FERC ORDER No. 2222 AND THE USE CASES IT CAN UNLOCK

ORDER No. 2222 UNLEASHES THE POWER OF DISTRIBUTED ENERGY TECHNOLOGIES. HERE'S HOW AGGREGATORS AND DEVELOPERS CAN BRING DERs TO WHOLESALE ENERGY MARKETS TO CREATE A MORE RELIABLE AND FLEXIBLE GRID.

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Order No. 2222 unleashes the power of distributed energy technologies. Here's how aggregators and developers can bring DERs to wholesale energy markets to create a more reliable and flexible grid

In September 2020, the Federal Energy Regulatory Commission (FERC) issued Order No. 2222, a landmark order enabling aggregations of distributed energy resources (DERs) to participate on a level playing field in the wholesale markets operated by Regional Transmission Organizations and Independent System Operators (RTOs/ISOs). DERs, which include small, flexible resources such as customer-sited batteries, electric vehicles, rooftop solar, and smart thermostats, have proliferated across the United States, primarily driven by customer demand, technology improvement, and falling prices.[1] However, DERs have been largely left out of U.S. wholesale power markets.

FERC Order No. 2222 embraces these market trends and directs RTOs/ISOs to remove market barriers to DER participation and allow aggregated DERs to compete. Allowing DERs to aggregate and participate in wholesale markets benefits everyone by optimizing overall asset utilization, increasing competition, and providing alternative solutions that reduce the need for costly infrastructure upgrades. Integrating DERs in wholesale markets also provides a new set of flexible resources that grid operators can call upon to maintain reliability and address resilience threats like extreme weather, which are becoming increasingly frequent. By opening the door for new revenue streams for DER owners and new business models for DER aggregators, Order No. 2222 holds promise for expanding investments in DERs, reducing the cost of DERs to allow more customers to access them, and delivering their full value to all customers on the grid.

[1] Wood Mackenzie (2020), United States Distributed Energy Resources Outlook: DER installations and forecasts 2016-2025E, https://www.woodmac.com/our-expertise/focus/Power--Renewables/der-outlook-us-2020/

While the goal of Order No. 2222 is to unlock market opportunities for a range of DER technologies—including some that have not yet reached commercial deployment—there are many categories of DERs that are poised to take advantage of new wholesale market participation models as soon as they become available. This report illuminates the near-term use cases that DER aggregators and other stakeholders expect to pursue under Order No. 2222. This should help policymakers and regulators better understand what wholesale market participation will look like for these resources and provide insight into the benefits they can provide, as well as the barriers preventing DER participation that compliance with Order No. 2222 must address. In this report, AEE offers several preliminary suggestions to overcome these barriers; these are intended to be starting points for discussions and not one-size-fits-all solutions.

USE CASES

- Use Case 1: Frequently Dispatched DERs
- Use Case 2: Residential Demand Response, e.g., Smart Thermostats and Water Heaters
- Use Case 3: Residential Behind-the-Meter Resources, e.g., Solar, Solar + Storage, Storage, and EV Charging
- Use Case 4: Front-of-the-Meter Distribution-Connected Resources

USE CASE 1: FREQUENTLY DISPATCHED DERS – ELECTRIC BUSES AND FLEETS, WORKPLACE CHARGING, AND BEHIND-THE-METER STORAGE

THE OPPORTUNITY:

Frequently dispatched DERs such as behind-the-meter storage, workplace charging, and electric buses and other vehicle fleets have the potential to provide significant grid benefits but also come with unique operational characteristics that must be considered in order to enable wholesale market participation. Typically, demand response (DR) resources are dispatched infrequently, only in response to conditions of severe stress on the grid. But certain DERs have characteristics that allow them to be used on a more frequent basis, providing more value to the grid and customers.

One type of frequently dispatched DERs are electric school buses. As battery costs continue to decline, a growing number of school districts across the country are replacing older diesel-fueled school buses with electric models. Unlike conventional buses used for public transportation, school buses are seldom used at night and sit idle much of the day and during the summer months. At these times, the batteries in electric school buses can become a flexible resource that can provide a number of grid services in both retail and wholesale markets, including energy, generation and distribution capacity, ancillary services, and voltage regulation.

There are currently 480,000 school buses serving more than 25 million students across the United States.[2] As school districts move toward electrification, utilities and wholesale market grid operators have a lot to gain from allowing these resources to participate in wholesale markets.

Transit fleets can also be frequently dispatched, although they generally follow different use patterns than school buses. Municipalities are increasingly replacing old fleet vehicles with electric models that have lower operating and maintenance costs as well as no tailpipe emissions. These fleet vehicles have the potential to provide valuable grid services if allowed to optimize for their unique usage patterns.

Workplace charging is another growing category of frequently dispatched DER. As more workplaces and retailers seek to meet the demand of their tenants and customers, they are installing charging infrastructure on site. According to forecasts, there could be over

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[2] American School Bus Council, https://www.americanschoolbuscouncil.org/about/#:~:text=American%20School%20Bus%20Council%20(ASBC)&text=Council%20members%20are%20committed%20to,480%2C000%20school%20buses%20each%20day.

half a million workplace chargers by 2025.[3] Participation in wholesale markets would give these DERs an opportunity to provide important services while also allowing grid operators additional visibility into the operation of these growing assets.

Ordinary behind-the-meter battery storage can also be dispatched frequently if needed, provided that it has proper incentives and does not face barriers to optimizing performance. Batteries at commercial and residential buildings are being deployed rapidly thanks to falling cost and increased customer interest in resilience and sustainability. Companies and homeowners can work with DER aggregators to optimize performance of behind-the-meter battery storage resources. (See Use Case 3 for additional specific discussion of residential behind-the-meter storage).

The DERs described above can provide multiple services in wholesale and retail markets, including:

Retail services like transportation/vehicle charging, distribution-level demand response, peak load shaving, and non-wires solutions for distribution utility needs.

Wholesale services like energy, capacity, and ancillary services such as frequency regulation, voltage support, and reactive power. Many DERs provide ancillary services and grid flexibility more reliably and efficiently than traditional generation because of their ability to respond quickly to grid disturbances (often in less than a second).

OVERCOMING BARRIERS:

Currently, there are fleet operators, school districts, and DER aggregators looking to combine these resources and offer their services in wholesale markets. To do that, several barriers to integration must be addressed.

First, transit fleets and behind-the-meter storage can both reduce load onsite (i.e., decrease the amount of electricity drawn from the grid for use on campus or at a home or business) and export energy from the customer site to the grid. However, under

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[3] Wood Mackenize (2019), The Emergence of Workplace, Medium-and-Heavy-Duty EV Charging: Europe and North America Fleet Electrification Scenarios 2019 – 2015, available at https://www.woodmac.com/reports/power-markets-the-emergence-of-workplace-medium-and-heavy-duty-ev-charging-europe-and-north-america-fleet-electrification-scenarios-2019-2025-353122/

existing DR participation models in wholesale markets, these resources can only provide load reduction and currently have no pathway to export energy onto the grid, limiting the services they can provide and the compensation they can earn.

> ***Recommendation 1:*** *To create a level playing field, grid operators need to work with stakeholders to develop a "continuous" participation model that gives these resources credit for their full capacity value—i.e., for their role as a flexible load-reducing resource and as a generation resource providing energy to the grid.*

Second, the ability to update energy offers in real-time is also important to enable these frequently dispatched DERs to reflect their operational needs and, as relevant, their participation in retail demand response programs that may call upon them to be available after day-ahead offers have already been submitted through the wholesale markets. If they are unable to update their energy offers after their initial offer in the day-ahead market closer to real-time, these resources will hold back in their day-ahead offers in order to preserve their ability to meet operational and retail needs and avoid the risk of penalties for failure to deliver. This would limit the wholesale services they can provide and, consequently, the ability to utilize them fully for the benefit of consumers and the grid. Allowing real-time updates to energy offers will allow DERs to optimize their performance while improving visibility for grid operators.

> ***Recommendation 2:*** *Grid operators should allow these resources to update energy offers in real-time.*

Third, to receive fair compensation, these DERs will also require a mechanism to measure and distinguish their performance from the facility load they are associated with. This can be done either through direct metering or through properly designed "baselines." The baseline is the normal expected energy usage (load) of the facility. Baselines are used to separate out the performance of a DR asset from the load pattern of the facility to determine how these resources perform. For DR that infrequently dispatches, separating out "event performance" (when the DR is dispatched) from baseline load patterns is relatively straightforward. For frequently dispatched DERs like energy storage and school bus fleets, this dispatch becomes the "norm" and gets reflected in an artificially reduced baseline, which is often referred to as "baseline erosion." This baseline erosion means that actual performance of DR and DERs will not be captured, which creates a risk that these resources will incur performance penalties when they are in fact performing and providing capacity or other wholesale services as promised.

Recommendation 3: To remove this barrier, grid operators could:
1. *Meter and determine performance at the "Retail Delivery Point" and add back any "performance" to the customer baseline (an approach in place in NYISO)[4], with "performance" representing what the DER clears and delivers in the energy market;*
2. *Allow the DER to be directly metered and assessed for performance (also called "submetering"). RTOs/ISOs, aggregators, and distribution utilities will need to work together to ensure that retail-level supply costs are netted out.*

If grid operators remove these barriers, participation by frequently dispatched DERs can create benefits for all participants in the electricity sector: Wholesale market operators gain the ability to utilize these assets to meet the needs of the larger grid, distribution utilities gain local resilience on the distribution grid, DER aggregators are provided a new revenue stream, and consumers benefit from cost savings passed on by DER aggregators while also receiving a desired service (pollution-free transportation, workplace charging, or on-site resilience from energy storage).

[4] FERC Approved Tariff Language: https://nyisoviewer.etariff.biz/ViewerDocLibrary//Filing/Filing1485/Attachments/Att%20XIV%20OATT%20marked%20eff%20999 8.pdf

USE CASE 2: RESIDENTIAL DEMAND RESPONSE (DR) – SMART THERMOSTATS AND WATER HEATERS

THE OPPORTUNITY:

Order 2222 also allows residential customers and their homes to also play a part in the power grid. Currently, residential devices such as smart thermostats and water heaters control the largest energy uses (loads) in homes.[5] For example, smart thermostats control the heating, ventilation, and air conditioning (HVAC) system, which contributes up to 51% of a residential homeowner's energy bill.[6] Smart thermostat market penetration is currently around 25% and is expected to grow.[7] As these resources continue to proliferate, the market potential remains significant, as over 100 million households in America (roughly 85% of all housing units) have central heating and/or cooling systems that could be controlled by a smart thermostat.[8] These devices are some of the most affordable DERs; with proper incentives in place, they can be offered to customers at low to no cost. This opens the door for millions of residential households, including many

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[5] In the future electric vehicle supply equipment is likely to control the largest load.

[6] U.S. Energy Information Administration (2020), Use of Energy Explained, https://www.eia.gov/energyexplained/use-of-energy/homes.php

[7] Statista, Which smart home devices does your household own?, https://www.statista.com/statistics/1124290/smart-home-device-ownership-us

[8] U.S. Energy Information Administration (2015), Space Heating in U.S. Homes by Climate Region, *available at* https://powersuite.aee.net/dockets/ferc-ad21-13-000/filings/14910035?version=beta&filing_search_id=939713&document_id=161214219

low-to-moderate-income households, to utilize them to participate in the bulk power grid.

As residential smart devices proliferate, DER aggregators are eyeing ways to pull these resources together and participate in wholesale markets. Enabling wholesale market participation for smart thermostats alone has the potential to contribute 40 GW of flexible and responsive load reductions from residential customers in jurisdictions affected by Order 2222.[9] When other technologies such as hot water heaters and EV charging are added in, this could translate to significant system efficiencies and ratepayer benefits by displacing the need for more costly and polluting resources while also strengthening grid resilience and increasing load flexibility to accommodate higher penetrations of variable renewable energy resources.

Residential demand response providers (who could be smart device manufacturers or DER aggregators) are interested in opportunities to provide capacity, energy, and ancillary services in the wholesale markets. Residential DERs have proven their ability to deliver capacity and energy resources in utility programs. Unfortunately, not all utilities are able to operate such programs, and where they do enrollment barriers can lead to very low participation rates. Enabling broad participation in wholesale markets by removing existing barriers would enable allow these resources to contribute to grid needs much more broadly.

For smart thermostats, for example, participation may be as low as 5% of installed devices.[10] This leaves 95% of the flexible load resources attached to these thermostats unable to be utilized to respond to grid needs. Enabling the participation of residential DR has benefits on the distribution level as well as the wholesale level as it would provide greater utilization of existing flexible load resources to enhance grid reliability and resilience. Given the reliability emergencies this past year in California and Texas, greater utilization of flexible load resources at scale through wholesale market participation

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[9] Ryan Hledik et al., The Brattle Group (June 2019), The National Potential for Load Flexibility, *available at* https://brattlefiles.blob.core.windows.net/files/16639_national_potential_for_load_flexibility_-_final.pdf (estimating a potential increase over existing DR capability of 40 GW by revamped customer engagement); also 200 million customers in jurisdictions covered by order 2222 * 25% market penetration of smart thermostats * average per device event impact of 1 kW = 50 GW; more details on per device DR impacts accessible at: ecobee.com/ecoplusEMV

[10] N. Kostora, ACHR News (August 2017), The Emergence of Demand Response Programs in HVAC, *available at* https://www.achrnews.com/articles/135551-the-emergence-of-demand-response-programs-in-hvac

could significantly increase emergency preparedness and prevent utilities from taking drastic measures such as rolling blackouts that have severe consequences.

Smart thermostats acting as DERs can provide a number of services:

Potential retail services include enhanced home comfort and energy cost savings, energy efficiency, demand response, peak load shaving, load shifting and smoothing.

Potential wholesale services include energy, capacity, and ancillary services that have long been supplied by traditional demand response.

OVERCOMING BARRIERS:

To deliver wholesale services, residential demand response providers must be able to access and use necessary data for market settlements. While residential DR devices operate with a high level of accuracy and precision, aggregators need the ability to submit data on their performance to the RTO/ISO, which either requires access to customer retail meter data or the option to directly submeter residential DR devices.

With respect to accessing customer data, aggregators face significant roadblocks. While the Department of Energy's Green Button is positioned as a potential solution to this issue, there are many problems with using it as a sole solution. First, not all distribution utilities have advanced metering infrastructure (AMI) data.[11] Second, not all distribution utilities with AMI have implemented Green Button. Third, Green Button implementation varies, and some utility implementations can require customers to electively undergo a cumbersome process to grant access, which creates unnecessarily burdensome barriers that result in very low participation rates.

These obstacles caused leading aggregator EnergyHub to enroll just 3% of eligible California customers it targeted for CAISO's Demand Response Auction Mechanism (DRAM), as compared with over 40% in ERCOT where Smart Meter Texas enables low

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[11] See https://openei.org/wiki/Green_Button#Participating_Green_Button_Utility_Providers for 48 utilities that have implemented Green Button Connect compared to the full list of utilities that have implemented AMI accessible at https://www.eia.gov/electricity/data/eia861/

friction access to customer retail meter data.[12] This means that CAISO, where extreme heat is expected to continue to stress the grid in coming years, will not have access to a flexible demand response resource to stabilize grid operations and avoid rolling blackouts during such events. Ecobee, a leading smart thermostat provider, has similarly seen customer participation rates that are approximately twenty times higher through low friction customer enrollments as compared to markets where they face barriers to accessing customer data.

> ***Recommendation 1:*** *To avoid barriers created by lack of data access and open up wholesale markets to these resources, allow direct metering (or submetering) of residential DR resources (see also Use Case 1, Recommendation 3).*

Unnecessarily stringent metering and telemetry requirements to participate in wholesale markets, designed for different types of resources, also pose a barrier to entry for these resources. To fully remove barriers, wholesale market operators should accept the use of proxy variables (such as HVAC runtime data) as a method of direct metering and broaden the definition of revenue-grade requirements to focus on data quality that meets a transparent threshold calibrated to the service being provided, rather than the type of metering collecting the data or the price format (e.g., Green Button).[13] A good example of this is provided by the requirements for energy efficiency resource participation in ISO-NE, which call for 10% relative precision at 80% confidence level.[14] This approach would enable broad participation everywhere, not only where AMI is in place, and will unlock gigawatts of flexible load through significantly higher participation rates. This approach would not sacrifice the reliable

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[12] California Public Utilities Commission (January 2019), Energy Division's Evaluation of Demand Response Auction Mechanism – Final Report [Public Version – Redacted] *available at* https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442460092 (citing EnergyHub's finding that requiring customers to provide utility account numbers to enroll in DR [demand response] programs – not required in programs in Texas – resulted in an 84% drop-off in customer enrollments.

[13] Revenue grade power meters must have an accuracy of 0.5% or higher to provide building owners with the data necessary to charge customers for individual energy It also allows for participation in utility rewards programs.

[14] ISO-NE (June 2014), Measurement and Verification of Demand Reduction Value from Demand Resources. See 7-3 at https://www.iso-ne.com/static-assets/documents/2017/02/mmvdr_measurement-and-verification-demand-reduction_rev6_20140601.pdf

contributions of these resources.[15] Telemetry requirements also need to be right-sized so that the fixed cost of participation does not become insurmountable for residential DERs.

> ***Recommendation 2:*** *Broaden the definition of revenue-grade metering requirements to focus on data quality needs that provide the RTO/ISO with needed, actionable information tailored to the services being provided.*

Finally, unlocking the full potential of residential DR as flexible load means allowing these resources to not only decrease load at times of peak demand and high prices, but to increase load when needed to maintain reliability. While many residential DR technologies are technically capable of such adjustments, they face barriers to doing so.

> ***Recommendation 3:*** *If residential DERs are dispatched to both consume energy and reduce load in response to grid needs, there will need to be procedures put in place, and likely cooperation from the local utility or load serving entity, to avoid charging customers twice for the same energy.*

[15] Thermostat runtime data is commonly used for DR program evaluation in utility programs. The U.S Department of Energy is currently establishing a national standardized Measurement &Verification (M&V) protocol for energy efficiency and demand response program evaluation named the Uniform Methods Project. Thermostat runtime data is being viewed as acceptable for M&V purposes in this standard. Specifically, in section 4 (pg. 14) of the draft protocol (available upon request via NREL2) the DOE supports the use of telemetry data as appropriate for M&V, stating: "As residential electricity demand for space heating and cooling often contributes significantly to peak demand, administrators of smart thermostat programs may want to estimate the peak energy savings from smart thermostats. To estimate accurately the energy savings for the utility's peak hour(s), evaluators should collect and analyze hourly or sub-hourly electricity consumption or thermostat runtime data using the methods for thermostat replacement programs or optimization programs described previously in this chapter."

USE CASE 3: RESIDENTIAL SOLAR, SOLAR +STORAGE, STANDALONE STORAGE, AND EV CHARGING

THE OPPORTUNITY:

With the issuance of Order 2222, DER aggregators will be seeking to bid customer-sited resources such as batteries, rooftop solar panels, and "smart loads" (e.g., EV chargers) into wholesale markets. Both distribution utilities and RTOs/ISOs stand to benefit from this participation, since it will optimize the use of these resources, help reduce peak load costs by avoiding the use of expensive, seldom used, polluting peaking generating plants, and provide flexibility to enable higher renewable penetration. This improved utilization, and the increase in competition they provide in wholesale markets, will lower wholesale prices and improve the economics of these resources for owners, spurring further adoption. Incorporating these resources into the wholesale markets will also increase visibility into the performance and status of these resources for transmission and distribution grid operators.

There is widespread interest in transitioning to an electrified economy among consumers, states, and federal regulators and policymakers because doing so will reduce total energy costs and greenhouse gas emissions. In fact, for the average family, a fully electrified household would save nearly $2,000 per year.[16] Powering our entire economy

[16] Griffith et al., (July 2020), Rewiring America: A Field Manual for the Climate Fight, Page 77, *available at* https://www.rewiringamerica.org/

on clean electricity will require a massive buildout of clean generation of all types, and DERs can contribute significantly. With every appliance, machine, and vehicle running on clean electricity, we could power half of the economy using rooftop solar alone.[17] In order to keep the grid efficient and keep peak costs down, these grid-edge generators and loads must be optimized in wholesale and retail markets. For example, in a high-electrification scenario in ISO-NE in 2040, the American Council for an Energy Efficient Economy ("ACEEE") modeled a deep demand-side management scenario that included a combination of deep building retrofits with rooftop solar, batteries and EVs, and found that it shaved peak demand by 34 percent and delivered approximately four times the energy savings of traditional efficiency and heat pumps.[18]

Residential behind-the-meter DERs can provide a range of services:

Potential retail services include customer bill management, peak load shaving, renewable energy credits (RECs), onsite backup generation.

Potential wholesale services include energy, capacity, ancillary services, demand response and increased energy consumption when additional load would benefit grid operators (as in"smart charging").

OVERCOMING BARRIERS:

Before these DERs can participate widely in wholesale markets, additional tariffs and rules will be required. Current metering and telemetry requirements, coupled with a lack of AMI, renders participation of these resources nearly impossible in many regions. First, specific metering requirements must be created for the residential sector, as standard metering practices such as baselining do not work well for frequently dispatched resources with unpredictable load shapes.

> ***Recommendation 1:*** *To address this market barrier, grid operators should create a participation option for smaller DERs that allows for sub-metering. These sub-metering options should not be dependent on distribution utilities' meter reading capabilities; rather they should allow non-utility third parties that meet*

[17] *Ibid*, Page 48

[18] Mike Specian et al., American Council for an Energy Efficient Economy (April 2021), Demand-Side Solutions to Winter Peaks and Constraints, available at https://www.aceee.org/sites/default/files/pdfs/u2101.pdf

certain transparently prescribed standards to provide metering and reporting services. (See also Use Case 1, Recommendation 3; Use Case 2, Recommendation 1).

As with residential DR, residential behind the meter resources can be precluded from wholesale market participation by unnecessarily stringent and costly metering and telemetry requirements.

Recommendation 2: *The data and telemetry required for these small, sub-metered resources should be limited to what is necessary to provide and measure the market service the resource is providing, and not based on legacy practices applied to traditional resources.*

Finally, given the range of behind-the-meter technologies and pace of innovation, participation models should provide as much flexibility as possible to accommodate different business models and different combinations and configurations of resources. Designing market rules based on specific combinations or configurations would stifle innovation and create roadblocks to full utilization of DERs behind-the-meter.

Recommendation 3: *New market rules should ensure flexibility so that providers have the ability to design and bid in different configurations (e.g., treating solar+storage as combined or separate resources as needed).*

USE CASE 4: FRONT-OF-THE-METER DISTRIBUTION-CONNECTED RESOURCES – COMMUNITY SOLAR AND SOLAR+STORAGE

THE OPPORTUNITY:

Deployment of front-of-the-meter distribution-connected resources has surged in recent years. States, municipalities, and local governments are encouraging the development of larger DERs such as community solar, which allows community members who are unable to host solar panels on their individual homes to share the output of a solar facility. According to the National Renewable Energy Laboratory (NREL), community solar has grown by approximately 121% since 2010 and now represents 2,625 MW of total installed capacity in the U.S.[19] Many sites are adding storage (such as batteries) to these solar facilities to absorb excess power generated for later use to enhance reliability for local customers. General retail customers and large industrial energy users such as factories can opt-in to purchase energy from these projects through utilities or third-party competitors.

Distribution-connected front-of-the-meter resources such as community solar are proliferating in many regions served by organized wholesale markets. The community

[19] NREL (2020), Sharing the Sun: Understanding Community Solar Deployment and Subscriptions, https://www.nrel.gov/docs/fy20osti/75438.pdf

solar model provides benefits to communities and landowners and has demonstrated results, meaning community solar is slated to grow even more in recent years. For example, Massachusetts has been successful in incentivizing the siting and building of hundreds of megawatts of community solar and storage within the ISO New England (ISO-NE) footprint through its Solar Massachusetts Renewable Target (SMART) program, leading the nation in community solar and storage deployment. However, bulk power grid operators and distribution utilities have struggled to take full advantage of these unique resources. While SMART systems currently participate in wholesale energy markets, these projects rarely align their dispatch to support bulk power system energy needs and even more rarely offer and sell other products such as reserves, regulation, and capacity. Further alignment between the design of state programs like SMART and wholesale energy market rules could unlock additional opportunities for resources to monetize market services and ultimately reduce consumer costs.

Distribution-connected front-of-the-meter resources can provide several services:

Potential retail services include peak load shaving, net metering, RECs

Potential wholesale services include energy, capacity, and ancillary services such as regulation, reserves, and reactive power.

OVERCOMING BARRIERS:

Current wholesale market rules are not designed to facilitate the sale of every product and service that front-of-the-meter distribution-connected systems can provide.

These resources, which in many ways do not resemble traditional resources, are not always designed and built for alignment with wholesale tariffs, and their location on the distribution system can create additional challenges. For example, many distribution-connected systems do not physically separate out and meter their station service (i.e., the amount of energy they consume for onsite purposes), which creates difficulty in assigning rates. The entire system might be charged retail rates while charging because there is no process to separately meter and account for what electrons were used for onsite needs (such as air conditioning) and what electrons were stored in the battery. Relatedly, storage is exempt from most transmission charges while the station service is not, and when they are combined, it creates the potential for the entire system to be charged these fees.

These resources are also sometimes precluded from providing services they are capable of providing. For example, ISO-NE's dispatch software cannot accurately model reserves on co-located resources in certain configurations, preventing these resources from offering and being compensated for reserves even though it is physically possible for them to do so.

Interconnection has been another major barrier to participation by front-of-the-meter solar and solar+storage projects. One key interconnection challenge relates to resources that are interconnecting to "dual-use feeders." If a project interconnects to a substation and then decides to participate in a wholesale market, the feeder becomes a "dual-use feeder" subject to FERC jurisdiction, which means all subsequent projects that want to participate in the market must go through FERC-regulated interconnection processes (such as Schedule 23 in ISO-NE) instead of the state-regulated interconnection process. This process is costlier, slower, and riskier, as compared to the state interconnection process, but delivers no appreciable difference in reliability benefits. It is therefore understandable when developers interconnecting to dual-use feeders opt out of wholesale capacity market participation and forego additional revenue streams.

Order No. 2222 resolves this issue for DERs participating in an aggregation by allowing these resources to go through a state interconnection process rather than the applicable RTO/ISO interconnection process. Ensuring that more projects can participate in Order No. 2222 aggregations will help address this challenge by ensuring these projects can utilize the state interconnection process.

> ***Recommendation 1:*** *Eliminate barriers to front-of-the-meter resources participating in Order No. 2222 aggregations by avoiding maximum size requirements that exclude their eligibility and ensuring that these resources participating as aggregations are eligible to sell the same products and services at the same rates as non-aggregated front-of-the-meter resources. These measures will ensure that these DERs are able, pursuant to Order No. 2222, to take advantage of state interconnection processes that are more appropriate and less burdensome to complete.*

While Order No. 2222 may provide an opportunity for these resources to participate in the market with state-jurisdictional interconnection agreements (even when interconnected to a dual-use feeder), the translation of these rules into RTO-specific processes and models will be critical to their success.

> ***Recommendation 2:*** *Solutions to this barrier may involve tariff, procedure, and manual revisions, new metering designs, and in some cases the development of new meter standards (for DC-coupled systems). It also requires a willingness from distribution utilities to help solve the problem, as these utilities are crucial to ensuring the successful implementation of Order No. 2222. Without such engagement, distributed resources may continue to be sidelined from RTO market participation.*

NEXT STEPS AND GENERAL RECOMMENDATIONS:

Order No. 2222 sets in motion the development of new tariffs and rules by wholesale grid operators to allow for greater participation of DERs in wholesale markets. Each FERC-regulated RTO/ISO is now developing the rule changes needed to implement Order No. 2222, but ushering in the wave of DERs will require the adoption of new approaches and enhanced coordination. Regulators, system operators, and utilities must develop innovative ways to reliably integrate the growing number of DERs and work to bring these flexible products to the grid and customers. While specific market rules will vary by region, there are several principles that should guide each RTO/ISO when creating participation models for DERs:

> ***Recommendation 1:*** *RTOs/ISOs should create market rules that maximize the participation of DERs. The goal of stakeholder processes in RTOs/ISOs should be to create pathways that allow full participation of aggregated DERs in all wholesale markets. Order No. 2222 envisions that aggregated DERs will be able to provide all the wholesale services they are capable of providing. To achieve that vision, RTOs/ISOs must conduct a full-scale review of their existing and proposed rules and procedures—including registration, qualification, and performance requirements—to ensure that they account for the unique technical and operational characteristics of DERs and do not create barriers to their participation.*

Recommendation 2: *RTOs/ISOs should ensure that a range of business models and technologies can participate. As these use cases demonstrate, DER aggregations can come in many sizes and flavors, each with unique capabilities and benefits. Participation models should allow a mix of technologies to aggregate while optimizing the capabilities of a range of DER aggregation types without creating undue barriers (especially for aggregations of smaller DERs).*

Recommendation 3: *Grid operators should seek to harmonize retail and wholesale use cases. When designing market rules, grid operators should account for the technical operational characteristics of DER aggregations and the services they can provide in both the wholesale markets and in state-regulated retail programs. RTOs/ISOs should allow DERs to participate to the maximum extent possible in both markets while working with local actors (such as distribution utilities and state regulators) to ensure that these resources are able to interconnect to their systems and operate safely and reliably, and that their obligations in both the wholesale market and retail programs can be harmonized. Focusing on harmonizing wholesale and retail participation is key to maximizing utilization of DERs across the grid, which will reduce costs for all customers.*