale markets; alongside distribution level compensation, this brings DERs closer to providing and being compensated for their full suite of benefits
- **Distribution Utilities:** Order 2222 creates an opportunity to play a role in enabling DER participation in wholesale markets while potentially deriving value from DERs at the distribution level
- **RTOs/ISOs:** Aggregated DER participation gives system operators access to more resources that increase grid flexibility and maintain reliability, particularly in the context of increasing renewables
- **Customers:** Utilization of DERs in wholesale/retail markets has the potential to lower overall customer costs by avoiding otherwise needed energy and capacity investments across the grid



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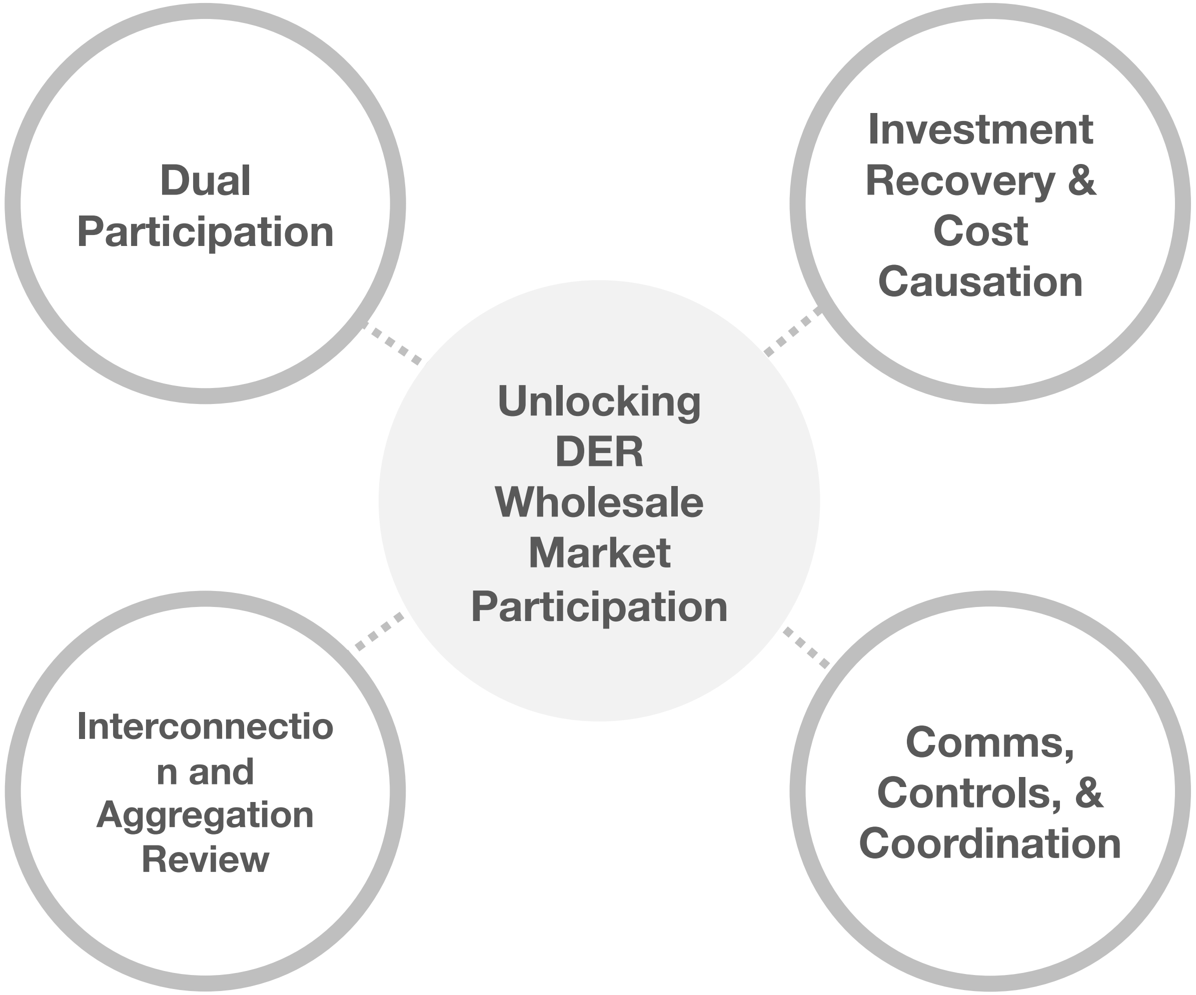
The collaborative prioritized four areas of focus and developed four Working Groups to address each



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Working Groups

Dual Participation

- AEE
- APS
- CLEAResult
- CPower
- Dominion
- DTE Energy
- Ecobee
- Enel X
- Greenlots
- Microsoft
- PECO
- PGE
- Recurve
- Uplight
- Xcel Energy

Communications, Controls & Coordination

- AEE
- APS
- CPower
- Cadeo
- Dominion
- DTE Energy
- Ecobee
- EnelX
- Google
- Greenlots
- GridLab
- Microsoft
- Oracle
- PGE
- Pepco Holdings
- Recurve
- Sidewalk Infrastructure Partners (SIP)
- Xcel Energy

Investment Recovery & Cost Causation

- AEE
- APS
- ComEd
- CPower
- Dominion
- DTE Energy
- Exelon
- Greenlots
- Pearl Street Station Finance Lab
- Walmart
- Xcel Energy

Interconnection & Aggregation Review

- AEE
- APS
- BGE
- Cadeo
- CPower
- CLEAResult
- Dominion
- DTE Energy
- EnelX
- Exelon
- Greenlots
- GridLab
- Highland Electric Transportation
- Microsoft
- Oracle
- PGE
- Uplight
- Walmart
- Xcel Energy

Acronyms

- ADMS Advanced Distribution Management System
- AMI Advanced Metering Infrastructure
- BCA Benefit Cost Analysis
- BTM Behind the Meter
- DA Day-Ahead
- DER Distributed Energy Resource
- DERA Distributed Energy Resource Aggregation
- DERMS Distributed Energy Resources Management System
- DR Demand Response
- EDC Electric Distribution Company
- FAN Field Area Network
- FOM Front of Meter
- IA Interconnection Agreement
- ISO Independent System Operator
- LSE Load Serving Entity
- NMS Network Management System
- RERRA Relevant Electric Retail Regulatory Authority
- RT Real-Time
- RTO Regional Transmission Organization
- SCADA Supervisory Control and Data Acquisition
- VVO Volt-var Optimization

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Table of Contents

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Interconnection/ Aggregation Review Introduction

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Issues Covered

- As aggregations become more prominent participants in ISO/RTOs, there is interest in understanding what adjustments may be needed to current interconnection processes and what an EDC aggregation review might entail
- This section considers how each party helps to ensure visibility and coordination at the onset for the other parties, namely through the following processes:
  - Distribution Interconnection
  - ISO/RTO DERA Registration
  - Distribution Aggregation Review
- The collection of these three processes represent the initial touchpoints between the ISO, aggregator, and distribution utility and therefore have potential ramifications on distribution system planning, operations, dispatch, commercial viability of DERAs, and on the continued reliability of the distribution grid
- This section addresses additional information, processes, and communications/coordination (if any) needed for the distribution interconnection of DER that plan to participate in wholesale markets

Current Landscape for DERA Interconnection, Registration, and Review

- ISO/RTOs are developing (or have already developed) DER Aggregation (DERA) Registration processes as a part of their FERC 2222 compliance filings
  - Purpose: to ensure ISO/RTO understands how a DERA can be expected to participate in the wholesale market
- Electric distribution companies (EDCs) have long set their own distribution interconnection processes (in coordination with state regulators)
  - Purpose: to ensure that interconnected DER does not affect safe and reliable operation of the distribution grid
- DERA Registration processes today note that EDCs have the authority (or obligation in some cases) to verify whether all or some portion of a DERA is eligible to safely participate in ISO
  - The EDCs' process for reviewing an aggregation is left to the EDC and its regulator (though 2222 does note there needs to at least be some process)

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Opportunity and Impact

- Given the landscape, there appears to be a need for clarity around what an Aggregation Review process might be (and what, if any relationship it has to other processes)
- Being mindful of unique dynamics of each EDC's context, consistency in the aggregation review processes (between service areas and/or jurisdictions) has the potential to:
  - Ease administrative burden for utilities and regulators
  - Reduce cost and time to scale DER aggregations
  - Increase reliability through greater transparency and coordination
- An approach that can accommodate different use cases and grid topologies may help ensure that some utilities aren't left at a disadvantage
- Clear steps to incorporate the outcome of Aggregation Reviews into distribution operations models will help with integration of aggregations

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Areas of Alignment

Guiding Principles

Wherever possible, aggregation review should leverage data/terminology/processes coming from interconnection, DERA registration

Interconnection is, and should remain, the jurisdiction of EDCs and their local regulators

While there may be consistency between local contexts, there will invariably be differences due to state policy priorities, utility business models, and/or varying grid conditions

DERA registration is, and should remain, the jurisdiction of ISOs/RTOs

- While there may be consistency between ISO/RTOs, there will invariably be differences
- The aggregation review step in the registration process will fall under state regulator jurisdiction. Coordination will be required among regulators, ISOs/RTOs, and EDCs

Aggregation review process should be distinct, and balance efficiency with the need to evaluate the safe and reliable operation of the system, and avoid undue barriers to DERA deployment

Aggregation review should be inclusive of power-injecting and load-modifying resources

Areas of Alignment

Relationship with Existing Processes

- To the extent possible, aggregation review should utilize existing data coming from the interconnection and/or DERA registration process
- Interconnection process may benefit from flagging whether a DER is likely to participate in an aggregation
  - Purpose is to increase transparency for distributions operations and planning
  - This tracking will be helpful in setting expectation, but will always be somewhat incomplete as interconnecting DERs may choose to join aggregations after interconnection
  - If desired, tracking may be used to model alternative baseline assumptions for current or future interconnection and/or hosting capacity studies
  - Noting intent to aggregate should not be used to discriminate in any way against the interconnecting DER (increased cost, wait time)
- The aggregation review process flows from both the distribution interconnection and DERA registration processes

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Areas of Alignment

The Aggregation Review Process

- The purpose of the aggregation review process is to give the EDC an opportunity to consider if aggregating DERs, that have received any necessary approval under distribution interconnection, would pose an undue risk to providing safe and reliable service
  Note: load modifying resources are not anticipated to require interconnection agreements
- A key consideration here is understanding differences in expected operation of DERs under aggregation versus previous baseline assumptions held during interconnection
- These assumptions can be referenced against proposed services and resource availability schedules that are provided to ISO/RTOs as a part of DERA registration
- EDC processes are expected to evolve over time as EDCs gain more experience with DER aggregations. State interconnection processes should be flexible enough to accommodate such evolution

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Areas of Alignment

The Aggregation Review Process

60-day timeline

Interconnection

- Interconnections take place under existing processes
- Where new DERs are added, aggregator/ developer/ host submits interconnection application and notes intent to aggregate

Pre-Enrollment

- Aggregator meets all ISO/RTO requirements for market participation in the ISO/RTO
- Aggregator verifies that all DERs that require an IA have fully executed IAs
- Collects relevant data on account, tariff, location, DER type/size, etc.
- Enrolls in aggregation

DERA Registration Submission

- Aggregator submits DERA registration information to ISO for eligible assets
- Aggregator/ISO notifies EDC of DERA registration submission
- Aggregator verifies no known double compensation
- If application deemed to be complete by EDC, 60-day timeline started for decision

Aggregation Review Submission

- ISO/RTO and aggregator securely provides information to EDC on intended aggregation participation
- Data provided includes all relevant information from distribution interconnection and DERA registration submission

Aggregation Review

- EDC validates interconnections of each DER (if applicable)
- Confirms no issues with dual participation in retail offerings
- Compare expected operation of DERs and inclusion of DR to planning assumptions at interconnection
- As needed, EDC updates assumptions and verifies hosting capacity based on mix of resources, services, and expected dispatch
- Review customer data like account number, name, address etc.

Aggregation Review Decision

- EDC determines if all or some portion of aggregation is eligible
- If EDC identifies all, or portions, of an aggregation that are ineligible, the EDC report may provide recommended modifications or further studies to be conducted toward eligibility

DERA Registration Decision

- EDC validates DERA based on aggregation review report
- If no issues identified, no further action required by aggregator
- If issues identified, aggregator adjusts and re-submits for aggregation review as necessary for ineligible/eligible with modifications
- 60-day timeline may be extended and/or restarted
- ISO approves/ denies DERA participation

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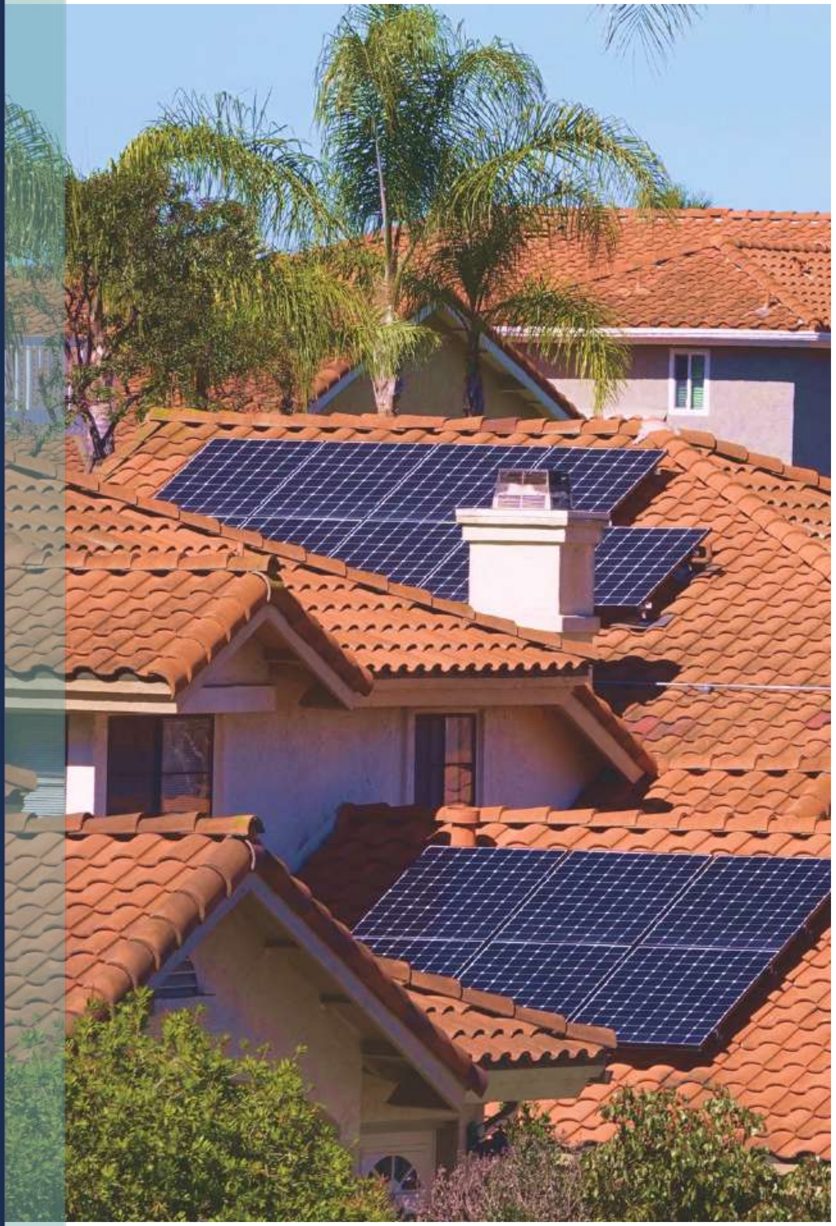
Considerations in the Distribution Interconnection

- As new distribution interconnects come online and flag their intention to participate in aggregation, EDCs may choose to proactively engage the DER developer/aggregator
  - This is by no means required but may be adopted by the EDC and the aggregator to streamline processes and realize cost savings
- Potentially proactive actions, might include, but are not limited to:
  - Hosting capacity analysis under aggregation scenarios, if feasible
  - Allowing for alternative/additional metering (as a cost to developer/aggregator)
  - Flagging any potential issues around dual participation
- None of these should be requirements or be applied in any way that discriminates against DER based on its stated intention to participate in aggregation
  - RERRAs should consider cost causation and cost assignment for these activities. (Aggregators disagree with this item)



Considerations in the Aggregation Review Analysis

- At aggregation review, the EDC will assess if previously interconnected DERs and any additional load modifying resources can safely and reliably operate in the manner intended by aggregator (per their DERA registration)
  - These would likely be outlined by the EDC/RERRA through a regulatory filing/tariff
- For the EDC, this means re-assessing the baseline grid conditions assumed for DER operation
  - For example, resources participating in capacity markets would be assessed at times of system peaks and loads adjusted based on concurrent load-modifying resources
- This may require full power flow analysis in some cases, but may be relatively simple in others
  - For example, where reverse power flow or thermal overloading is a concern, concurrent dispatch of DER during high load periods may reduce distribution issues
  - In contrast, cases where aggregation is providing regulation may interact in complex ways with existing volt-VAR optimization (VVO) schemes

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Role of the Regulator in Aggregation Review

- The RERRA has jurisdiction over distribution system reliability, so the local regulator may play an active role in the aggregation review process
- This role would likely be one of oversight and engagement as with current interconnection processes today:
  - Likely to play a role in defining the process to ensure transparent, balanced, and timely dispute resolution
- How aggregation review is done and any dispute resolution within process is state jurisdictional and therefore between EDC, aggregator, and RERRA
- While the RERRA's role in aggregation review may add additional steps to the process, it may also provide helpful feedback on process improvement, ensure balanced treatment of resources, and flag any potential issues related to dual participation

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Gaps

- Many EDCs do not have existing staff dedicated to conduct aggregation review
- There will need to be interim processes as ISO DERA registration takes off before EDC aggregation review is operational
- Clear communication between aggregators, EDCs, and ISO/RTOs will be critical
- Unclear what could/should trigger a re-review of aggregation
  - Potential areas: deviation of size +/- X%, change in services provided
  - There will likely be regular aggregation rereviews as DER enrollment changes under a DER aggregation. The re-reviews may reflect entire or portions of the initial aggregation review process, depending on the size of the changes
- Sophisticated power flow modeling for every circuit and multiple scenarios is still out of reach for many utilities
- Historically there has not always been the need for coordination between assumptions in distribution interconnection process and distribution operations that will now be required
  - This will be critical to understand where, why, and when distribution overrides might happen

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Gaps
Resource Needs

- Depending on the state interconnection process requirements, the EDC may or may not need additional analytic tools to support aggregation reviews
- Increased adoption of aggregated DERs may accelerate the need for interconnection streamlining and supporting tools
- Personnel to stay abreast of evolving industry research and tools
- Additional staff time and business process development will likely be the incremental cost of aggregation review in the short term though there may also be a long-term need for further tool development

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Recommendations

- As EDCs establish an aggregation review process, they should utilize existing data from interconnection or ISO aggregation registration processes where possible to minimize the impact on all parties
- EDCs should work with RERRAs to modify existing distribution interconnection processes to include an option to indicate if a DER is intended to be included in an aggregation
- EDCs should distinguish aggregation review processes for different use cases and penetration levels
  - For example, low/medium penetration of DERs on a feeder and/or DERAs that do not provide ancillary services may be suited for a simpler process
  - High penetration DERs on a feeder and/or those providing ancillary services may require a more sophisticated process
- DER aggregators should share ISO aggregation registration data with EDCs wherever possible and make best efforts to share any updates that take place on a regular basis
- ISO/RTOs should maintain up-to-date records accessible to EDCs on aggregations currently operating or under review
- RERRA have an important role to play in approving tariffs, aggregation review processes, relevant cost recovery, adjustments to distribution interconnection, and potentially resolving any disputes that may arise

Recommendations
(continued)

- Requirements in the aggregation review process and any necessary impact studies should align with expected dispatch of the aggregation and any restrictions should be transparent for all parties
- Any new/modified processes should be feasible for EDCs of varying degrees of sophistication
- All parties should expect that these processes will evolve as DER penetrations increase and/or EDC operations become more complex

Table of Contents

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Communications, Controls, Coordination Introduction

Purpose

- This WG endeavored to analyze the issues associated with the communication, controls, metering, and coordination required to enable implementation of O.2222 in a manner that protects the safety and reliability of the distribution system without unduly impeding DERA participation in wholesale markets

Questions Considered Included the Following

- How can the EDC override of DER aggregation dispatch (noted in O.2222) work at the aggregate level, given that distribution utility problems will be more specifically related to the activities of individual DERs?
- Under what conditions would an override need to take place in less time than the bidding schedule (and what are the consequences of this)?
- What are the aggregate level vs. device level DER controls and metering/monitoring requirements that can meet utility and aggregator needs?
- How can AMI data access to DER providers be facilitated?

Key Consideration

- A key component of this work was to distinguish the requirements for controls and visibility (i.e., controls is the function of sending a signal to a device or set of devices with an expected response; while visibility is the function of the utility having information related to the real time performance of a device or set of devices)

Responsibilities and Landscape: *Communications, Controls, Coordination*

Problem

- FERC Order 2222 requires unprecedented coordination between the RTO/ISO, aggregator, and EDC. Coordination is required well ahead of the operating horizon in the context of interconnection and aggregation review. In the operating horizon, coordination is required day-ahead and in real-time. Existing tools and processes do not provide the functionality needed to enable the required coordination
- O.2222 requires the DERA to update its offers (both in terms of products and quantities/capabilities) on a day-ahead basis to allow EDC review of the impact of planned operations based on proposed RTO/ISO market clearing to ensure that no safety or reliability problems will arise on the distribution system. In real-time, EDCs may need to override an RTO/ISO dispatch of a DER aggregation when needed to maintain the reliability and safety of the distribution system

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Opportunity, Impact, and Challenges

Opportunity

- Improved coordination and communication between DERAs and EDCs in the implementation of O.2222 has the potential to:
  - Increase flexibility in the power system
  - Reduce cost and burden to both aggregators and EDCs
  - Increase reliability by virtue of greater transparency and coordination

Challenges

- Order 2222 defines the relationship between the aggregator and the ISO/RTO, but the Order leaves the various coordination functions associated with the EDC largely undefined
  - EDCs are seeking to understand how DERAs will impact distribution planning and operations
  - Aggregators are seeking ways to manage costs and streamline processes as they participate in multiple EDC/RERRA jurisdictions
  - Solutions need to minimize burdens to DERs/DERAs while maintaining or improving reliability and safety

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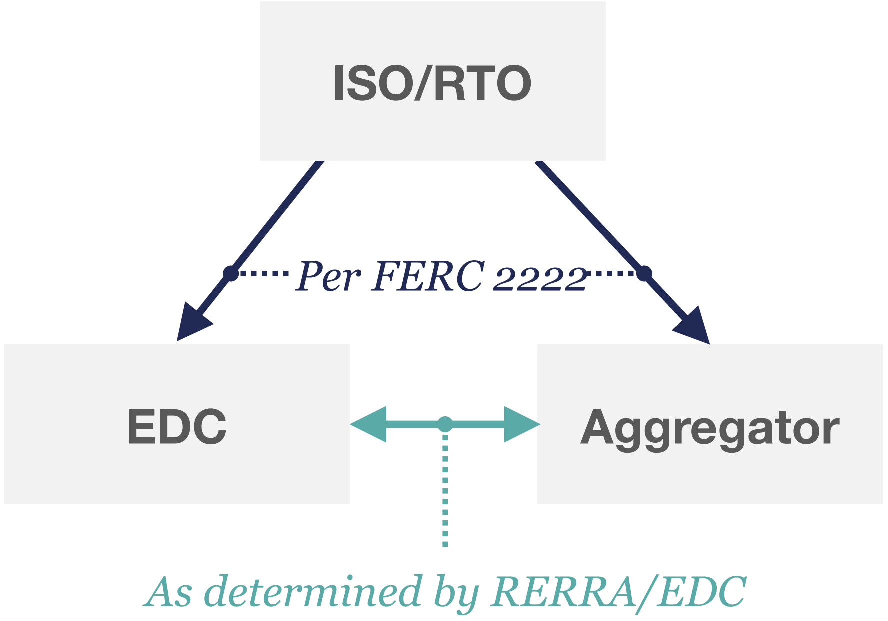
Jurisdiction and Coordination/Controls/ Communications

- Under FERC 2222, ISO/RTOs play an intermediary role between EDCs and the aggregators
  - While important, this coordination has limited value to distribution and DER operations as it is only concerned with DERA operation and override in aggregate
- Additional coordination between EDCs and aggregators related to 2222 would likely fall to EDCs and their RERRAs to develop any new coordination, communications, and/or controls
  - Expanding coordination could help to reduce/mitigate the need for overrides, increase market efficiency, and improve distribution planning/operations



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Crawl, Walk, Run Approach

- Given varying levels of DER penetration, grid modernization, and distribution grid complexity, different EDCs and RERRAs will approach the issues of coordination, communications, and controls with varying degrees of sophistication
- This group proposes taking a “Crawl, Walk, Run” approach to these issues, with stage-gating applied to flag when and where processes should proceed to the next stage

Crawl

What processes can be adapted given current or planned tools/ requirements/ processes in place while safely and reliably minimizing costs/burden for all parties?

Walk

What incremental improvements can be made to reduce costs and/or increase benefits of aggregated DERs to all ratepayers?

Run

How do we create a dynamic ecosystem that can accommodate and co-optimize value across the entire energy system safely, reliably, and cost-effectiveness?

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Key DER Aggregation Use Cases

- Recognizing controls, coordination, and metering requirements will differ based on the use case of the DER aggregation, identified use cases as combination of DERA type and grid services
  - Results in nine maximum possible use cases if each DER aggregation type and grid service are considered
- Common assumptions that DERA could be used for distribution services and/or located across multiple distribution nodes
- After considering all use cases, it became clear that key distinctions were:
  - BTM vs. FOM
  - Pure DR vs mixed/injecting only
  - As a result, only these cases were analyzed

DER Aggregation Type

- Demand response
- Behind the meter (BTM) mixed asset
- Front of meter (FOM) injecting
- BTM injecting resources

Grid Services

- Wholesale energy
- Capacity
- Ancillary services

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Guiding Principles

Controls and Monitoring - Crawl Stage

Solutions will evolve over time - following a “crawl”, “walk”, “run” sequencing over time as DER penetration increases and broader grid modernization efforts evolve

Solutions should recognize that EDCs currently have limited operational visibility into the demand side, below the distribution substation level, outside of AMI data

Recognize that DERs are heterogeneous and will require heterogenous solutions to mitigate EDC challenges; right size solutions for the use case /application

Integration of distribution SCADA and AMI information should be a priority for the EDC to enable greater visibility about grid conditions; this can be viewed as a feasible prerequisite to additional investments for additional DER device level visibility

Installations of DERs should leverage autonomous control features that have been adopted as standards – IEEE 1547- to encourage DERs to be good grid citizens in a cost-effective manner and in one that does not compound utility responsibilities

Consideration of solutions and cost recovery should consider concurrent investment in grid modernization efforts (AMI, OMS, ADMS, NMS, DERMS, DA, FAN, VVO) and how they might be leveraged to assist in coordination, communications, controls for 2222 compliance/facilitation

Solutions need to recognize that the functions of controls and monitoring are distinct processes and should not be used synonymously. As such, distinct requirements for controls, and monitoring should be developed for cost effective and technically feasible solutions

Data access barriers, such as AMI and DER operational data, must be addressed, subject to appropriate privacy and cybersecurity requirements, to facilitate implementation in the residential market (e.g., low friction models such as Smart Meter Texas)

Solutions should avoid unnecessary redundancy in monitoring and controls. Any additional requirements for utility control and/or visibility at the DER device level should consider existing aggregator controls and visibility at the DER device level. Additional requirements may be avoided with appropriate coordination procedures between the utility and DER Aggregator

Solutions should recognize that the practices, capabilities, and resources of EDCs will vary widely. EDCs of varying DER penetration, operational visibility, network configurations, and regulatory contexts will need to develop processes to accommodate 2222 compliance. There is no one size fits all

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Guiding Principles: *Coordination Framework – Crawl Stage*

- There is mutual benefit to aggregators, EDCs, and all rate-payers to increasing visibility on the distribution network where it can be done safely and securely
- Where systems exist within EDCs to share network information (such as distribution network outages or constraints), there is benefit to all parties for this information to be shared with DERAs
- Where systems exist for DERAs to share DER device level information (such as DER operational state and DA schedule), there is benefit to all parties for this information to be shared with EDCs
  - FO 2222 notes that aggregation review procedures must be established but does not require additional coordination processes between the EDC and DERA
  - However, it is compatible with FO 2222 for EDCs and DERAs to establish coordination procedures that go beyond the minimum requirements (of establishing aggregation review) if found to be beneficial

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Illustrative Application of Coordination Principles for BTM Use Cases - Crawl Phase

Note: illustrative and not meant to be prescriptive for regulators

Pre-day ahead

Aggregator likely to have data on location, technology, type, operating parameters, etc. from DERA registration

Aggregators will not likely have information on distribution system data without requesting from EDC

EDC would have data on bid capacity from aggregation review

Maintaining distribution planning assumptions that account for aggregations

Planned outages/ reconfiguration communicated between EDC and aggregator

- EDC would notify ISO/RTO of planned and forced outages as needed
- Aggregator notifies ISO/RTO of DERA outages as needed

Day ahead

EDC notification of any outages or expected distribution system constraints/aggregator notification of DER outages to ISO-RTO that may impact delivery of DERA's scheduled obligations

Formal procedures not yet defined for how EDCs or ISOs will provide notice to aggregators of distribution constraints

DA schedules following market clearing for all ISO/RTO services provided by each DERA shared with EDC (by ISO/RTO) for reliability/safety review

- Data provided by the ISO/RTO will be by service at the DERA level only
- Details of which resources may deliver the scheduled services may not be available, unless DERA's full capability is bid in each hour

Intraday

EDC notification of distribution system constraints/aggregator notification of DER outages to ISO-RTO that may impact delivery of DERA's scheduled obligations

Aggregators notified of restrictions impacting a DERA's ability to meet the DA schedule and update schedule accordingly prior to RT market closing

- Likely communicated by EDC to ISO/RTO and from ISO/RTO to aggregator

Aggregators will update DA schedules with ISO/RTO if availability of DERAs planned to meet DA schedule impacted

Real Time

Data on RT performance (either through telemetry/SCADA or alternate means) provided by aggregator to ISO/RTO at granularity specified for products scheduled

- Only break out of RT values for LMR vs injecting resources within DERA

If Aggregator providing telemetry, data provided to ISO/RTO via Direct ICCP in most cases (some ISO/RTOs may allow alternate methods)

EDC overrides in RT, due to emerging issues creating reliability/safety risks of DERAs operating (likely only power-injecting)

Settlement

ISO supplies EDC with settlement data from DERA for dual participation issues

If Aggregator is using 3rd party metering and data, may differ from utility meters (though should be small where ISO/RTO requirement for revenue grade metering)

Sub-metering BTM resources to participate separately may create additional steps necessary to reconstitute metered load to align with EDC

Key Questions on Monitoring and Controls - Crawl Stage

Demand Response Only Use Cases (Load Modifying, Non-exporting)

Will RTO participation require aggregators to install a baseline level of metering & controls to satisfy wholesale market participation?

- Yes: there is a long history of RTOs defining rules for load modifying resources, and where there are utility programs, similarly, there are many examples of baseline levels of metering and controls to support utility program participation
- Demand Response (DR) events consist of only a portion of the loading identified by customer metering. Additional submetering may not be needed (it is hard to measure how much energy "is not used") but establishing a load model for settlements may provide more reasonable value and ease adoption. This may vary between large C&I vs mass market (residential/commercial) DR, where device run time/operation data may be sufficient

What information is specifically needed by EDCs for detecting and maintaining network stability?

- Operations: there are few concerns; one caveat is that in some cases where there is very high density of DR available, pre-conditioning and/or "snap back" from DR can be a concern; generally, reliability concerns for EDCs on a real-time basis are less than that of injecting resources because DR does not change direction of power flow
- Planning: information on DR deployment (e.g., expected capacity by location) – even at an aggregate level can be helpful towards improving planning models
- Real time data may not be needed at the device level (distribution service transformer may suffice) whereas historical data (after the event) of DER specific activity is highly valuable for refining constraint model and for planning purposes

Are there additional device level controls and/or monitoring that are needed for supporting EDC reliability in the "crawl phase"?

- Generally not: operational concerns from LMRs are a low concern
- At later stages, EDC planning models can be potentially improved with more information (less about more tools, than fostering coordination between aggregator and EDC)
- The above information pertains mainly to energy/capacity markets. DR may also be used for providing ancillary services, where requirements may be more onerous

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Key Questions on Monitoring and Controls - Crawl Stage

BTM Injecting

Will RTO participation require aggregators to install a baseline level of metering & controls to satisfy wholesale market participation?

- Yes: There is a need to avoid unnecessary redundancy and this data should be the first option considered when looking to integrate DER/DERA data into distribution operations/planning

What information is specifically needed by EDCs for detecting and maintaining network stability?

- Real and reactive power is crucial due to the interconnection agreement and reactive power can be important information depending on the complexity of services DERA is providing
- Planning information (such as inverter settings) can be used to infer real-time operational conditions, particularly for power quality
- Systems may be required to support information management and flow between operational and planning tools
- EDC's will likely need to obtain/maintain a DER Asset Repository for Inverter settings and interconnection information
- Market schedules and added system level or direct monitoring for larger DER and frequency services can be required

Are there additional device level controls and/or monitoring that is needed for supporting EDC reliability in the "crawl phase"?

- In general, no, particularly for smaller systems: however, it is worth noting that requirements for controls and monitoring depends on a number of factors including (but not limited to) size of the installation and DER penetration monitoring
- For smaller devices, monitoring is typically not necessary at the device level (aggregation at the distribution service transformer may suffice; a combination of planning assumptions and line sensors in select positions can be helpful in the crawl phase)
- Large installations may include SCADA device monitoring
- At high levels of DER penetration, more visibility may be required, and aggregators should be able to provide this
- For operations, real-time data is important whereas real-time individual device data may not be essential in most cases. In contrast, for planning, granularity from the activity is crucial but not needed in real time
- For controls, the requirements will come through interconnection

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Pre-operational and Operational Gaps

- Aggregators bear market risk to the extent that they are not able to predict the frequency, duration, or degree to which distribution overrides, constraints, or outages, may interfere with market bids
- EDCs can require new capabilities to account for aggregate levels of highly coordinated services under DER/DERA market participation within planning, aggregation review, and operational models, where schedules may not be known upfront within typical study processes
- Data requirements, telemetry requirements, data flows, protocols and communication standards need to be established to give EDC's visibility of expected and actual behavior of DER/DERA for baseline development for planning, interconnection and operational model accuracy
  - This will evolve over time and need to account for differences in needs between resource types (large and/or power-injecting resources vs small and/or demand response), services, and grid context
- Few EDC's currently have advanced operational systems, tools or real-time monitoring capabilities that can support real time constraint management and operational coordination. Development of such systems would require RERRA approval

Planning Gaps

- Existing EDC planning approaches will be challenged by new consumption patterns, changing power demands and increased complexity of grid operations
- Information needs for baseline planning and interconnection model development supporting studies are more complex and need to account for DER access provisions, DER dispatch schedules and disaggregation of load and generation (see section on Interconnection and Aggregation)
- Metering of wholesale and retail tariffed services must be accounted for separately and accurately, either through direct measurement or calculation
- EDCs retain the right to set metering, communications requirements and infrastructure needs that are distinct from RTO/ISO requirements for DER participation under FERC Order 2222

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Operational Gaps

- For EDCs with Advanced Distribution Management Systems (ADMS) systems that manage outages and operate the distribution system using near real-time SCADA data:
  - As DER penetration increases, load profiles will no longer align with historical usage, and will create inaccuracy and possible operational blind spots for ADMS
  - Where adequate visibility may benefit from more localized measurements to maintain real-time visibility, additional DER telemetry and/or day-ahead forecast/schedules may be required
- Maintaining grid-edge voltage quality is essential to provide ongoing reliability and efficiency to all connected customers, as often required by state regulations
- To maintain voltage quality to all customers under increasingly more complex operational conditions, EDCs and DERAs will also need to proactively incorporate advanced voltage management systems and adjusting smart inverter setpoints at a minimum
- Aggregators face challenges regarding access to meter data for settlements
- Better communication and coordination are required to scale DERs in the wholesale markets
- It is not clear what types of information and calculation methodology should be used for heterogeneous DER aggregations that might include a mix of power injecting (and measurable) vs. load modifying resources

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Operational Gaps

- As backflows increase, increased visibility and more complex operational capabilities including use of DER advanced capabilities can be required for voltage and capacity management under daily, maintenance and contingency operations
- Increasing levels of backflow may require more direct control of individual DERs to support grid operations
- EDCs without ADMS may not have visibility beyond SCADA at the feeder head; these EDCs may be more reliant on maintaining operational margins for safety and reliability
- Compared to transmission, distribution systems incur more and lengthier outages due to exposure to environment
- EDC operational coordination capabilities to inform day-ahead markets may be limited and will vary between EDCs

Conclusions

- More complex operational capabilities may be required to support system operations, particularly as EDCs move to “walk” and “run” stages
- To maintain operational visibility, a combination of methods may be required, including:
  - Direct telemetry measurements for larger power-injecting DER
  - Direct telemetry for DER providing ancillary services
  - Allocation methods based on aggregation schedules and DER locational information within scheduled aggregations
- The more visibility and certainty EDCs have, the more EDCs can accommodate DERs
- ISOs/RTOs need to provide a reasonable amount of time for EDCs to complete reliability analysis of the DERA dispatch schedule
- Solutions should recognize that the practices, capabilities, and resources of EDCs will vary widely. EDCs of varying DER penetration, operational visibility, network configurations, and regulatory contexts may require differing processes to accommodate 2222 compliance. There is no one size fits all.

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Recommendations

- Do not assume a complete solution will be implemented immediately; follow a “crawl, walk, run” approach. Start with least regrets deployments
- At the early stage, scrutinize whether additional investments in communications, monitoring and controls above what the RTO/ISO and the interconnection procedures will require are necessary
- Consider if there are simple and lower cost approaches for fostering coordination, controls and visibility between EDCs and aggregators
- The functions of controls and monitoring are distinct, and these terms should not be used synonymously; distinct requirements should be developed
- Requirements on controls, coordination, and monitoring for various types of DERs can be very different
- DER installations should leverage autonomous control features that have been adopted as standards, such as IEEE 1547

Recommendations
(Continued)

- For distribution overrides, there may be two levels of overrides:
  - **Soft override** where aggregator can act based on early notice from EDCs
  - **Hard override** where EDC directly curtails or interrupts DER for safety and/or reliability purposes
- The need for hard vs. soft overrides will depend on circumstances and degree of coordination between EDC and aggregator
  - Soft overrides will be the preferred option in non-real time applications and demand response
  - Hard overrides will be a last resort where system reliability or safety is at risk
- Level of automation (i.e., machine-to-machine) vs. manual communication will depend on level of complexity, existing tools at the EDC/aggregator, DER penetrations, and/or grid topology
- Setting clear expectations and open communications between EDCs and aggregators on drivers and likely conditions that lead to distribution overrides will benefit all parties

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Recommendations

(Continued)

- EDCs alerting aggregators prior to bidding windows and aggregators adapting bidding behavior to expected conditions from EDC could help to alleviate the need for hard overrides
- Support foundational EDC actions that bring greater visibility into the distribution system (such as linking AMI with SCADA and/or ADMS); these can be part of broader grid modernization efforts
- The EDC functions of planning and operations are distinct. Any proposed hardware/software investment should be understood in the context of how they support these distinct functions, and how the EDC plans to institutionalize these new procedures and the feasibility of doing so vis-à-vis current planning and operations
- For small DER applications (especially residential DR), access to AMI data has been a barrier; consider frameworks that reduce friction for aggregators to access AMI data and/or create systems that don't require aggregators to access AMI data by coordinating the data exchange between the EDC and ISO/RTO
- Low friction aggregator access to relevant meter data for settlement purposes and low friction utility access to relevant metering and controls data for planning, operation and settlement purposes need to be specified and mandated by applicable RTO/ISO tariffs and/or state jurisdictional tariffs in order to scale DERs in wholesale markets

Table of Contents

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Dual Participation Introduction

Dual Participation Issues Covered

Purpose

- Order No. 2222 requires all RTOs/ISOs to provide aggregated DERs with access to the wholesale markets. FERC defined DERs as any resource located on the distribution system, any subsystem thereof or behind a customer meter. This could allow the same DER aggregation to provide both wholesale and retail services, known as dual participation. Enabling dual participation will require thoughtful construction of both RTO/ISO-level market rules and state-level programs, reasonable oversight, and appropriate compensation for participating resources. This WG sought to identify the potential opportunities and challenges to enable dual participation and develop recommendations with respect to addressing those challenges.

Challenges

- Double Counting: To the extent that a DER's wholesale participation coincides with the LSE/EDC peak demand and that participation impacts the amount of capacity for an ISO or LSE/EDC to procure, the DER's wholesale activities will need to be added back to the peak load to ensure the ISO or LSE/EDC can accurately plan for system peak demand
- Double Compensation: Absent mechanisms to prevent duplicate payments, DERs engaged in dual participation may inappropriately receive compensation for the same service within the same time interval at both wholesale and retail levels
- Operational Compatibility: There could be instances when wholesale participation and retail obligations conflict with one another

Opportunity

- Some states and RTOs/ISOs already have retail and wholesale constructs for dual participation while others may need to implement new constructs. RERRAs will continue to have a key role, as recognized by FERC, particularly as it relates to oversight and design of retail programs. A thorough understanding by all parties of best practices and considerations will facilitate the regulatory decision-making process and pave the way for DER dual participation in a way that appropriately balances the interests of DER owners and aggregators, distribution utilities, and retail customers

Current Landscape

FERC Guidance on Double Counting and Double Compensation

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FERC requires RTOs/ISOs to allow DERs to participate in both wholesale and retail programs, but...

- Allows RTOs/ISOs to "limit the participation of resources in RTO/ISO markets … that are receiving compensation for the same services as part of another program" (O2222 P 159)
- FERC requires the ISOs to "include any appropriate restrictions on the DERs' participation in RTO/ISO markets … if narrowly designed to avoid counting more than once the services provided" (O2222 P 160)

FERC provided guidance on double counting and/or double compensation and allowed restrictions to prevent double counting. Examples include:

- DERs registered to provide the same services either individually or as part of another RTO/ISO market participant, or
- DERs included in a retail program to reduce a utility's or other load serving entity's obligations to purchase services from the RTO/ISO market" (O2222 P 161)

Current Landscape

FERC Guidance on RERRA Jurisdiction Over Dual Participation

FERC considered the bounds of RERRA jurisdiction over DER wholesale market participation, particularly as it relates to wholesale/retail participation

- "A RERRA cannot broadly prohibit the participation in RTO/ISO markets of all distributed energy resources or of all distributed energy resource aggregators" (O2222 P 58)
- However, "under a RERRA's jurisdiction over its retail programs, such a regulatory authority is able to condition a DER's participation in a retail DER program on that resource not also participating in the RTO/ISO markets" (O2222 P 61)
- This provision "should allow [RERRAs] to mitigate any double-compensation concerns" (O2222 P 162)

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Current Landscape

Existing Constructs For Dual Participation

- NYISO's market rules have allowed resources that provide wholesale market services to also provide services to another entity (e.g., the utility or a host facility) since May of 2020. Certain demand response programs have allowed dual participation as early as 2001
- Resources engaged in dual participation are required to:
  - Comply with all NYISO market rules for services offered to the wholesale market
  - Appropriately offer into the wholesale markets to reflect any non-wholesale (e.g., retail) obligations
- Although NYISO needed to ensure that its tariff complied with Order No. 2222, the New York construct can provide instructive examples for thinking about dual participation in other contexts

New York ISO Independent System Operator

- New York utilities have also developed retail tariffs and programs to dovetail with the NYISO dual participation construct while providing support to its distribution system
  - Examples are shown on the following page

nationalgrid Orange & Rockland conEdison PSEG LONG ISLAND Central Hudson Gas & Electric Corporation RG&E NYSEG

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Current Landscape

Existing Constructs For Dual Participation (continued)

Select New York Retail-Level Programs for DERs as of Fall 2021

Retail Level Program	Overview	Compensation Structure	Is dual participation allowed by utility tariff/contract?
Distribution Load Relief Program (utility tariff)	Compensates DERs for providing relief during distribution-level contingencies. Two-hour notification	Availability payment ($/kW-mo subject to performance) during summer months and per event energy payment	Yes, full wholesale participation allowed, but no energy payments if dispatch overlaps with NYISO dispatch
Commercial System Relief Program (utility tariff)	Compensates DERs for providing relief during utility network/utility system peaks	Availability payment ($/kW-mo subject to performance) during summer months and per event energy payment	Yes, full wholesale participation allowed, but no energy payments if dispatch overlaps with NYISO dispatch
Value of DER (utility tariff)	Compensates injecting DERs for providing different value streams, including distribution relief value, locational system relief value, capacity, energy, and environmental	Based on value stack and performance during value stack hours (e.g., distribution relief value summer weekdays 2-6, capacity during system peak hour)	No, since the value stack includes all wholesale values except ancillary services. Capacity value provided through reduction to utility's wholesale capacity requirements and credited to DER
Non-Wires Solutions (utility bi-lateral contracts)	Utility contracts for non-wires solution for defined periods of time with DER provider	Case-specific	Case-specific: contracts may include details on prohibition of dual participation for certain wholesale products or during certain time periods

Areas of Alignment

To the extent that wholesale and retail services are wholly distinct products, do not pose operational conflicts, and do not result in double compensation, then this would be an allowable form of dual participation

RERRAs will have an important role in regulating dual participation

Constructs for dual participation should ensure that double counting and double compensation do not occur

Constructs for dual participation should ensure that resources can reliably satisfy both retail and wholesale obligations

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Recommendations

Double Counting

Challenge

- Both RTOs/ISOs and LSEs/EDCs may rely on wholesale participating DERs to ensure reliability. Absent mechanisms to prevent entities from including the same capacity in their load and supply forecasts, both sets of entities could rely on the same resource at the same time
  - To the extent that a DER's wholesale participation coincides with the LSE/EDC peak demand and that participation impacts the amount of capacity for an RTO/ISO or LSE/EDC to procure, the DER's wholesale activities will need to be added back to the peak load to ensure the ISO or LSE/EDC can accurately plan for system peak demand

Recommendation

- Load forecasting reconstitution practices exist today for wholesale DR in markets such as NYISO and ISO-NE; other grid operators can leverage these existing practices for DERs

Recommendations

Double Compensation

Challenge

- Absent mechanisms to prevent duplicate payments, DERs engaged in dual participation could inappropriately receive double compensation for the same service within the same interval at both wholesale and retail levels
  - Ex. 1: There are retail interruptible tariffs that include wholesale capacity revenues as part of the participant's value stream. A DER participating in the retail tariff would receive double compensation if it also sold its capacity as part of a DERA
  - Ex. 2: If the same DER is providing energy during the same interval in response to a DERA's wholesale energy market schedule during an interval where it is providing distribution system support that also compensates for energy, it could be compensated twice for the same kWh during the overlapping dispatch intervals

Recommendations

Double Compensation (continued)

Recommendations

- RERRAs should establish a process through which the utility can identify where duplicate compensation may occur and RERRAs should develop appropriate mechanisms to prevent duplicate compensation (e.g., eligibility criteria in the aggregation enrollment and review, including ways to operationalize those criteria)
- Consideration of, and accounting for, instances of dual participation where a DER's capability may be split to provide more than one distinct wholesale or retail service in a given interval
  - ISO/RTO participation models for joint ownership may be an example of how dual participation could be structured
- New York utilities' CSRP and DLRP tariffs provide useful models for preventing double compensation of energy
- Periodic re-review (annually, at minimum) may be necessary to affirm double compensation is not occurring once the DER is operating and engaged in dual participation. If instances of double compensation are found to have occurred, it may be appropriate to implement mechanisms which would correct for the duplicate revenue arising from overcompensation

Recommendations

Operational Compatibility

Challenge

- There could be instances when wholesale participation and retail obligations conflict with one another

Recommendations

- DER Aggregators should update the DERA's operational status to the ISO to appropriately reflect any retail activities and/or obligations of DERs that comprise the DERA that impact resource availability for wholesale services. Therefore, if DERs are dispatched for retail-level purposes, ISOs/RTOs will have visibility and account for this activity
- Retail tariffs and contracts should have guidelines for governing DER dual participation (such as identifying incompatible wholesale market services), with consideration for both normal and emergency operations at the bulk- and distribution-system levels
  - For instance, if a battery storage device is providing a Non-Wires Solution to Distribution Utility for a certain window, the storage should be required to maintain the state of charge necessary to meet its retail-level obligation, and to notify the ISO/RTO that the storage device will not be available for wholesale dispatch in the hours leading up the NWS dispatch (such as via an outage management system, DERA adjustments to wholesale market schedules, or other notification mechanism)

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Recommendations

RERRA Roles In Regulating Dual Participation

Context

- The RERRA's role of developing guardrails within retail tariffs and/or contracts to address dual participation is important to facilitate DER access to wholesale markets and to provide all services, at both wholesale and retail levels, for which it is capable
  - RERRAs have the option of precluding DER participation in specific retail tariffs, contracts, or programs if the DER is participating in a DERA*
  - RERRAs have responsibility to regulate the aggregation review process and ensure instances where dual participation is prohibited are enforced
  - RERRAs may offer clarity on the compatibility of retail programs with wholesale participation
  - Additional investments in EDC systems may be required to facilitate dual participation (see Investment Recovery and Cost Causation section for more discussion)

Recommendations

- RERRAs should proactively collaborate with utilities, DERs, Aggregators, and RTOs/ISOs to develop dual participation rules that are transparent and accommodate DER capabilities while preventing those issues outlined earlier in this document
  - For example, RERRAs in states without existing dual participation constructs may consider pilots to test dual participation frameworks
- RERRAs should recognize that on-site metering will be necessary to facilitate wholesale participation and/or participation in retail programs

**Note that as of the time of this writing, the full extent of RERRAs' ability to preclude DER participation is the subject of ongoing dialog at FERC, particularly as it relates to the state opt-out under Order 719. The item denoted here refers more specifically to the language in paragraph 61 of Order 2222*

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Additional Considerations and Areas for Future Discussion

Areas Needing Additional Discussion

- Frequently dispatched DERs may be subject to baseline erosion. While this is not unique to dual participation, the provision of both wholesale and retail services could exacerbate this issue
- Measurement and verification considerations related to dual participation will require further discussion, particularly highlighting the need for transparency and consistency of methods for assessing performance in retail and wholesale situations
- Dual participation by DERs in a DERA may introduce additional considerations for LSE's load bids which need to be addressed in a market setting (although this issue extends beyond just dual participation)
- Potential for multiple aggregators to represent a single resource could introduce complexity, particularly in the early stages of implementation

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Table of Contents

Identification of Potential Costs

Implementation of Order No. 2222 will result in incremental distribution level costs. The timing and level of at least some of the investments required to implement O.2222 may depend on the pace of DERA participation in wholesale markets. Further, some of these costs may have been experienced due to organic growth of DERs even without O.2222

1. **Interconnection Studies & Upgrade Costs**
2. **Utility Review of DERA Registration Requests**
3. **Day-to-Day Utility Management of DERs**
4. **Investments to Increase or Maintain Hosting Capacity**
5. **Wholesale Market Access Charge**

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1

Interconnection Studies & Upgrade Costs

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Explanation of Potential Costs

- In Order No. 2222, FERC declines to exert jurisdiction over DERs interconnecting for the purposes of participating in the wholesale markets through an aggregation, meaning that states have jurisdiction over the interconnection process and allocation of associated costs
- Interconnection studies—and especially any needed upgrades that they identify—can be time-consuming and resource intensive. These studies (which are required for all DERs independent of wholesale market participation and DERA review) evaluate the impact of interconnecting resources to the distribution system (and potentially impacts on the transmission system)
- Generally, interconnection studies and upgrades are paid for by the DER developer/owner
- Utilities may require additional staff and analytical tools to manage incremental DER interconnection requests, and the potential increased complexity of DER interconnection studies as DER penetration increases

Bottom Line

- While Order No. 2222 may lead to higher DER penetration, incremental interconnection requests, and a potential increase in needed upgrades or operational changes to address transmission and distribution system impacts, the approach and cost allocation of these studies and upgrades for interconnection is not expected to change significantly or to differ between DERs that do and do not participate in wholesale markets

2

Utility Review of DERA Registration Requests

Explanation of Potential Costs

- Implementation of Order No. 2222 will add a new responsibility for distribution utilities to review DERA registration requests. Distribution utilities will need to analyze the impacts to the system from changes in DER operation associated with wholesale market participation
- Aggregation review may in some cases require new analysis of distribution system impacts, where there is high penetration of DERs, wholesale services that may conflict with distribution system needs (such as frequency regulation), or the inclusion of coincident load modifying resources may impact reliability or safety
- Utilities may require additional staff to develop and manage DER aggregation review and re-registration review processes in a timely fashion (as specified in ISO/RTO tariffs), as well as manage any disputes that may arise, and may also require additional planning software to track information on all DERs within the system, including their interconnection status, DERA registration and dual participation status and all associated data

Bottom Line

- For most Distribution Utilities, DERA registration review may result in increases in operational labor resource needs and perhaps require tools beyond those currently in use for interconnection studies. There may be some additional upfront cost to integrate data from ISO/RTO DERA registration processes

3

Day-to-day Utility Management Of DERS

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Specific Costs May Include

- Metering - Installation of metering by utilities (or 3rd parties) capable of achieving ISO/RTO's and/or state metering and telemetry requirements)
- Communication networks (fiber may be needed to support high-frequency data flows)
- Distribution system monitoring upgrades (additional distribution system hardware may be needed to monitor flows and injections from DERs in order to maintain reliability and safety)
- Increased staffing and analytical support (to manage distribution system planning, coordination w/ RTO, DER aggregators, and RERRAs; to monitor and manage operations of DERs, including review of offers into specific ISO/RTO market(s), and as needed controlling or overriding asset dispatch to maintain reliability and safety; and to track dual participation by DERs
- Software tools, including operations software to manage the operations and control of DERs and DERAs, which may include interfacing with DER aggregators and ISO/RTO software, as well as DERMS platform; cybersecurity upgrades to ensure all data transfers comply with applicable cybersecurity requirements; and customer management & billing software to coordinate payments between DER aggregators and customers); and new and modified planning and forecasting analytical tools

3

Day-to-day Utility Management Of DERS

(continued)

Explanation of Potential Costs

- Utilities are responsible for maintaining distribution-system safety and reliability, day-to-day and minute-to-minute, and will need to account for the impacts of DERs on the distribution system, including those participating in RTO/ISO markets. Issues that may need to be addressed include DER tracking, managing load forecast changes in light of DER activity (in particular, DR), receipt of metering and telemetry data, information sharing with the RTO/ISO, real-time analysis, system switching and redispatch, etc. These activities will need to occur both day-ahead and in real-time and will likely rely on a combination of automated systems and tools and utility staff to run and review these processes, conduct real-time planning, and perform other related functions
- Some of these costs may not be necessary until the walk/run stages of DERA participation. (See the interconnection and communication/controls/coordination sections for a description of crawl/walk/run stages)

3

Day-to-day Utility Management Of DERS

(continued)

Bottom Line

- The incremental hardware, software products, and other tools that may become necessary to perform these activities could entail significant capital expenditures as well as ongoing costs for personnel, training, operations, and maintenance
- The immediate impacts of these costs may be ameliorated to the extent that existing tools (e.g., processes and software used to enable DR participation in wholesale markets) can be relied upon at least in part. In some cases, further system and staff additions may be required on an incremental basis as penetration of DERs participating in wholesale markets increases
- Some of these systems and processes, such as advanced meters, may provide benefits independent of facilitating DERA participation in wholesale markets. Such benefits can be factored into the determination of the most appropriate cost allocation mechanism

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4

Investments to Increase or Maintain Hosting Capacity

Explanation of Potential Costs

- Utilities make decisions and investments in distribution system capacity based on anticipated future service needs, including load growth. These costs are generally included in embedded cost rates and allocated to all customers through retail distribution rates
- Growth in DERs participating in wholesale markets may erode some of the capability of the distribution system to accommodate DERs for individual customers or retail purposes. Distribution investments may be needed to increase DER hosting capacity

Bottom Line

- States may wish to evaluate whether and how excess distribution system capability built for future retail needs should be preserved for such needs or utilized to accommodate DERs that may participate in wholesale markets

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5

Wholesale Market Access Charge

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Explanation of Potential Costs

- Delivering energy from distribution-connected resources to the transmission system requires use of the distribution system; distribution wheeling is the cost associated with this use
- For energy used locally without the need for transmission system resources; distribution wheeling charges may not apply

Bottom Line

- There is ample FERC precedent for application of these charges, which are subject to FERC jurisdiction and would require FERC approval

Summary of Potential Costs

Cost Category	Hardware Costs	Staffing and Analytical Costs	Software Costs
Interconnection Studies & Upgrade Costs	Metering, telecommunications, general infrastructure and interconnection upgrades (if necessary)	Additional staff and analytical support may be needed to accommodate incremental volume of DER interconnection requests and the increased complexity of DER interconnection studies	Updated billing & customer tracking systems Modeling upgrades to incorporate DER and DERA forecasts and behaviors into all studies
Utility Review of DERA Registration Requests	Metering upgrades (if necessary)	Potential need for additional operational staff to facilitate timely DERA review and manage any disputes	Additional or incremental software tools over and above those used for interconnection studies may be required. In addition, software to track all DERs within the system (including their interconnection and aggregation status) may be needed
Day-to-day Utility Management of DERs	Communication hardware and telecom backbone; and distribution system monitoring upgrades, and augmented billing systems may be needed	Additional staff may be needed to accommodate increased system planning demands, DER operations coordination, and monitoring dual participation by DERs providing both wholesale and retail services	Potential need for operations software, cybersecurity software, and upgrades to customer management and billing software
Investments to Increase or Maintain Hosting Capacity	Distribution investments may be needed to increase DER hosting capacity	Additional staff likely needed to review proactively and retroactively how DERA assumptions and actual activities fit with original assumptions and plans. Increased rigor in hosting capacity analysis and periodic re-review of DERA assumptions	Investments to ensure hosting capacity meets DERA resources and data analysis needs for accurate and timely reporting requirements
Wholesale Market Access Charge	Additional upstream metering may be needed to properly allocate in-network power flow to multiple transmission connections or across switching points for non-radial networks	Additional distribution utility staff resources may be needed to develop wheeling rates and pursue approval through FERC processes	

Note: Some of the above costs may need to be incurred by the EDCs regardless of FERC Order 2222

Areas of Alignment

Recommended Considerations by Which to Evaluate Proposed Investments[1]

1. Identify costs required to enable DERs sited on the distribution system to participate in wholesale markets

2. Identify relevant benefits of enabling DER penetration in wholesale markets

3. Avoid duplication of DER benefits in benefit cost analysis

4. Establish an objectively quantifiable basis for measuring, quantifying, and allocating relevant identified benefits and costs

5. Equitably allocate costs between retail customers, DERs, and aggregators, taking into consideration applicable benefits and implications of any cost shifts to retail customers

[1] These principles are focused on costs incurred at the distribution level; costs incurred by RTOs/ISOs are expected to be recovered through existing RTO/ISO cost recovery mechanisms

Areas of Alignment

Guiding Principles

Wherever possible, aggregation review should leverage data/terminology/processes coming from interconnection, DERA registration

Interconnection is, and should remain, the jurisdiction of EDCs and their local regulators

- *While there may be consistency between local contexts, there will invariably be differences due to state policy priorities, utility business models, and/or varying grid conditions*

DERA registration is, and should remain, the jurisdiction of ISOs/RTOs

- *While there may be consistency between ISO/RTOs, there will invariably be differences*
- *Aggregation review will fall under state regulator jurisdiction. Coordination will be required among regulators, ISOs/RTOs, and EDCs*

Aggregation review process should be distinct, and balance efficiency with the need to evaluate the safe and reliable operation of the system, and avoid undue barriers to DERA deployment

Aggregation review should be inclusive of power-injecting and load-modifying resources

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1

Identify costs required to enable DERs sited on the distribution system to participate in wholesale markets

- A first step to evaluating appropriate costs is identifying those costs (see slide 65)
  - Regulators should keep in mind that all investments may not be known initially, and that it may be feasible and appropriate to phase-in some of these investments over time as penetration of DERs participating in wholesale markets increases
- While there will be costs specifically related to wholesale market participation by DERs, growth of DERs is also happening independent of wholesale market participation. Consideration should therefore be given to the appropriate allocation or attribution of costs of systems that provide capabilities beyond enabling participation of DERAs in wholesale markets
  - For example, investments in advanced metering infrastructure (AMI) or distribution energy management systems (DERMs) may be proposed to meet retail-level needs in addition to helping to facilitate DERA participation in wholesale markets

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2 Identify potential benefits associated with DER penetration that may result from enabling wholesale market participation

Benefit	Description	Benefits to Dist. & Trans. System	Benefits to All Customers	Benefits To DER Owners/ Operators
Resilience	Depending on size, location, configuration, DER penetration on a feeder, and market services provided, local resiliency may benefit from DERs sited on the distribution system. Increased on-site resilience due to ability to self-serve a portion of electricity needs on-site (depending on technology and configuration); this will be more valuable for some customers than others (e.g., hospitals and supermarkets will likely place higher value on resilience than other businesses or residential customers)	X	X	X
Reduced System & Supply Costs	DERs may help reduce the need for transmission and distribution capacity investment or help alleviate congestion. Potential for reduced wholesale supply costs if DERs result in lowering market clearing costs	X	X	
Flexibility	Dispatchable DERs may provide regulation, ancillary services, and voltage control that can help with the integration of intermittent generation sources, provide demand response, or make loads more flexible and dispatchable	X	X	
Societal Benefits	DERs may provide benefits that accrue to society at large including attainment of state/local policies & regulations (e.g., GHG reductions, reduced public health costs, local econ development, reduced electric bills for all customer classes, potential for improved environmental justice outcomes, and increased energy security)		X	
Wholesale Revenue	Revenues earned from providing wholesale market services			X
Improved DER Cost-Effectiveness	Increased utilization and additional revenues enabled through access to wholesale markets may improve the cost effectiveness of DERs for some customers, and make DERs more accessible for customers and communities			X
Bill Savings	Reduced electric bills due to ability to self-serve a portion of electricity, reducing overall consumption and/or peak demand			X
Incentives	Depending on the technology utilized, potential tax incentives may further improve the cost-effectiveness and return on investment			X

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2

Identify relevant benefits of enabling DER penetration in wholesale markets
(continued)

- When evaluating potential benefits, regulators should keep in mind:
  - The extent to which benefits considered are also delivered by non-DER resources (such as zero carbon resources) and whether DERs warrant separate consideration
  - The potential for DERs in some situations to exacerbate rather than alleviate issues on the grid, which may offset some or all benefits (e.g., congestion, distribution feeder instability, safety concerns)
  - Whether the benefits accrue to all customers or a subset of customers (e.g., DER owners)
  - Costs for non-participating customers may increase

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3

Avoid duplication of DER benefits in benefit-cost analyses

- When conducting benefit-cost analyses, evaluating whether benefits should be applied to offset costs allocated to DERs/DERAs to enable participation in wholesale markets, states should ensure that the same benefits have not already been incorporated into credits or offsets associated with other elements of such analyses
  - For example, if interconnection costs are offset for DERs to capture reduced distribution investments, those system distribution investment savings should not also be used to justify a reduction in other costs assigned to the DER absent a rational justification

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4

Establish an objectively quantifiable basis for measuring, quantifying, and allocating relevant benefits and costs

- Any costs borne and recovered by Distribution Utilities for the purpose of facilitating DER participation in wholesale markets should be subject to appropriate state oversight and approval processes
- When considering the costs and benefits of DERA participation in wholesale markets, such costs and benefits should be objectively quantified; however, mechanisms may be needed to assign costs and benefits when these items are difficult to quantify
- Some participants pointed to existing examples of benefit-cost analysis (BCA) frameworks and principals that could be considered as potential models, although the working group did not review or endorse these examples.[2]

[2] Benefit-Cost Analysis Handbooks published and updated by the various New York utilities (see ConEdison Electric Benefit Cost Analysis Handbook, Version 3.0, Chapter 4, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b991161C9-1125-4A47-81EA-BCD73081D327%7d; NYSEG and RG&E Benefit Cost Analysis Handbook, Version 3.0, Chapter 7, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BC6575ECA-9A6F-4D13-A1F5-7E71FE3DF9CF%7D), and the National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (Chapter 2), https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-DERs_08-24-2020.pdf.

5

Equitably allocate costs and benefits identified that may be borne and realized by retail customers, with consideration of social justice

For costs deemed prudent for recovery from retail customers consistent with the recommendations above, these costs should be allocated fairly and in a way that reflects the flow of benefits as well as equity and cost burden considerations

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Selection of Appropriate Mechanism

- Likely mechanisms to consider for O.2222 related cost recovery include:
  - Upfront charges to DER host (e.g., via interconnection) and/or aggregators (e.g., through aggregation review)
  - Usage charges to aggregators through wholesale distribution access (e.g., wheeling) charges
  - Recovery through retail rates (either through general rate case or rider/tracker)
- When choosing the appropriate recovery mechanism for a given cost there are two sets of considerations:
  - What is the appropriate mechanism given regulatory rate-making principles?
  - What are the likely consequences on the market and market actors (utility, aggregators, and ratepayers) over the short and long term of choosing a given mechanism?

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*Principles of Rate-Making and O.2222**

Regulators Should Consider Cost Recovery Mechanisms Using Rate-Making Best Practices

- Just and reasonable
- Simple and understandable
- Broadly acceptable
- Free from controversy in interpretation
- Stable
- Non-discriminatory

**Much of this slide borrows from: Rábago, K. and Valova, R. (2018) "Revisiting Bonbright's principles of public utility rates in a DER world" The Electricity Journal, vol 31 issue 8 https://psc.ky.gov/pscecf/2020-00174/dspenard%40strobobarkley.com/11022020033905/2020.11.02_kpc_16_attachment_Rabago_and_Vaolva,_Revisiting_Bonbright.pdf*

In the Context of the General Rate Making Principals above, the Factors Below May Warrant Consideration

- Reflect resource value
- Grounded in a careful assessment of practical economic impacts on all actors, especially non-participating customers
- Be aligned with State regulatory and policy goals in DER development
- Designed to account for incentives they create for utilities, customers, and third-parties
- Just and reasonable rates require accurate accounting for utility costs
- Rate design and cost allocation are separate functions, driven by distinct policy objectives

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Consequences of Reliance on Different Cost Recovery Approaches

Upfront Charges

- Simple and direct accounting
- Incentivizes efficient siting with respect to the distribution grid
- Avoids cost shifts to non-participants (though not necessarily between DER/aggregators)
- Higher upfront costs for DER owner/operator and aggregator
- May create “free rider” issues between DER owners/operators

Usage Charges

- Provides ongoing utility cost recovery over life of participation
- Could optimize the bidding activity and incentivize efficient operation of DERAs
- Could cause conflicting market signals and discourage participation during periods of distribution grid constraints
- Cyclical with market conditions

Recovery through Rates

- Lowers uncertainty/volatility in DER/aggregator costs
- Allows for bundling of diverse set of costs/benefits
- Depending on rate structure, may not provide direct price signal for beneficial siting of DERs
- Can be more complex for regulators/EDCs
- Can potentially shift costs to non-benefiting ratepayers

Recommendations for Policymakers

- Consider the following potential cost categories:
  - Interconnection studies and upgrade costs
  - Utility review of DERA registration requests
  - Day-to-day utility management of DERs
  - Investments to increase or maintain hosting capacity
  - Distribution wheeling
- Follow the five proposed guiding considerations when evaluating all utility investments that relate to Order No. 2222:
  - Identify costs required to enable DERs sited on the distribution system to participate in wholesale markets
  - Identify relevant benefits of enabling DER penetration in wholesale markets, which may include ratepayer, societal, utility system, environmental, social justice, and DER owner/operator benefits
  - Avoid duplication of DER benefits in benefit-cost analyses
  - Establish an objectively quantifiable basis for measuring, quantifying, and allocating relevant identified benefits and costs of enabling DERs to access wholesale markets on the distribution system
  - Equitably allocate costs associated with DER participation in wholesale markets among retail customers, DERs, and DERAs
- Take into account state-specific circumstances, such as state policy objectives and retail programs intended to capture DER value, etc.

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Table of Contents

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Conclusion

- *DER aggregation in wholesale electricity markets under Order 2222 presents unique opportunities and challenges*
  - Opportunities to increase utilization of DERs, reduce consumer costs, and increase reliability and flexibility
  - Challenges rooted in the unprecedented coordination and collaboration that will be required between DER owners and aggregators, distribution utilities, RTOs/ISOs, and state utility regulators
- *Order 2222 implementation will only be successful for customers and grid reliability with active engagement from state utility regulators*
  - State commissions have jurisdiction over utility investments (e.g., advanced metering) and processes (e.g., interconnection review) that will evolve as DER adoption, and aggregation of DERs in wholesale markets grow
  - State commissions will be at the forefront of addressing the opportunities and challenges of Order 2222, since they impact utilization, safety and reliability of the distribution system
- *This collaboration sought to develop a framework for state regulators to navigate key issues at the intersection of wholesale and retail markets that are raised by Order 2222 implementation*
  - Issues examined: 1) Interconnection and Aggregation Review, 2) Communications, Controls, and Coordination, 3) Dual Participation, and 4) Investment Recovery and Cost Causation

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Conclusion
(continued)

- ***Existing processes and tools developed by states, distribution utilities, and stakeholders to support DER integration should be built on to facilitate Order 2222 implementation***
  - For example, existing interconnection processes and standards, distribution system planning and hosting analyses, models for defining and managing dual participation (e.g., New York), and investments in AMI and software tools should all be leveraged
  - Existing data collection under these and other processes and tools can also be utilized for Order 2222 implementation; reducing friction in accessing this data can improve outcomes for DER aggregators, distribution utilities, and customers
- ***In the future, processes and tools adopted by states and utilities related to DER adoption and integration should anticipate participation in wholesale aggregations***
  - For example, interconnection processes for new DERs, hosting capacity analyses, and other tools should include wholesale market participation as a consideration
  - States should allow for evolution as growth in DERs occurs and grid needs change

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Conclusion
(continued)

- ***New requirements and investments to support Order 2222 implementation should be aligned with the services provided and scaled as participation increases***
  - Requirements should be aligned with the needs created by the use case and the services being provided; for example, some wholesale services (like ancillary services) may call for more detailed communication and control requirements than others (like capacity)
  - A "crawl, walk, run" approach should be used for developing and implementing requirements and approaching investments needed to support Order 2222 participation; "least regrets" deployments should come first
- ***Processes, tools, and policies enacted to support Order 2222 implementation must set clear expectations of all participants***
  - Communication and coordination obligations, the wholesale services that DERs participating in retail programs may provide, and the circumstances that may result in distribution utility overrides of DER dispatch, are just some of the examples of areas where clear expectations must be defined to ensure successful implementation and avoid disputes

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Conclusion
(continued)

- ***Equitably addressing the potential incremental distribution-level costs of Order 2222 implementation requires identification of a range of potential costs and benefits***
  - Potential costs include hardware (e.g., metering), staffing and analytical costs (e.g., increased labor to review DER aggregation requests), and software (e.g., billing system upgrades)
  - Potential benefits include increased resilience, reduced system costs (avoiding other investments), enhanced system flexibility, and increased cost-effectiveness of DERs for customers
  - Regulators should carefully apply principles of ratemaking to allocate costs among DERs, DERAs, and retail customers based on identified benefits, taking into account state-specific circumstances such as state policy objectives and retail programs intended to capture DER value
- ***State regulators could consider establishing dedicated forums to examine and address the complex distribution system issues identified in this report***
  - Existing forums are generally focused on RTO/ISO market rules needed to comply with Order 2222, and do not consider the key distribution-level issues addressed in this report
  - Ordinary rate cases or grid modernization proceedings may not capture the unique opportunities and challenges of Order 2222 implementation, and it may be difficult for non-utility stakeholders to participate in them
  - Forums could develop guidance for utility filings and future retail DER program design

DISCLAIMER

The engagement between AEE and its members and the utility sector has provided for a valuable exchange of insights and perspectives. Participants generally believe that the recommendations in the report, in the aggregate, are worthy of consideration. The materials reflect the discussion and conclusions of participants in the collaboration, but not all parties necessarily concur with the entirety of this document.

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