FERC Order 2222

Recommendations for the U.S. Department of Energy—Outline

April 2021

EAC

ELECTRICITY ADVISORY COMMITTEE

FERC Order 2222—Recommendations for the U.S. Department of Energy

Introduction

During the Electricity Advisory Committee (EAC) meetings in February 2021, members participated in two panels[1] related to Federal Energy Regulatory Commission (FERC) Order 2222[2] that featured presentations from industry experts on the scope and potential implications of the order. The FERC order requires each independent system operator (ISO) and regional transmission organization (RTO) to develop a wholesale market participation model that allows distributed energy resource (DER) and demand response (DR)[3] aggregations to provide and be compensated for wholesale market services.[4] Each ISO/RTO must develop a compliance plan[5] that outlines how it will comply with Order 2222 across a broad array of requirements, including DER interconnection, aggregation composition and size, information and data sharing, and coordination among the ISO/RTO, distribution utility, DER aggregator, and state and local regulatory authorities.

The order introduces requirements that regions must resolve to support timely compliance plan development and successful implementation. One of the most critical requirements relates to the types of operational coordination needed across the transmission, distribution, and customer domains to enable DER aggregation for wholesale market participation while preserving system safety, reliability, and resilience. For example, because ISOs/RTOs lack distribution system visibility, there will need to be active coordination among ISOs/RTOs, distribution utilities, transmission utilities, and DER aggregators to ensure that wholesale market obligations (i.e., schedules and dispatch instructions) are compatible with real-time distribution and transmission system conditions. Another critical requirement the order raises is what types of enhancements to transmission, distribution, and resource planning are required to maintain reliability and meet other policy objectives given the greater ability for DERs to provide grid services across the transmission-distribution interface. Further, although Order 2222 applies to markets, the implications of similar approaches for handling DER aggregators will eventually also extend to other

[1] DOE Office of Electricity, *February 3–4, 2021 Meeting of the Electricity Advisory Committee*. Accessed April 14, 2021.
[2] FERC, *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Docket No. RM1809-000; Order No. 2222, September 17, 2020. Accessed April 14, 2021.
[3] FERC clarified in Order 2222-A that demand response participating within a heterogeneous DER aggregation is not subject to the "opt-out" established in Order Nos. 719 and 719-A. Further information can be found at https://www.ferc.gov/news-events/news/ferc-addresses-demand-response-opt-out-certain-der-aggregations.
[4] ISOs/RTOs may also comply by modifying an existing participation model to accommodate DER aggregations.
[5] Order 2222 requires each ISO/RTO to submit its compliance plan by July 19, 2021. However, on April 9, 2021, FERC granted extension requests to the Midcontinent Independent System Operator, PJM Interconnection, and Southwest Power Pool to submit their compliance filings by April 18, 2022; February 1, 2022; and April 28, 2022; respectively. As part of its order granting extension, FERC requires each of these ISOs/RTOs to submit a detailed stakeholder process schedule within 30 days of this order and status reports every 90 days until submission of final compliance plans. FERC's order can be found at https://elibrary.ferc.gov/eLibrary/filedownload?fileid=15763579.

non-ISO/RTO utilities that are not required to comply with Order 2222. Those utilities may interact with DER aggregators through their Balancing Authorities (BAs).[6]

While these examples illuminate the types of challenges that regions must address because of Order 2222, they represent a much broader range of requirements that the order raises related to technology, operations, market design, regulation, and planning (see Appendix for full listing). Informed by a deeper appreciation of these myriad requirements following the Order 2222 panels in which EAC members participated, the Committee collectively recognized that prospective actions to comply with Order 2222 present significant complexities for successful implementation.

These complexities are compounded by the expeditious timeline for ISOs/RTOs to submit compliance filings and the challenge of enabling states, localities, utilities, and other important stakeholders to meaningfully engage in the development of these compliance filings and implementation plans. Although ISOs/RTOs are actively engaging stakeholders to inform the development of compliance filings, the limited remaining time to engage stakeholders on critical issues could create obstacles to developing fully informed regional plans. The multitude of pathways each region can pursue in addressing these issues necessitates significant due diligence, which requires enough time to closely assess optimal pathways and the requirements for corresponding coordination models. Additionally, while the most immediate focus is on compliance filing development, there is also a need for action to guide each region's implementation efforts.[7]

The EAC believes that DOE should take immediate actions to help stakeholders meet the urgent challenge of complying with Order 2222. DOE has already done significant work that can support regional efforts to address the complex requirements that Order 2222 raises. For example, the Office of Electricity's (OE) extensive work on smart grid development[8] can guide stakeholder development and implementation of systems and standards to enable two-way power flow, DER dispatch, and load and voltage management, and cybersecurity measures that are harmonized across the transmission and distribution systems. Additionally, DOE's work on grid architecture[9,10,11] can help identify pathways for mitigating issues related to transmission-distribution-customer operational coordination processes, including how to allocate roles and responsibilities between various system actors based on a jurisdiction's policy objectives, and define information and data exchange requirements. Another example is DOE's recommendation on leveraging big data capabilities. Big data can support prediction of ancillary service requirements and allow aggregators to more effectively prepare constituent DERs for providing these services.

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[6] The balancing authority has the responsibility of maintaining reliable real-time operation of the bulk electric system by balancing supply and demand and supporting system frequency over a designated balancing authority area.
[7] Order 2222 requires each ISO/RTO in its compliance filing to propose a reasonable implementation date.
[8] DOE. *SmartGrid.gov,* Office of Electricity – Advanced Grid Research. Accessed April 14, 2021.
[9] Taft, J. *Grid Architecture 2,* Pacific Northwest National Laboratory (2016). Accessed April 14, 2021.
[10] DOE. *Modern Distribution Grid Project,* Pacific Northwest National Laboratory. Accessed April 14, 2021.
[11] De Martini, Paul and Lorenzo Kristov. 2015. *Distribution Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation, and Oversight*, Lawrence Berkeley National Lab, LBNL-100397. Accessed April 14, 2021.

Building from its prior work and by virtue of its role as a convening authority, programmatic and technical resource, conduit for education, and policy leader, DOE is uniquely positioned to take steps to ensure timely and successful outcomes of Order 2222. The success of these efforts will require DOE to leverage its capabilities and coordinate closely with other federal agencies, states, utilities, and other important actors.

Findings

Order 2222 provides a compressed timeframe for ISO/RTO compliance plan development, given the magnitude of impacts the order will have on the nation's electric grid. Order 2222 requires significant action on the part of ISOs/RTOs to develop informed compliance and implementation plans by meaningfully engaging with electric distribution and transmission utilities, state regulators, DER aggregators, and other important stakeholders. Consequently, regions need adequate time to effectively address the convergence of wholesale market functions (e.g., ISO/RTO dispatch, DER provider bidding strategies) and distribution system operations by evaluating and allocating roles and responsibilities to preserve system safety, reliability, and resilience while enabling DER wholesale market participation.

Regions will need to assess the need to refine or create new tools, technologies, and protocols critical to the implementation of the order. These include a myriad of processes and software and hardware tools, including communication protocols for the various types of DERs on the system, DER day-ahead forecasting, analytical approaches to model and analyze DER aggregation system impacts, system and DER visibility requirements, and resource planning that supports greater coordination between distribution and bulk system needs. Although not necessarily a comprehensive list, the Committee identified a set of requirements (see Appendix for full listing) the DOE should consider as it plans activities related to Order 2222.[12]

While the EAC provides a set of recommendations for how DOE can lead multiple efforts to help address these requirements, it also acknowledges that there are other actors who are best positioned to lead work on certain requirements. For example, the National Institute of Standards and Technology (NIST) and Institute of Electrical and Electronics Engineers (IEEE) are actively leading efforts to develop technology standards and protocols to support more seamless integration of advanced technologies into system planning and operations processes. One such example is the IEEE *Draft Guide for Distributed Energy Resources Management System (DERMS)*[13] *Functional Specification* (P2030.11), which contains details of a myriad of potential configurations of aggregators, distribution operators, and transmission operators to inform data exchange requirements and required operational interfaces. Accordingly, DOE should collaborate with other key actors to identify opportunities to continue leveraging the success and expertise of other ongoing forums.

[12] Although the order is limited in scope to FERC-jurisdictional ISOs/RTOs, other entities (e.g., vertically integrated utilities, federal power administrations) not directly impacted by the order may face the same coordination issues that arise with a proliferation of DERs and third-party aggregators.
[13] The guide, which is currently being balloted, incorporates operational requirements for DER provision of grid services at all levels of the grid.

Recommendations

The EAC has developed the following recommendations for DOE-led activities related to Order 2222. The recommendations recognize DOE's unique ability to exert policy leadership, convene key actors, deliver technical assistance, and develop educational materials.

Recommendation 1: Support FERC in identifying the range of complexities needing resolution before ISO/RTO compliance filings and through implementation.

DOE should exert its policy leadership to engage with FERC to clearly identify the many complexities that must be addressed in the compressed timeframe for finalizing compliance filings and as part of ongoing implementation efforts. While the EAC commends FERC for granting compliance filing extension requests for Midcontinent ISO, Southwest Power Pool, and PJM Interconnection, it is still of the utmost urgency to continue addressing these complexities. This engagement could include discussions with FERC of the myriad technical issues that need to be addressed prior to finalizing a compliance plan, such as the list in the Appendix. Senior DOE officials, including Secretary Granholm, should be directly involved in these engagement activities with FERC given the critical need to develop informed compliance filings and implementation plans.

Recommendation 2: Engage in RTO/ISO compliance development processes to support due diligence of regional plans.

DOE should establish a Rapid Response Team and/or War Room, with the objective of having DOE personnel actively engage in existing fora to inform stakeholders on the range of information available to address specific issues related to ISO/RTO compliance filing development. This engagement should focus on organizing and prioritizing all technical support efforts on topics related to Order 2222, including transmission-distribution-customer coordination and technology development. With its deep expertise on key issues related to Order 2222, DOE can support existing fora in assessing a wider range of potential pathways forward that preserves state/local utility optionality and flexibility for individual regions to tailor plans to their specific needs. These activities should ultimately support development of a detailed coordination framework for each region to determine the roles and responsibilities of key actors and define information and data exchange requirements.

DOE should also provide research experience to distribution utilities of how various processes related to Order 2222 may work. Distribution utilities have varying levels of familiarity with, understanding of, and existing capabilities and resources to effectively satisfy many of the critical requirements that Order 2222 introduces. The EAC recognizes the broad diversity of distribution utilities in terms of their ability to effectively engage with ISOs/RTOs to inform the development of compliance plans. Given the short timeframe for compliance plan development and the scale of complexities that must be addressed, DOE should help distribution utilities prioritize their efforts through a clear identification of targeted outcomes and their implications.

Recommendation 3: Catalog existing DOE work to support stakeholder education on critical issues.

There is a near-term need for stakeholders to have access to educational and reference materials that further their understanding of the most critical issues related to Order 2222. DOE and the national labs have published numerous reports and articles on topics like grid architecture and transmission-distribution-customer coordination that can provide valuable reference material for regions as they contemplate potential pathways forward for complying with Order 2222. This includes recent resources developed by the EAC on a variety of topics such as energy storage, electric vehicles, and data analytics that may be relevant to Order 2222. Separately, DOE has published on topics related to other supporting activities, such as integrated planning, and it continues to work on these activities.[14,15,16,17,18] By developing an accessible repository of key source materials related to Order 2222 compliance and other supporting activities, DOE will enable stakeholders to contribute to the selection of the most pragmatic pathways forward on a range of key topics.

Recommendation 4: Establish ongoing policy collaboration structures to enable federal agency coordination and collaboration with industry, state, and local stakeholders.

DOE should establish an ongoing structure that organizes collaboration with other federal agencies, NARUC, the National Association of State Energy Officials, National Association of State Utility Consumer Advocates, ISOs/RTOs, industry groups (e.g., Edison Electric Institute, American Public Power Association, National Rural Electric Cooperative Association, North American Electric Reliability Corporation, Electric Power Research Institute, Smart Electric Power Alliance, Energy Systems Integration Group, Energy Storage Association, Solar Energy Industries Association, Peak Load Management Alliance, Association of Energy Services Professionals, Advanced Energy Economy), and other critical stakeholders such as DER aggregators. While not an exhaustive list, by working with these types of entities, DOE could serve as the central entity that brings stakeholders together to help highlight potential gaps and methodologies and clarify how to support compliance with Order 2222. DOE's education and outreach can support coordination of activities relevant to Order 2222 across federal labs, industry groups, and academia. Through these outreach efforts, state and local officials can be supported in identifying the steps needed to successfully implement regional compliance plans (e.g., establishment or refinement of benefit-cost analysis frameworks for evaluating distribution utility investments to optimize asset utilization, such as the National Standard Practice Manual for DERs[19]). This collaboration should include a focus on the types of enabling regulations (both federal and state)

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[14] NARUC. n.d., *Task Force on Comprehensive Electricity Planning*. Accessed April 1, 2021.
[15] Frick, Natalie Mims, Snuller Price, Lisa Schwartz, Nicole Hanus, and Ben Shapiro, *Locational Value of Distributed Energy Resources*, Lawrence Berkeley National Laboratory (2021). Accessed April 14, 2021.
[16] U.S. DOE, *Integrated Distribution Planning: Utility Practices in Hosting Capacity Analysis and Locational Value Assessment*, Office of Electricity (2018). Accessed April 14, 2021.
[17] Cooke, AL, JS Homer, and LC Schwartz, *Distribution System Planning--State Examples by Topic*, Pacific Northwest National Laboratory (2018). Accessed April 14, 2021.
[18] Homer, JS et al., *Electric Distribution System Planning with DERs–High-Level Assessment of Tools and Methods*, U.S. DOE Grid Modernization Laboratory Consortium (2020). Accessed April 14, 2021.
[19] National Energy Screening Project (NESP), *National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources*, August 2020. Accessed April 14, 2021.

that, when combined with enhanced market designs, planning methodologies, and operational processes, support DER optimization across the transmission, distribution, and customer domains.

As part of these efforts, DOE should support stakeholders in developing a common set of use cases that illuminate the types of impacts introduced by Order 2222 that need to be addressed. These use cases should capture a wide range of potential considerations stemming from the order, including but not limited to aggregation characteristics (e.g., resource type mix, size, grid services provided), distribution utility requirements for studying aggregation impacts to the distribution system, and information/data exchange between key system actors. Importantly, these use cases should also consider impacts to jurisdictions outside the geographic footprint of ISOs/RTOs. Efforts may be taken through testbeds and pilots that are supported by DOE across federal labs and academic institutions to test these use cases to identify any critical gaps. In addition to use case development, DOE can support research that leads to the creation of a standardized set of questions that ISOs/RTOs, distribution utilities, transmission utilities, aggregators, and other relevant stakeholders must answer to support decisions around the allocation of roles and responsibilities to different entities to fulfill a range of required functions (see Appendix for further discussion). Additionally, DOE can support efforts to identify requirements for advanced tools (e.g., system modeling) needed to meet Order 2222 requirements.

Recommendation 5: Deliver technical assistance on topics to support implementation and develop educational materials on critical topics to expand upon a robust set of existing reference materials.

DOE should provide technical assistance on a range of topics to directly support implementation efforts, including state regulation and governing practices for electricity cooperatives and municipal utilities and the implementation of enabling tools to dynamically manage DER operations. It is likely that the primary audience for this technical assistance includes stakeholders who typically participate in state-level and utility forums. This technical assistance could also include topics like transmission, distribution, and resource planning; greater coordination between distribution and bulk system needs; state resource adequacy issues; DER locational value; and management of asset lifecycle considerations for distributed and central station resources. Although the focus as part of this recommendation is on topics outside the direct scope of Order 2222, this remains a critical piece for supporting the timely implementation of regional compliance plans.

DOE efforts as part of Recommendation 3 can help identify gaps where development of new educational materials will provide a more complete set of references on key topics related to Order 2222. DOE can develop new educational materials such as process maps and other organizing frameworks to help regions make decisions on key topics (e.g., distribution system platform capabilities and operational coordination frameworks) that enable DER participation in a way that recognizes the requirement for reliability and safety while balancing cost, complexity, scalability, and security. DOE's educational materials should inform both topics directly related to Order 2222 and other relevant activities that support implementation of regional plans. Additionally, these materials will support regions in understanding how implementation decisions inform a region's ability to achieve relevant policy objectives.

Conclusion

The immediate timeframe for developing Order 2222 compliance plans requires very timely action. DOE has limited time to be influential and provide incremental value given already active efforts to develop

ISO/RTO compliance plans. In approaching efforts related to Order 2222, DOE should consider the following:

- Recommendation 1 is the highest priority. Sufficient time is needed to develop fully informed compliance plans given the complexity introduced by Order 2222 to define coordination frameworks for each region.
- By leveraging its convening authority to enable broad-based engagement by a diverse set of stakeholders, DOE can support regions in achieving optimal results.
- DOE's prior work on grid architecture and operational coordination is highly relevant and applicable to Order 2222, and DOE will now need to refocus some resources on applying this work via the Rapid Response Team to support development of compliance plans and enable successful implementation.

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Appendix

Critical Issues Raised by FERC Order 2222

	Technology
1.	Ensuring systems and standards exist for two-way power flow, dispatch, load and voltage management, multiple DER co-development, and integration of platforms and tools such as Distributed Energy Resource Management System (DERMS), Advanced Distribution Management System (ADMS), and Geographic Information System (GIS)
2.	Data management and ownership of systems and ICS across transmission and distribution systems (e.g., sensors, machine learning, advanced power electronics)
3.	Implementation of cybersecurity measures that are harmonized across transmission and distribution systems and DER aggregators
	Operations
4.	Evaluation of load management and balancing between the transmission and distribution system
5.	Transmission, distribution, and Balancing Authority operational reserve requirements
6.	Transmission-distribution-customer operational coordination processes (e.g., information and data exchange, including distribution utility DER visibility and controllability requirements) to preserve system safety and reliability, including evolution to more automated processes over time

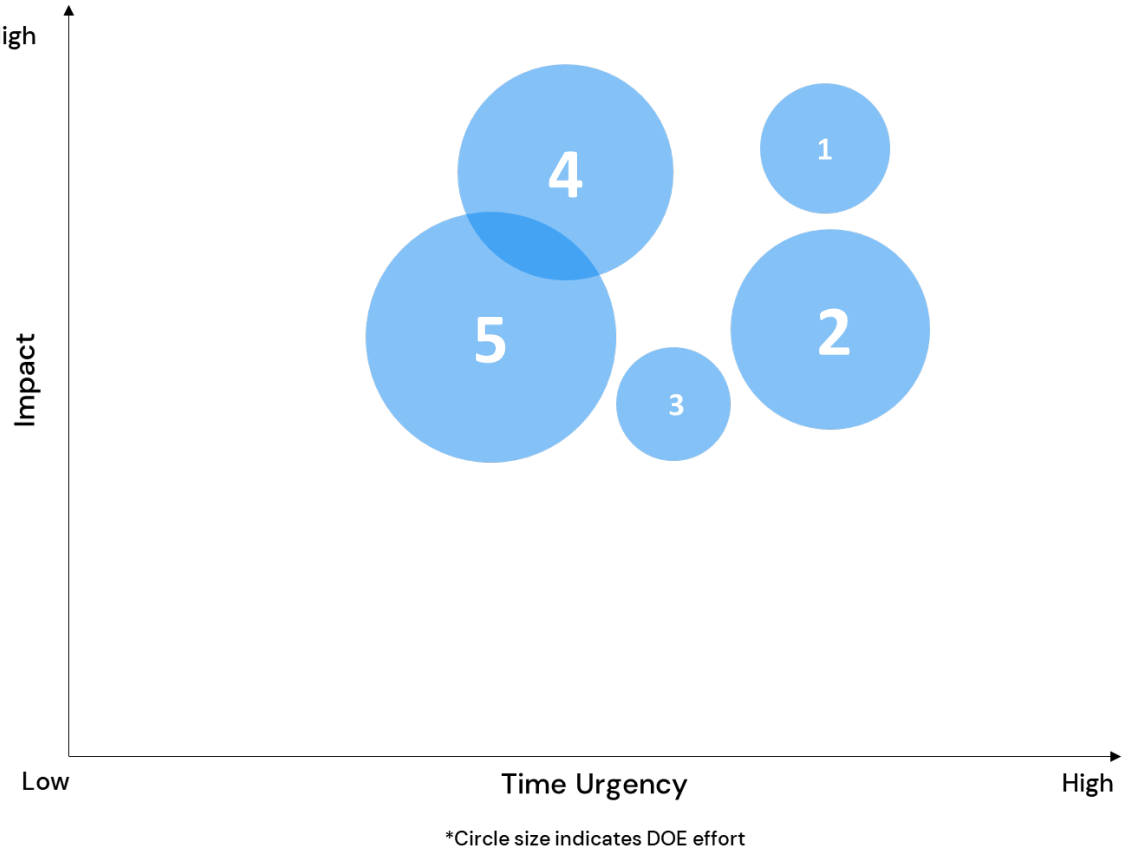
7. Data requirements and processes to model DER aggregation impacts to the distribution and transmission system
8. Processes governing aggregation operation (e.g., defining capabilities of heterogeneous aggregations; enrolling excess capacity to provide aggregation "reserves")
9. DER interconnection process compliance
10. Ensuring DER aggregations are compliant with applicable requirements or standards (e.g., metering and telemetry)
11. Role of DERMS in outage management, advanced forecasting (e.g., aggregation deliverability based on grid conditions)
Market Design
12. Market disruption and risk, including accountability for resource non-performance
13. ISO/RTO market rules (e.g., aggregation maximum size; minimum and maximum size for individual DERs; locational requirements for aggregations; allowance for DER injections)
14. Frameworks for avoiding duplicative compensation or double-counting of resources
15. Harmonization of retail-level use cases with wholesale market participation
16. Wholesale market treatment of state and regional incentives
Regulation
17. Regulation governing reliability and resilience requirements, frameworks, guidelines, and metrics, and identification of cross-functional areas requiring coordination between entities[20]
18. Role of state and local regulators with respect to retail services and preserving distribution system safety and reliability
19. Guidance on cost-effectiveness assessments for required investments, upgrades
20. Transparency of coordination processes (e.g., distribution utility review of individual DERs comprising an aggregation during the enrollment process)
21. Ongoing monitoring of compliance with applicable regulations and standards (e.g., IEEE 1547-2018)
22. Data management
23. Data privacy
24. State and federal parity on cybersecurity and equipment standards (e.g., due diligence, software accountability, chain of custody, quality assurance standards for software applications, testing of supply chain components)
25. Customer impacts and protections (e.g., affordability, privacy, oversight of contractual arrangements)
26. Implications of ISO/RTO plans for smaller utilities that do not intend to opt-in[21]
Planning
27. Transmission, distribution, and resource planning requirements to maintain reliability and meet other policy objectives (e.g., decarbonization; electrification; affordability)
28. Identification and funding of analytical tools for ISOs/RTOs and utilities that can be tailored to inputs, assumptions, and objectives of each region
29. Cost allocation and recovery for transmission and distribution investments (e.g., operational systems; cybersecurity) to support implementation efforts

[20] Order 2222 may also impact Electric Reliability Organizations (EROs) despite not being directly subject to the order. EROs have the responsibility of establishing and enforcing reliability standards for the bulk power system. As such, regional efforts to comply with Order 2222 and carry out implementation efforts may have important implications for developing and refining reliability standards, frameworks, and guidelines.

[21] FERC, *Staff presentation on Participation of Aggregators of Retail Demand Response Customers in Markets Operated by RTOs and ISOs*, Docket Nos. RM18-9-002 and RM21-14-000; Order No. 2222-A, March 18, 2021.

30. DER day-ahead forecasting tools
31. Full lifecycle considerations for distribution and central station resources
32. State and regional resource adequacy planning
33. Development and maintenance of DER inventories, including audits of DER deliverability in each ISO/RTO region
34. Behavioral studies on customer/DER/Aggregator behavior in response to price signals

Prioritization of Recommendations



Recommendations

1: Support FERC in identifying the range of complexities needing resolution before ISO/RTO compliance filings and through implementation.

2: Engage in RTO/ISO compliance development processes to support due diligence of regional plans.

3: Catalog existing DOE work to support stakeholder education on critical issues.

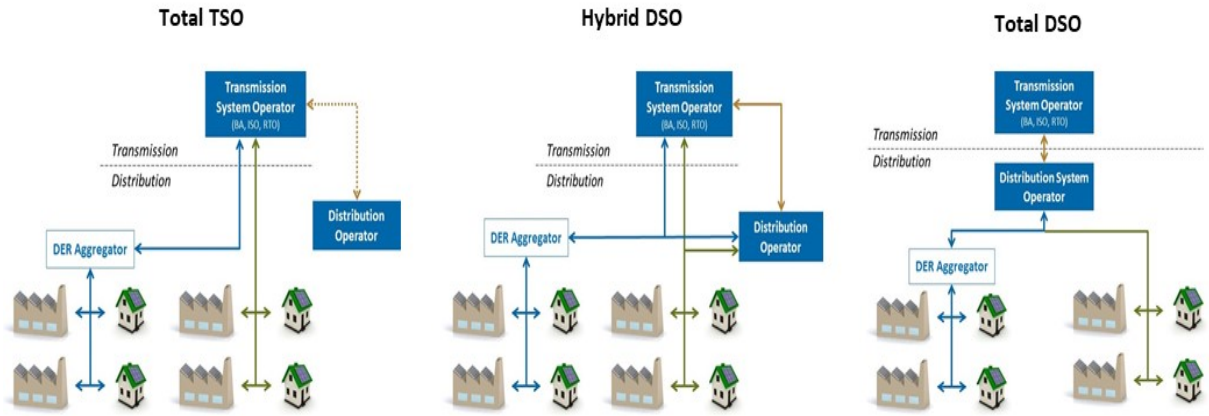
4: Establish ongoing policy collaboration structures to enable federal agency coordination and collaboration with state and local stakeholders.

5: Deliver technical assistance on topics to support implementation and develop educational materials on topics without a robust set of existing reference materials.

Grid Architecture Background

Two main actors—the transmission system operator (TSO) and distribution system operator (DSO)—will remain at the epicenter of operational coordination processes, but there will be a growing role for other actors (e.g., DER aggregators and customers) to support operational coordination requirements as DERs participate in wholesale markets. Figure 1 illustrates a range of conceptual transmission-distribution (T-D) coordination models, with the Total TSO model having the TSO perform all DER operational coordination, the Total DSO model having the DSO perform all DER operational coordination, and between these bookend models a spectrum of Hybrid DSO models with varying TSO and DSO roles and responsibilities.

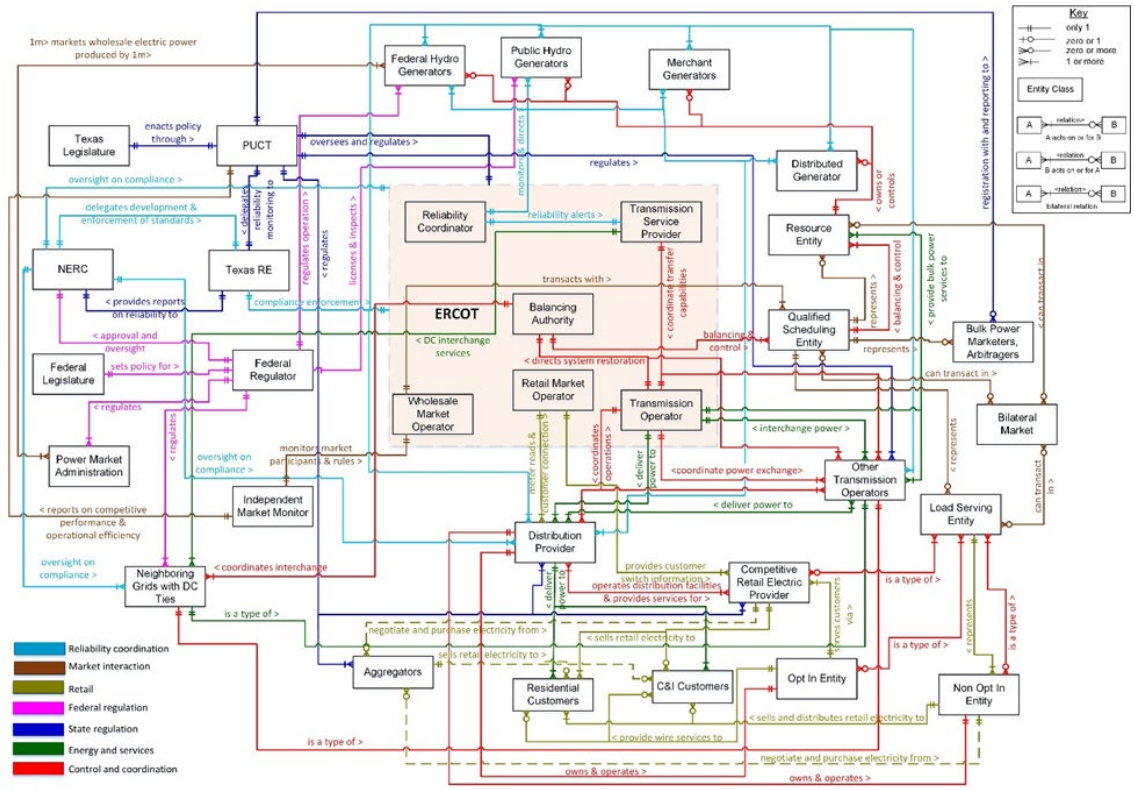
FIGURE 1: CONCEPTUAL ILLUSTRATION OF T-D COORDINATION MODELS



Source: Jeffrey Taft, Pacific Northwest National Laboratory and Paul De Martini, Newport Consulting Group

While conceptual T-D coordination models provide a simplified means to understand potential pathways for operational coordination, in practice there is significant complexity involved with allocating roles and responsibilities between the myriad system actors in a region entails. For example, Figure 2 presents an illustration of the various interfaces (e.g., market interactions, operational control, federal/state regulation) in the Electric Reliability Council of Texas (ERCOT) region. This industry structure diagram illuminates the level of detail required to assess and allocate roles and responsibilities to various system actors to implement the mix of market mechanisms and control schemes necessary to reliably operate a vastly more complex grid.

FIGURE 2: ERCOT INDUSTRY STRUCTURE DIAGRAM



Source: Jeffrey Taft, Pacific Northwest National Laboratory

At the heart of industry structure is a determination of functions needed to enable the flow and coordination of power, operational, market, and data exchange signals. Some of these functions in the context of Order 2222 include the following:

- Determination of security constraints on the distribution and transmission system
- Balancing of loads and resources over a geographic region (nodal, multi-nodal, or zonal)
- Direct operational control of individual or aggregated DERs
- DER aggregation provision of grid services between balancing authorities

Before assigning the above functions to market entities, it is important to have a clear understanding of the existing and emerging electricity industry structures, which depict the various flows and interactions between the functional entities. A close study of these structures with consideration of system engineering can reveal gaps that exist to enable the evolution toward a structure that supports achievement of grid objectives. Jurisdictions will need to make decisions about the timing and scaling of the evolution of these functional capabilities to determine the assignment of roles and responsibilities and coordination flows between market entities. Some of the types of questions that will need to be addressed to guide the decision-making process include the following:

- Is the wholesale market operator also the Balancing Authority (BA)?[22]
- Is the wholesale market operator or BA also the TSO?
- Is the wholesale market operator or BA also the Reliability Coordinator?
- Is the DSO serving the role of DER aggregator?
- What is the allocation of functional responsibilities between the DSO and TSO?

[22] The balancing authority has the responsibility of maintaining reliable real-time operation of the bulk electric system by balancing supply and demand and supporting system frequency over a designated balancing authority area.