ENERGY STORAGE AND THE FUTURE OF THE ELECTRIC MARKET

By Caroline Trum[*]

Synopsis: In recent years, there has been expanded use of energy storage systems, particularly batteries, within the wholesale electric markets. While energy storage represents only a small percentage of the total number of resources deployed on the electric grid today, the U.S. Department of Energy has identified the use of energy storage as a potential path to help ensure the future reliability and resiliency of the United States power grid. The Federal Energy Regulatory Commission (FERC) has taken important steps through the issuance of a series of orders addressing the participation of energy storage within the wholesale market, culminating with the landmark Order No. 841 *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*,[1] but there may be barriers that are slowing the industry's realization of the full benefits of these resources. This article focuses on the use of energy storage resources by the electric industry and includes an overview of the types of energy storage facility technologies in use as well as an examination of how the FERC jurisdictional regional transmission organizations and independent system operators responded to Order No. 841. The article also discusses the steps that can be taken to promote wider integration of energy storage resources, including policy initiatives that facilitate energy storage development implemented by FERC, the U.S. Department of Energy, the Electric Reliability Council of Texas, and state regulators (particularly in Hawaii and Massachusetts) and industry standardization efforts to support energy storage use within the market.

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1. Final Rulemaking, *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 83 Fed. Reg. 9,580 (2018) (codified at 18 C.F.R. § 35) [hereinafter Order No. 841].

I. INTRODUCTION

The U.S. Department of Energy (DoE) has called for the expanded use of energy storage resources as one method to resolve some of the most critical needs facing our electric grid: reliability and resilience; modernization; and diverse, secure electric generation.[2] The term energy storage covers an array of resource types, from hydroelectric facilities that have historically made up the bulk of energy storage deployed on the electric grid, to batteries which have only become technologically and economically viable for large-scale use in recent years. While there are several types of storage mediums, the focus of this article is energy storage resources that fall within the Federal Energy Regulatory Commission's (FERC) definition of Electric Storage Resource – a resource that can withdraw electricity from the grid and store that electricity until some later point in time before injecting it back onto the grid.[3]

It is this unique feature of delaying the need to consume energy as soon as it is produced that makes energy storage such an appealing resource, especially as an ever-increasing percentage of the electric generation in the United States comes from variable renewable sources like solar and wind. Perhaps the largest hindrance in utilizing solar and wind generation has been that these resources often produce the greatest amount of electricity at times when demand is lowest, necessitating the use of peaking power plants to meet high demand during times when renewable generation cannot be produced.[4] Over the next ten years, there have been estimates that the grid will need an additional twenty gigawatts of peaking capacity to meet growths in demand, especially in states like California and Texas.[5] Energy storage, with its ability to convert excess energy from renewable sources during periods of low demand, represents a viable solution for meeting

2. U.S. DEP'T OF ENERGY, SPOTLIGHT: SOLVING CHALLENGES IN ENERGY STORAGE 2 (2018), https://www.energy.gov/sites/prod/files/2018/09/f55/2018-08-23_Spotlight%20on%20Energy%20Storage%20-%20Brochure%20and%20Success%20Stories_0.pdf.

3. Order No. 841, *supra* note 1, at P 29.

4. Will McNamara, *Issue Brief: Energy Storage to Replace Peaker Plants*, SANDIA NAT'L LABORATORIES 3 (Nov. 2020), https://www.sandia.gov/ess-ssl/download/4887/.

5. *Id.* at 1.

future increases in peak demand without having to build new peaking power plants, which require significant investment costs while typically operating less than 7% of the time in a given calendar year.[6]

Although energy storage facilities are often discussed as a standalone category, a number of smaller energy storage resources, such as batteries, can also be classified as part of a broader grouping known as distributed energy resources.[7] One important feature of energy storage (and all types of distributed energy resources), is that these resource types are considered fast-responding resources.[8] As such, these resource types will likely have an important role to play in securing the future reliability of the electric grid. The growing penetration of wind and solar resources, coupled with the retirement of aging, traditional power plants, means that an increasing percentage of generation will be produced by variable renewable resources.[9] In comparison to the synchronous generation produced by traditional power plants, variable resource generation is considered non-synchronous and cannot be relied upon to provide certain innate functionalities, like inertia (i.e. kinetic energy), that are integral to reliably delivering electricity.[10] While energy storage does not produce inertia as a byproduct of generation, the ability of these resources to quickly infuse electricity onto the grid could fill the same role inertia plays, momentarily maintaining the grid after an unexpected outage until other generation resources respond to produce more electricity.[11]

Energy storage facilities also could be key in helping to mitigate the reliability impacts of extreme weather events. One analysis has shown that weather-related power outages within the United States have increased by 67% since 2000,[12] and the North American Electric Reliability Corporation (NERC) has identified "extreme weather events as a leading contributor to transmission, generation, and load loss."[13] In 2012, Hurricane Sandy caused outages for more than 8,000,000 customers across parts of the Northeast, Mid-Atlantic, and Ohio Valley.[14] More recently, Winter Storm Uri left more than 4,000,000 Texas residents without

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6. *Id*. at 3.

7. *Solar Integration: Distributed Energy Resources and Microgrids*, OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, https://www.energy.gov/eere/solar/solar-integration-distributed-energy-resources-and-microgrids (last visited Sept. 10, 2021). Distributed energy resources are small-scale generating units located on a distribution system and include resources like batteries, rooftop solar panels, and microgrids.

8. Will McNamara, *supra* note 4, at 9.

9. Per the U.S. Energy Information Administration, approximately 63% of electricity was produced by traditional generation facilities consuming fossil fuels, 20% from nuclear energy, and 18% from renewable energy sources in 2019. *Frequently Asked Questions (FAQs),* U.S. ENERGY INFORMATION ADMINISTRATION (Mar. 5, 2021), https://www.eia.gov/tools/faqs/faq.php?id=427&t=3.

10. Inertia and the Power Grid: A Guide Without the Spin, Nat'l Renewable Energy Lab 1 (2020), https://www.nrel.gov/docs/fy20osti/76534.pdf.

11. *Id.* at 2.

12. *Power Off: Extreme Weather and Power Outa1ges*, CLIMATE CENTRAL (Sept. 30, 2020), https://medialibrary.climatecentral.org/resources/power-outages.

13. 2019 STATE OF RELIABILITY, NORTH AMERICAN ELECTRIC RELIABILITY CORP. (June 2019), https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2019.pdf.

14. *Electricity restored to many in the Northeast but outages persist,* U.S. ENERGY INFO. AGENCY (Nov. 9, 2012), https://www.eia.gov/todayinenergy/detail.php?id=8730.

power in freezing temperatures, many for several days,[15] and Hurricane Ida knocked out power across eight states, impacting approximately 1,200,000 customers.[16] These outages can cost tens of billions of dollars in yearly economic loss in addition to posing dangerous risks to human life.[17] While energy storage systems alone cannot keep the lights on, the pairing of energy storage resources with renewable generation and their utilization within microgrids could help support critical infrastructure during outages. Puerto Rico is taking this approach following the aftermath of Hurricane Maria, which rendered nearly 80% of the island's transmission and distribution network inoperable.[18] In 2020, the Puerto Rico Energy Bureau ordered the island's utility provider, Puerto Rico Electric Power Authority (PREPA), to improve resiliency and safeguard against the effects of weather event outages through the utilization of microgrids, renewable generation, and energy storage, coupled with transmission system hardening practices.[19] In response, PREPA issued a request for proposal seeking construction of 1,000 megawatts of renewable energy capacity and 500 megawatts of energy storage capacity (of which at least 150 megawatts will be distributed virtual power plants).[20]

Beginning a decade ago, FERC began to carve a pathway for the participation of energy storage resources in the wholesale electric market. Order No. 755 was the first in a series of orders aimed at removing barriers to entry faced by third-party ancillary service providers while also enhancing the ability of owners of fast-responding resources to compete in the ancillary services market.[21] In this Order, FERC ruled that the established compensation methods for certain ancillary services failed to adequately recognize the inherent ability of then emerging fast-responding resources, like energy storage and demand response, to provide these

15. Tim Stelloh et al., *Millions in Texas without power as deadly storm brings snow, freezing weather,* NBC NEWS (Feb. 16, 2021), https://www.nbcnews.com/news/weather/knocked-out-texas-millions-face-record-lows-without-power-new-n1257964.

16. Owen Comstock, *Hurricane Ida caused at least 1.2 million electricity customers to lose power*, U.S. ENERGY INFO. AGENCY (Sept. 15, 2021), https://www.eia.gov/todayinenergy/detail.php?id=49556.

17. Weather-related power outages that occurred between 2003 and 2012 are estimated to have cost between $18 billion and $33 billion in yearly economic damages. ECONOMIC BENEFITS OF INCREASING ELECTRIC GRID RESILIENCE TO WEATHER OUTAGES, EXECUTIVE OFFICE OF THE PRESIDENT (Aug. 2013), https://www.energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf.

18. U.S. Energy Information Agency, *Puerto Rico electricity generation returned to pre-2017 hurricane levels one year later*. (November 25, 2019). Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=42095#:~:text=Damage%20from%20Hurricane%20Maria%20rendered,million%20MWh%20in%20October%202017.

19. Government of Puerto Rico Public Service Regulatory Board Puerto Rico Energy Bureau, *Final Resolution and Order on the Puerto Rico Electric Power Authority's Integrated Resource Plan*. Case No. CEPR-AP-2018-0001 (August 24, 2020).

20. *See* Puerto Rico Electric Power Authority, *Renewable Energy Generation and Energy Storage Resources*, Request for Proposal No. 112648 (February 22, 2021). Retrieved from: https://aeepr.com/es-pr/Documents/RFP%20Renewable%20Energy%20Generation/PREPA%20RFP%20112648%20-%20Renewable%20Energy%20Generation.pdf

21. Order No. 784, *Third-Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technologies*, 144 FERC ¶ 61,056 at P 14 (2013) (codified at 18 C.F.R. 35) [hereinafter Order No. 784].

services as compared to traditional water, steam, and combustion turbine generators from which the services had been historically procured, resulting in unjust, unreasonable, and unduly discriminatory or preferential rates of compensation and economically inefficient use of resources.[22] To remedy this, FERC required that the compensation for these types of ancillary services, in part, reflect the quantity of the service provided.[23]

Next, followed Order Nos. 784 and 819, which revised FERC's *Avista Corp*. policy regarding the sale of ancillary services by third-party providers.[24] In Order No. 784, FERC expanded the circumstances under which third parties could sell certain services at market-based rates to public utility transmission providers.[25] Prior to this ruling, the Commission's *Avista Corp.* policy required public utility transmission providers to purchase ancillary services from third parties at cost-based rates if the provider was purchasing those services as part of Open Access Transmission Tariff (OATT) obligations to provide services to its customers.[26] Order No. 784 expanded the types of services for which third party providers were eligible to receive market-based rate compensation as opposed to cost-based rate[27] as well as mandated public utility transmission providers consider the speed and accuracy of resources in establishing reserve requirements for certain ancillary services in order to help prevent undue discrimination against customers that procure them from fast-responding resources.[28] Further, in recognition of the increased availability of energy storage resources for use in public utility transmission provider operations, FERC modified its accounting and reporting requirements to provide greater transparency with regards to utilization of these resource types.[29] FERC further built upon this expansion a few years later with the inclusion of additional ancillary services eligible for market-based rate compensation in Order No. 819.[30]

In addition to addressing the participation of energy storage resources in the ancillary services market, FERC also issued orders aimed at providing greater clarity and consistency regarding the interconnection process for energy storage facilities. First, through Order No. 792, FERC addressed the interconnection requirements for generating facilities no larger than 20 megawatts by modifying its *pro*

22. Order No. 755, *Frequency Regulation Compensation in the Organized Wholesale Power Markets*, 137 FERC ¶ 61,064 (2011), 76 Fed. Reg. 67,259 (2011) (codified at 18 C.F.R. § 35) [hereinafter Order No. 755].

23. *Id*. at P 3.

24. Order No. 819, *Third-Party Provision of Primary Frequency Response Service*, 153 FERC ¶ 61,220 at P 2 (2015), 80 Fed. Reg. 73,965 (2015) [hereinafter *Order No. 819*].

25. Order No. 784, *supra* note 21, at P 7.

26. *Id.* at P 12.

27. *Id*. at P 13.

28. *Id*. at P 4. Specifically, the Commission stated that "acknowledging the speed and accuracy of the resources used to provide this [ancillary] service will help to ensure that self-supply requirements of the public utility transmission provider do not unduly discriminate by requiring customers to procure a different amount of regulation reserves than the particular speed and accuracy characteristics of the resources in question justify."

29. *Id*. at P 5.

30. Order No. 819, *supra* note 24, at P 58.

forma Small Generator Interconnection Procedures and *pro forma* Small Generator Interconnection Agreement to incorporate energy storage.[31] This was followed by the issuance of Order No. 845 which made similar changes to the *pro forma* Large Generator Interconnection Procedures and *pro forma* Large Generator Interconnection Agreement by expanding the definition of generating facility within the *pro forma* documents to include energy storage resources.[32] Order No. 845 also clarified that energy storage resources can be a generating facility and/or a transmission asset.[33] Together, these Orders provide clarity to the wholesale interconnection process for energy storage resources, helping to promote their integration into the wholesale market.

Issued in 2018 a few months prior to Order No. 845, FERC's most consequential ruling to date regarding the participation of energy storage has been Order No. 841. Through this Order, FERC mandated the participation of energy storage resources within organized wholesale markets consistent with the treatment of other market participants.[34] However, for the energy industry to capitalize on the benefits of energy storage, there must be wider use of the resource type across the grid. While FERC has created a strong regulatory foundation to support the expansion of energy storage within the wholesale markets, there are additional actions that can be taken by policymakers, regulators, and the electric industry to foster greater utilization of energy storage and breakdown remaining roadblocks that are unintentionally impeding integration.

II. TYPES OF ENERGY STORAGE

To better understand the capabilities of energy storage, a brief primer on the resource may be beneficial. The most common application of energy storage within the electric industry today is hydroelectric storage. Known also as pumped hydro storage, this system involves pumping water into a stored area that can then be released at a later point in time, flowing downhill through turbines to create electricity.[35] Although pumped hydro storage still dominates the market, comprising approximately 90% of all energy storage capacity,[36] recent advances in technology have led to a greater prominence by other storage mediums. In total, there are generally five identified storage medium classifications:

31. Order No. 792, *Small Generator Interconnection Agreements and Procedures*, 145 FERC ¶ 61,159 (2013), 78 Fed. Reg. 73,239 (2013) (codified at 18 C.F.R. § 35) [hereinafter Order No. 792].

32. Order No. 845, *Reform of Generator Interconnection Procedures and Agreements*, 163 FERC ¶ 61,043 (2018), 83 Fed. Reg. 21,342 (2018) (codified at 18 C.F.R. § 37) [hereinafter Order No. 845].

33. *Id*. at P 278.

34. Order No. 841, *supra* note 1.

35. NAT'L TECH. & ENG'G SCIENCES OF SANDIA ENERGY STORAGE GLOSSARY OF TERMS 7, https://www.sandia.gov/ess-ssl/download/4433/.

36. UNIV. OF MICHIGAN CENTER FOR SUSTAINABLE SYSTEMS, U.S. GRID ENERGY STORAGE FACTSHEET 2 (2020), http://css.umich.edu/sites/default/files/US%20Grid%20Energy%20Storage_CSS15-17_e2020.pdf

1. Mechanical storage mediums, which include systems like pumped hydro,[37] compressed air,[38] and flywheels;[39]

2. Electrochemical storage mediums, which include all battery types (e.g. lithium-ion, flow, and lead-acid);[40]

3. Thermal storage mediums, which convert and store energy from phase-change conversion (such as the heating of ice to water);[41]

4. Electrical storage mediums, which include supercapacitors[42] and superconducting magnetic energy storage;[43] and

5. Chemical storage mediums, such as fuel cells.[44]

While most are likely familiar with the commercial application of batteries to power electric vehicles, the electric industry has begun to deploy large-scale batteries as part of grid energy storage systems. In 2010, only seven battery energy storage systems, often referred to as BESS units, were in use on the U.S. power grid, amounting to a total of 59 megawatts of capacity.[45] By the end of 2018, that number climbed to 125 units and 869 megawatts of capacity,[46] with some projected growth estimates indicating that by 2050, between 59 gigawatts and 108 gigawatts of battery storage capacity will be added to the grid.[47]

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37. NAT'L TECH. & ENG'G SCIENCES OF SANDIA ENERGY STORAGE GLOSSARY OF TERMS 7, https://www.sandia.gov/ess-ssl/download/4433/. Pumped hydro refers to a system that stores energy through the "gravitational potential energy of water" by pumping water from areas of lower elevation to higher elevation.

38. *Id.* at 1. Compressed air refers to a system that forces air through a compressor which is then stored in a cavern or chamber until released through a turbine to create energy.

39. *See* The Environmental Protection Agency, *Electronic Storage*, EPA (2020) https://www.epa.gov/energy/electricity-storage (last visited Sept. 10, 2021). Flywheels refer to a system that utilizes electricity to spin a specific rotor type known as a flywheel. Energy is stored via the kinetic rotational energy of the spinning flywheel and converted back into electricity by using the flywheel to turn a generator.

40. Geoffrey J. May et al., *Lead Batteries for Utility Energy Storage: A Review*, 15 J. OF ENERGY STORAGE 145, 146-47, 152 (2018).

41. Ioan Sarbu et al., *A Comprehensive Review of Thermal Energy Storage*, SUSTAINABILITY (Jan. 14, 2018), https://www.mdpi.com/2071-1050/10/1/191.

42. Pietro Tumino, *An Introduction to Energy Storage Systems*, EE POWER (Sept. 14, 2020), https://eepower.com/technical-articles/an-introduction-to-energy-storage-systems/. Supercapacitors are an advanced type of capacitor that possess the capability to store energy through an electrostatic charge.

43. EUROPEAN ENERGY RESEARCH ALL., SUPERCONDUCTING MAGNETIC ENERGY STORAGE (2019), https://eera-es.eu/wp- content/uploads/2019/04/EERA_JPES_SP5_Factsheet_final.pdf. Superconducting magnetic energy storage refers to a system that stores power through magnets by passing an electric current through a coil of superconducting material.

44. N. AM. ELEC. RELIABILITY CORP., ENERGY STORAGE: IMPACTS OF ELECTROCHEMICAL UTILITY-SCALE BATTERY ENERGY STORAGE SYSTEMS ON THE BULK POWER SYSTEM 8 (2021), https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/Master_ESAT_Report.pdf.

45. U.S. ENERGY INFO. ADMIN., BATTERY STORAGE IN THE UNITED STATES: AN UPDATE ON MARKET Trends 5 (2020), https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf.

46. *Id*.

47. U.S. ENERGY INFO. ADMIN., EIA'S AEO2021 SHOWS GROWING USE OF BATTERIES ON THE U.S. ELECTRICITY GRID (2021), https://www.eia.gov/todayinenergy/detail.php?id=47276.

III. KEY WHOLESALE MARKET REFORMS UNDER FERC ORDER NO. 841

Within the contiguous United States, the operation of much of the bulk electric system, including managing reliability and ensuring commercial optimization of the electric grid, is overseen by seven entities, referred to as Regional Transmission Organizations (RTOs) or Independent System Operators (ISOs).[48] Six of these organizations fall under FERC jurisdiction: California Independent System Operator Corporation (CAISO), ISO New England, Inc. (ISO-NE), Midcontinent Independent System Operator, Inc. (MISO), New York Independent System Operator, Inc. (NYISO), PJM Interconnection, L.L.C. (PJM), and Southwest Power Pool, Inc. (SPP).[49] The seventh entity is the Electric Reliability Council of Texas (ERCOT), which manages the Texas Interconnection, a portion of the electric grid wholly contained within the borders of the state of Texas.[50] As this portion of the grid is not synchronously interconnected to the Eastern or Western Interconnection, the transmission and consumption of electricity that occurs within ERCOT is considered intrastate commerce under the Federal Power Act and not subject to FERC jurisdiction regarding market design.[51] Oversight of ERCOT is performed by the Texas Legislature and the Public Utility Commission of Texas.[52] The Texas Reliability Entity, referred to as Texas RE, is the designated regional reliability organization for the ERCOT footprint.[53]

FERC requires the RTOs and ISOs under its jurisdiction to maintain a collection of market rules, collectively known as a tariff, that govern, among other

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48. ENERGY FREEDOM COLO., THE U.S. ELECTRICITY SYSTEM (last visited Sept. 24 2021), https://energyfreedomco.org/elec-system.php.

49. *Id.*

50. OFFICE OF ELEC., DEP'T OF ENERGY, LEARN MORE ABOUT INTERCONNECTIONS (last visited Sept. 24 2021), https://www.energy.gov/oe/services/electricity-policy-coordination-and-implementation/transmission-planning/recovery-act-0.

51. 16 U.S.C. § 824(b)-(c) (2015). While the Texas Interconnection is not synchronously interconnected to any other grid, ERCOT does maintain asynchronous connections to the Eastern Interconnection and Mexico's power grid through direct current (DC) ties that allow small amounts of electric generation to flow between grids. FERC has stated that these asynchronous connections, authorized by the Commission under sections 210 and 211 of the Federal Power Act (16 U.S.C. § 824(i)-(j)), do not cause ERCOT or any utility within ERCOT to become a public utility under the Federal Power Act. *See City of College Station, TX*, 137 FERC ¶ 61,230 (2011); *Brazos Elec. Power Coop., Inc*., 118 FERC ¶ 61,199 (2007); *Kiowa Power Partners, LLC*, 99 FERC ¶ 61,251 (2002) (Kiowa); *Central Power and Light Co*., 40 FERC ¶ 61,077 (1987); *Central Power and Light Co*., 17 FERC ¶ 61,078 (1981). FERC recently affirmed this determination but indicated that the asynchronous connections between Texas and Mexico could result in interstate power flows if additional interconnection ties between the Mexican grid and border states like Arizona and California are built. This would lead to a co-mingling in Mexico of electricity produced in these states with the electricity produced in Texas, which would then flow back into Arizona and California through the cross-border ties, creating interstate power flows. *AEP Energy Partners, Inc.*, 164 FERC ¶ 61,056 at P 2 (2018).

52. ERCOT is a 501(c)(4) nonprofit corporation governed by a board of directors and overseen by the Public Utility Commission of Texas and the Texas Legislature. ERCOT, ABOUT ERCOT (n.d.), http://www.ercot.com/about.

53. Texas RE, through a FERC approved delegation agreement with NERC, has the authority to "(1) develop regional standards; (2) develop, monitor, assess, and enforce compliance with NERC Reliability Standards; and (3) assess and periodically report on the reliability and adequacy of the bulk power system." Texas Reliability Entity, Inc., *About Us*, TEXASRE (last visited Sept. 24 2021), https://www.texasre.org/pages/aboutus.

items, participation within its wholesale market.[54] Over the years though, FERC has found that certain market participants require special provisions to ensure just, reasonable, and non-discriminatory participation within the wholesale marketplace and, in turn, has required jurisdictional RTOs and ISOs to develop distinct tariff provisions in order to create a separate participation model for these market participants.[55] As previously mentioned, FERC's landmark decision in Order No. 841 was one such instance, laying the groundwork for widespread use of energy storage systems within the wholesale marketplaces operated by RTOs and ISOs. In the Order, FERC determined that energy storage resources, due to their distinctive ability to both take energy from and put energy onto the grid, possess unique physical and operational characteristics that warrant their own wholesale market participation model.[56] Although prior to the issuance of this rulemaking energy storage resources were already participating in the RTO and ISO markets, Order No. 841 introduces a number of key reforms aimed at removing barriers to entry and expanding participation.[57]

A. Defining Electric Storage Resources and the Participation Model

Under Order No. 841, FERC opted to establish a broad definition for energy storage, which it refers to specifically as Electric Storage Resources. As a result, any resource, regardless of the storage medium, can qualify as an Electric Storage Resource as long as the resource possesses the ability to both withdraw and inject electric energy from and to the grid.[58] The location of the resource is immaterial, meaning that the requirements of the Order are applicable to any Electric Storage Resource regardless of location on the grid – in front of or behind the meter as well as on the interstate transmission system.[59]

At a high-level, the Electric Storage Resource Participation Model established by each RTO and ISO must:

> "(1) ensure that a resource using the participation model for Electric Storage Resources is eligible to provide all capacity, energy, and ancillary services that it is technically capable of providing in the RTO/ISO markets;
> (2) ensure that a resource using the participation model for Electric Storage Resources can be dispatched and can set the wholesale market clearing price as both a wholesale seller and a wholesale buyer consistent with existing market rules that govern when a resource can set the wholesale price;
> (3) account for the physical and operational characteristics of Electric Storage Resources through bidding parameters or other means; and
> (4) establish a minimum size requirement for participation in the RTO/ISO markets that does not exceed 100 kilowatts."[60]

Under the participation model, an Electric Storage Resource is considered eligible to provide capacity, energy, and ancillary services within the RTO and

54. Order No. 841, *supra* note 1, at P 1.
55. *Id.*
56. *Id*.
57. *Id*. at P 2.
58. *Id*. at P 29. *See also* 18 C.F.R. § 35.28(b)(9) (2019).
59. Order No. 841, *supra* note 1, at P 29.
60. *Id.* at P 4.

ISO marketplace as long as the resource is technically capable.[61] To be considered technically capable, the Electric Storage Resource must be able to meet all requirements – technical, operational, and performance – necessary to provide the service in question.[62] However, the Order does not require RTOs or ISOs to implement new market functionalities.[63] Within ISO-NE, MISO, NYISO, and PJM, these existing market functionalities include the administration of energy markets,[64] capacity markets,[65] and ancillary services markets.[66] Within CAISO and SPP, these existing market functionalities include administration of energy and ancillary service markets, as neither maintains a capacity market.[67]

In response to Order No. 841, CAISO opted to make modifications to two of its existing participation frameworks – the Non-Generator Resource (NGR) Participation Model and the Pumped-Storage Hydro Units Participation Model – to meet the prescribed requirements for an Electric Storage Resource Participation Model. The CAISO NGR model can be utilized by resources operating as generation or load that are dispatchable but constrained by some limiting factor in the megawatts they can generate, curtail, or consume.[68] While this model accommodates resources identified by FERC as Electric Storage Resources, it can also be used by other energy-constrained resources that may not be energy storage facilities, including microgrids and dispatchable demand response.[69] To qualify to participate under the CAISO NGR Participation Model, an Electric Storage Resource must be able to consume and generate energy and — in cases of demand response — curtail the consumption of energy.[70] The CAISO Pumped Storage Hydro Units Participation Model is specifically for resources that qualify as hydroelectric dams, and qualifying resources must be capable of producing electricity and possess "the ability to pump water between reservoirs at different elevations to store such water for the production of electricity."[71]

Similar to the distinction made by CAISO to establish participation models based on resource type, ISO-NE created a singular participation model, its Electric

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61. *Id*. at P 76.

62. *Id.* at P 78.

63. Order No. 841-A, *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127 (2018), *order on reh'g*, Order No. 841-A, 167 FERC ¶ 61,154 at P 68 (2019) [hereinafter *Order No. 841-A*].

64. *Id.* The energy market refers to the marketplace operated by RTOs and ISOs to buy and sell electricity in real-time to meet current demand by end-use customers.

65. *Id.* The capacity market refers to the marketplace operated by RTOs and ISOs to buy and sell capacity to ensure enough future generation will be available to meet anticipated projected demand.

66. *Id.* The ancillary services market refers to the marketplace operated by RTOs and ISOs to obtain grid services necessary for maintaining reliable operations.

67. *Id.* Although CAISO and SPP do not provide a capacity market, both entities ensure future generation needs will be met by defining resource adequacy (capacity) requirements for all generating facilities participating within its market footprint.

68. *Cal. Indep. System. Operator Compliance Filing Transmittal Letter,* FERC Docket No. ER19-468-000, at 7 (Dec. 3, 2018) [hereinafter *Initial CAISO Compliance Filing*].

69. *Id*.

70. *Id*. at 10.

71. *Id*.

Storage Facility Participation Model, but classifies Electric Storage Resources into one of two categories based on the physical characteristics of storage technology: Continuous Storage Facility or Binary Storage Facility.[72] Continuous Storage Facilities encompass resources that can seamlessly transition between states of charge and discharge, such as batteries.[73] To qualify as a Continuous Storage Facility, the Electric Storage Resource must both consume and supply energy as well as be able to switch between a charging state and discharging state rapidly (i.e., transition between maximum consumption and maximum generation in ten minutes or less) and continuously (i.e., be able to be dispatched to any megawatt level in the resource's range).[74] Resources categorized as Continuous Storage Facilities, unless declared unavailable by the resource owner, must also be able to "operat[e] in an on-line state at all times" and cannot share storage capabilities with another resource.[75] Binary Storage Facilities, by contrast, are resources that "cannot switch nearly instantaneously from charging to discharging nor operate continuously across the boundary between their negative and positive [megawatt] range," such as pumped hydro units.[76] To qualify in this category, the Electric Storage Resource must be able to consume and supply energy as well as be capable of offering as a Rapid Response Pricing Asset within ISO-NE, meaning the resource can come online within thirty minutes of receiving an instruction to do so.[77]

Next, MISO created its Electric Storage Resource Participation Model through the expansion of existing market constructs and the creation of new market mechanisms.[78] To qualify under the participation model, an Electric Storage Resource must have "the capability and intention to withdraw [e]nergy from, and inject it back to, MISO's Transmission System, for purposes of participating in MISO's markets by offering to provide market services or products the [Electric Storage Resource] is technically capable to provide" and either become a market participant within MISO or be represented by an existing MISO market participant.[79] Electric Storage Resources will utilize a commitment status mechanism to identify the resource's availability and which market products or services the resource can provide.[80] To delineate between the injection and withdrawal of energy by Electric Storage Resources and the consumption of energy by load-serving entities, MISO will specifically classify the charging and discharging activities of Electric Storage Resources as electric storage transactions.[81]

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72. *Indep. Sys. Operator New England Compliance Filing Transmittal Letter*, FERC Docket No. ER19-470-000, at 6 (Dec. 3, 2018) [hereinafter *Initial ISO-NE Compliance Filing*].

73. *Id*.

74. *Id*. at 8.

75. *Id*.

76. *Id*. at 7.

77. Initial ISO-NE-Compliance Filing, *supra* note 72, at 8.

78. *Midcontinent Indep. Sys. Operator, Inc. Compliance Filing Transmittal Letter*, FERC Docket No. ER19-465-000, at 5-6 (Dec. 3, 2018) [hereinafter *Initial MISO Compliance Filing*].

79. *Id*. at 7.

80. *Id*.

81. *Id*. at 5.

Within NYISO, Electric Storage Resources can opt to participate under its Energy Storage Resource Participation Model.[82] To do so, the resource must meet five separate and distinct criteria: (1) qualify as a generator under NYISO's guidelines; (2) be able to receive, store, and inject energy from and onto the grid; (3) have the ability to actually inject energy onto the grid; (4) "receive and inject energy at the same location on the grid" and (5) have the capability "to inject at a rate of at least 0.1 [megawatt] of [e]nergy for a period of at least one hour."[83] To account for the technical feasibility of incorporating the participation of Electric Storage Resources in the NYISO marketplace, these resources will be considered dispatch-only.[84] This requirement is a unique feature within NYISO as compared to the participation models created by the other RTOs and ISOs.

In PJM, Electric Storage Resources may participate under its Energy Storage Resource Participation Model[85] or Pumped Storage Hydroelectric Participation Model.[86] In response to Order No. 841, PJM modified its Energy Storage Resource Participation Model to ensure Electric Storage Resources would be able to fully participate within its marketplace, in part by expanding upon previous requirements that limited the purchase of energy from PJM to only certain market participants.[87] In defining the eligibility of a resource to use the Energy Storage Resource Participation Model, PJM requires that Electric Storage Resources only purchase energy that is stored for later resale to PJM.[88] Qualifying Electric Storage Resources that are eligible to participate under the Pumped Storage Hydroelectric Participation Model will annually select which model the resource will use to participate within PJM.[89]

Finally, prior to the issuance of Order No. 841, SPP required any market participant that possessed at least 0.1 megawatts that could be injected into or directly connected to the transmission system to register as an SPP Electric Storage Resource.[90] Now, these resources can elect to participate under a newly created resource registration type exclusive for use by FERC-qualifying Electric Storage Resources, the SPP Market Storage Resource.[91] The SPP Market Storage Resource Participation Model introduces three new functionalities in compliance with Order No. 841 not previously available within the SPP marketplace for entities qualifying as Electric Storage Resources: (1) the ability to be dispatched to withdraw energy; (2) the inclusion of physical and operational characteristics of

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82. *N.Y. Indep. Sys. Operator, Inc. Compliance Filing Transmittal Letter,* FERC Docket No. ER19-476-000, at 6-8 (Dec. 3, 2018) [hereinafter *Initial NYISO Compliance Filing*].

83. *Id*. at 13.

84. *Id*. at 18-19.

85. *PJM Interconnection, L.L.C. Compliance Filing Transmittal Letter*, FERC Docket No. ER19-469-000 (Dec. 3, 2018), at 5-6 [hereinafter *Initial PJM Compliance Filing*].

86. *Id*.

87. *Id*. at 13.

88. *Id*. at 14.

89. *Id*. at 18.

90. *Southwest Power Pool, Inc. Compliance Filing Transmittal Letter*, FERC Docket No. ER19-460-000, at 43 (Dec. 3, 2018) [hereinafter *Initial SPP Compliance Filing*].

91. *Id*. at 7.

the resource in the market dispatch and (3) the clarification that transmission charges are not applicable if withdrawals of energy are the result of market dispatch instructions.[92] As an alternative to the SPP Market Storage Resource model, an Electric Storage Resource may opt to register as any other existing resource type within the SPP marketplace.[93]

With the exception of MISO, which requested and was granted a delay in implementation until June 6, 2022 to effectuate necessary changes to its market software,[94] all Electric Storage Resource Participation Models within the RTOs and ISOs have now been implemented.[95]

B. Accommodations for Unique Electric Storage Resource Characteristics

1. De-Rating Capacity to Meet Minimum Run-Times

One important determination in Order No. 841 that effectuates participation by energy storage is that Electric Storage Resources must be permitted to de-rate capacity in order to meet the minimum run-time requirements established by each RTO and ISO.[96] As part of their tariffs, RTOs and ISOs identify the minimum amount of time that a resource participating within its market must be able to continuously provide energy, referred to as the minimum run-time. FERC recognized that in order to meet the minimum run-times proscribed by the RTOs and ISOs, an Electric Storage Resource may need to lower its output below the resource's maximum capability. For instance, a battery may be technically capable of storing twenty megawatts and releasing that energy at a maximum output of ten megawatts per hour for two hours. This would mean that for an RTO or ISO with a four-hour minimum run-time requirement, the battery may not qualify to participate in that marketplace based on its maximum output duration; however, that same battery, if allowed to de-rate its output to five megawatts per hour, is now capable of meeting the four-hour minimum run-time.

As part of Order No. 841, FERC declined to establish uniform rules regarding minimum run-time requirements,[97] and each RTO and ISO established provisions consistent with its existing requirements. MISO,[98] NYISO,[99] and SPP[100] all provide for de-rating by Electric Storage Resources to meet the four-hour minimum run-times within their marketplace, while ISO-NE requires a two-hour minimum

92. *Id*. at 5.

93. *Id*. at 7.

94. *Midcontinent Indep. Sys. Operator, Inc.,* 169 F.E.R.C. ¶ 61,137 at P 268 (2019).

95. David DesLauriers, Caroline Heilbrun, & Neve Stearns, *Order No. 841 – Planning for Next Steps*, CRA INSIGHTS (Apr. 13, 2020), https://media.crai.com/wp-content/uploads/2020/09/16164527/CRA-Insights-Order-841_-Planning_for_Next_Steps_04_2020.pdf.

96. Order No. 841, *supra* note 1, at P 94. *See also* 18 C.F.R. § 35.28(g)(9)(i)(A) (2019).

97. Order No. 841, *supra* note 1, at 96.

98. Initial MISO Compliance Filing, *supra* note 78, at 7.

99. Initial NYISO Compliance Filing, *supra* note 82, at 44.

100. Initial SPP Compliance Filing, *supra* note 90, at 13.

run time and will automatically de-rate for resources participating under its Electric Storage Facility Participation Model.[101] Within CAISO, resources set their own minimum capacity level based on technical capability and are able to de-rate to meet any service-specific requirements.[102] Additionally, resources participating under CAISO's NGR Participation Model can avoid having to de-rate capacity through the utilization of CAISO's Regulation Energy Management function.[103]

PJM, like the other RTOs and ISOs, established through tariff revisions that resources participating in its Energy Storage Resource Participation Model would be allowed to de-rate capacity to meet PJM's ten hour minimum run-time requirement.[104] Although FERC accepted PJM's proposal as consistent with Order No. 841 requirements, FERC initiated a separate paper hearing proceeding under section 206 of the Federal Power Act to determine if PJM's ten-hour minimum run-time, as applied to Electric Storage Resources is just, reasonable, and not unduly discriminatory.[105] FERC later consolidated this proceeding with a related matter to determine the just and reasonableness of the ten hour minimum run-time requirement as applied to all resource types.[106] In response, PJM proposed use of a new construct in order to determine the maximum amount of capacity non-traditional resources, like Electric Storage Resources, are capable of offering, replacing the current ten-hour capacity requirement.[107]

As described by PJM, its proposed Electric Load Carrying Capability (ELCC) construct is a technology-neutral approach that establishes a maximum level of capacity a resource may offer based on a reliability analysis that determines the amount of load a resource can be expected to serve in stressed system conditions.[108] PJM's ELCC calculation would apply to intermittent resources like solar and wind, limited duration resources such as batteries, and hybrid resources (i.e. resources that combine wind or solar generation with an energy storage component).[109] PJM purports that this methodology is similar to those employed by

101. Initial ISO-NE Compliance Filing, *supra* note 72, at 15.

102. Initial CAISO Compliance Filing, *supra* note 68, at 13.

103. *Id*. at 12-13, n. 64. CAISO maintains a 60-minute continuous energy requirement for regulation service in the day-ahead market. Regulation Energy Management is a function offered by CAISO to non-generator resources that solely provide regulation service to facilitate full participation in the regulation market by limited energy resources. Resources utilizing this function must be able to continuously curtail or generate energy for 15 minutes and can submit a bid for capacity up to four times the maximum megawatt-hour of the resource's capability within the 15-minute time period after the issuance of a dispatch instruction. CAISO offsets energy in the real-time market as needed to accommodate this participation. *See* CAISO Open Access Transmission Tariff § 8.4.1.2 and CAISO "Energy storage and aggregated distributed energy resource education forum" (2015). Available at https://www.caiso.com/Documents/Presentation-EnergyStorageandAggregatedDistributedEnergyResource-EducationalForum.pdf.

104. Initial PJM Compliance Filing, *supra* note 85, at 2.

105. *PJM Interconnection, L.L.C.*, 169 FERC ¶ 61,049, at PP 138 – 142 (2019).

106. *PJM Interconnection, L.L.C.*, 171 FERC ¶ 61,015 (2020).

107. *PJM Interconnection, L.L.C., Effective Load Carrying Capability Construct*, FERC Docket No. ER21-278-000, at 2 (Oct. 30, 2020).

108. *Id*. at 3.

109. *Id*. at 8.

CAISO, MISO, and NYISO.[110] While PJM's initial ELCC proposal was rejected by FERC due to a finding that certain, specific components of the proposal were unjust and unreasonable,[111] FERC subsequently approved a revised version of the PJM ELCC proposal that removed these aspects.[112] PJM's ELCC construct became effective on August 1, 2021.[113]

2. Electric Storage Resources as Wholesale Buyers and Sellers

In Order 841, FERC upheld its prior finding from *Norton Energy Storage* that electricity an Electric Storage Resource buys from the grid, stores, and then later resells into a RTO's or ISO's energy or ancillary services market qualifies as a sale for resale, meaning that Electric Storage Resources are eligible to participate as both wholesale buyers and wholesale sellers.[114] This will allow RTOs and ISOs to utilize Electric Storage Resources in the most efficient economical manner – demand when the market clearing price is lower than the resource's bid and supply when the market clearing price is higher than the resource's bid.[115] In allowing Electric Storage Resources to participate as both buyers and sellers, FERC anticipated that these resources could submit simultaneous bids to buy and offers to sell within the same market interval.[116] To prevent the issuance of conflicting instructions to the Electric Storage Resource, FERC required each RTO and ISO to employ a market design that will ensure the resource is only dispatched as either supply or demand.

To meet this requirement, ISO-NE uses its existing software capabilities which prohibit the consideration of simultaneous supply offers and demands bids for any Electric Storage Resource utilizing its Energy Storage Resource Participation Model.[117] Comparatively, MISO,[118] NYISO,[119] PJM,[120] and SPP[121] all utilize mechanisms that reflect the entire operating range of an Electric Storage Resource on a singular energy curve, allowing the resource to be dispatched at a singular point within its identified limits. PJM's mechanism to prevent conflicting dispatch signals also incorporates designations of operating modes by the Electric Storage Resource. For an Electric Storage Resource in charge mode, PJM will only accept demand bids,[122] and for resources in discharge mode, PJM will only accept supply

110. *Id*. at 3.
111. *PJM Interconnection, L.L.C,* 175 FERC ¶ 61,084 (2021).
112. PJM Interconnection, L.L.C., 176 FERC ¶ 61,056 (2021).
113. *Id* at P 3.
114. Order No. 841, *supra* note 1, at PP 141, 143.
115. *Id*. at PP 141, 143.
116. *Id*. at P 141.
117. Initial ISO-NE Compliance Filing, *supra* note 72, at 17-18.
118. Initial MISO Compliance Filing, *supra* note 78, at 11.
119. Initial NYISO Compliance Filing, *supra* note 82, at 9.
120. Initial PJM Compliance Filing, *supra* note 85, at 61.
121. Initial SPP Compliance Filing, *supra* note 90, at 15-16.
122. Initial PJM Compliance Filing, *supra* note 85, at 50.

offers.[123] Finally, CAISO utilizes a mix of processes to prevent conflicting dispatch. For Electric Storage Resources participating in its NGR Participation Model, CAISO uses a singular energy curve to represent the full charging and discharging range of an Electric Storage Resource participating in its NGR Participation Model.[124] For its Pumped-Storage Hydro Unit Participation Model, CAISO utilizes a market optimization process that dispatches the resource to its most economical use for a given market interval.[125]

3. State of Charge Management

Under Order No. 841, FERC granted the owner of an Electric Storage Resource the ability to manage the state of charge for the resource.[126] The state of charge, often expressed as a percentage, represents the expected amount of energy an Electric Storage Resource will have available at the beginning of a given market interval.[127] By managing its own state of charge, the owner of an Electric Storage Resource can self-schedule, controlling when the resource charges or discharges and the amount of energy stored. This ensures equal treatment of Electric Storage Resources by providing parity with the operational controls other resource owners are afforded in the wholesale marketplace. While recognizing the importance of self-determination for a resource, FERC also permitted RTOs and ISOs the option of developing a mechanism to manage state of charge on behalf of an Electric Storage Resource so long as participation is optional and resource owners are the default state of charge managers.[128]

In response, ISO-NE,[129] MISO,[130] PJM,[131] and SPP[132] all required Electric Storage Resources self-manage state of charge and provided various market mechanisms to accomplish this, such as bidding parameters, state of operation indicators (i.e. charge mode versus discharge mode), and real-time telemetry requirements. While CAISO and NYISO also provide these capabilities, both entities also opted to offer state of charge management services to its Electric Storage Resource participants. CAISO's management services are available to Electric Storage Resources participating in its market optimization process,[133] and NYISO's through a specific bidding parameter that allows the resource owner to elect how the energy levels for its Electric Storage Resource will be managed.[134]

123. *Id*.
124. Initial CAISO Compliance Filing, *supra* note 68, at 15-16.
125. *Id*. at 16.
126. Order No. 841, *supra* note 1, at P 246.
127. *Id*. at PP 208, 246.
128. *Id*. at P 249.
129. Initial ISO-NE Compliance Filing, *supra* note 72, at 26.
130. Initial MISO Compliance Filing, *supra* note 78, at 14-15.
131. Initial PJM Compliance Filing, *supra* note 85, at 32-33.
132. Initial SPP Compliance Filing, *supra* note 90, at 32-33.
133. Initial CAISO Compliance Filing, *supra* note 68, at. 18-19.
134. Initial NYISO Compliance Filing, *supra* note 82, at 24.

4. Charging of an Electric Storage Resource

The ability of an Electric Storage Resource to participate in both the retail and wholesale markets is by its nature complex as there may be times in which the retail activities of the resource are not easily distinguishable from the resource's wholesale activities, especially charging activities. In recognition, FERC required each RTO and ISO to develop metering and accounting practices as part of Order No. 841 to help delineate between a resource's wholesale and retail participation.[135] Specifically, the RTOs and ISOs must, either through direct metering or some alternative method (such as obtaining data from metering requirements imposed by other entities, like the distribution utility), measure all energy flowing into and out of an Electric Storage Resource in order to differentiate between wholesale and retail activities.[136]

As with other resources participating in the wholesale marketplace, Electric Storage Resources, regardless of the participation model being utilized, are eligible to pay the wholesale nodal locational marginal price[137] for any energy the resource purchases for later resale back into the market.[138] FERC encouraged each RTO and ISO, in the development of accounting practices, to coordinate with both distribution utilities and relevant retail regulators within its footprint.[139] These accounting practice must ensure that the Electric Storage Resource is charged the wholesale nodal locational marginal price for wholesale charging activities.[140] However, FERC realized that there may be instances in which retail and wholesale activities cannot be distinguished and established protections to prevent double payment by the Electric Storage Resource for the same energy charging event. In instances where a distribution utility cannot or will not net out the wholesale charging activities of an Electric Storage Resource from the retail bill, and the resource has already paid the retail rate for its charging activity, FERC prohibited RTOs and ISOs from recouping payment from the resource for that charging energy.[141] RTOs and ISOs cannot circumvent this requirement by requiring Electric Storage Resources in these situations to participate under a retail customer participation model.[142]

Although Electric Storage Resources are not required to purchase all energy for future use from the RTO and ISO,[143] when a resource does engage in wholesale charging activities, FERC considers these purchases to be interstate commerce.[144]

135. Order No. 841, *supra* note 1, at P 302.

136. *Id.* at P 322.

137. The locational marginal price, or LMP, represents the locational value of electricity at a particular point on the grid based on conditions at that point, including the generators that are being used to produce the electricity and limitations (congestion) on the transmission system; *See* FERC, ENERGY PRIMER – A HANDBOOK FOR ENERGY MARKET BASICS (2020).

138. Order No. 841, *supra* note 1, at P 294. *See also* 18 C.F.R. § 35.28(g)(9)(ii) (2019).

139. Order No. 841, *supra* note 1, at P 319.

140. *Id*. at P 275.

141. *Id*. at P 321.

142. *Id.* at P 41.

143. Order No. 841, *supra* note 1, at P 294.

144. *Id*. at P 295.

As with traditional generation resources, when an Electric Storage Resource is engaged in charging activities, the resource may be subject to transmission charges as it is behaving in a similar manner to other load-serving entities that are assessed transmission charges for energy usage.[145] These charges are to be assessed in a manner consistent with how the RTO's or ISO's existing rate structure assesses transmission charges to other wholesale loads.[146] Transmission charges are not applicable and should not be assessed if the Electric Storage Resource is charging in response to being dispatched by an RTO or ISO to provide a specific service.[147] The specific service being provided by the Electric Storage Resource in response to dispatch is not limited to ancillary services and can include any service defined within the RTO's or ISO's tariff.[148] While FERC declined to define the types of charging activities that could qualify as providing a service, Order No. 841-A clarified that an Electric Storage Resource could provide benefits, under certain system conditions, by engaging in economic charging activities.[149] If the resulting system benefits of a resource's economic dispatch charging activities constitute a service as defined by the RTO's or ISO's tariff, then the resource can be exempt from transmission charges consistent with the RTO's or ISO's existing rate structure.[150] Any new service that involves economic dispatch charging requires a revision to the RTO's or ISO's tariff through a separate filing under section 205 of the Federal Power Act.[151]

Both CAISO and NYISO proposed to exempt Electric Storage Resources from transmission charges based on a classification of energy withdrawn during charging as negative generation.[152] However, FERC determined that only CAISO's proposal was consistent with its existing rate structure.[153] Under market rules in place prior to Order No. 841, CAISO considers all Electric Storage Resources engaging in charging activities during periods of high supply and low demand or price to be providing a critical reliability service by reducing the need for generation curtailment, thus mitigating risk.[154] As such, CAISO classifies this type of charging energy from Electric Storage Resources as negative generation (as opposed to load) which, under its tariff, is settled at the wholesale nodal locational marginal price and not assessed transmission charges.[155] While such exemptions from transmission charges were historically provided only to resources participating under CAISO's NGR Participation Model, CAISO revised its tariff to exempt resources participating under the Pumped-Storage Hydro Unit Participation Model

145. *Id*. at P 297.

146. Order No. 841-A, *supra* note 63, at P 121.

147. Order No. 841, *supra* note 1, at P 298.

148. Order No. 841-A, *supra* note 63, at P 120.

149. *Id*.

150. *Id*. at P 121.

151. *Id*. at P 120.

152. Initial NYISO Compliance Filing, *supra* note 82, at 32.

153. *California Independent System Operator Corporation*, 169 FERC ¶ 61,126, at P 30 (2019) [hereinafter Order on CAISO Compliance Filing].

154. Initial CAISO Compliance Filing, *supra* note 68, at 27.

155. *Id.* at 27-28.

as well.[156] In approving the proposal, FERC found that the exemption from transmission charges for Electric Storage Resources participating under its NGR Participation was consistent with CAISO's existing rate structure, as was the expansion of applicability to Electric Storage Resources participating under its Pumped-Storage Hydro Unit Participation Model.[157]

Comparatively, NYISO proposed that all withdrawals of energy by Electric Storage Resources that are stored for later injection back to the grid be treated as negative generation,—rather than load,—and exempted from certain transmission charges,[158] consistent with its existing rate structure, which provides this type of exemption for a singular pumped hydro-storage facility.[159] Bids submitted by this facility to withdraw energy for later injection to the grid are categorized as negative generation rather than withdrawals to serve load, and are assessed at the wholesale locational based marginal price.[160] Unlike CAISO, which historically applied the transmission charge exemption to all resources participating under its NGR Participation Model, FERC determined that NYISO's historical exemption from transmission charges of a singular resource was a "limited exception" and not representative of the assessment of transmission charges to load under NYISO's existing rate structure.[161] For this reason, FERC determined that NYISO's proposal was not consistent or reasonable under its existing rate structure.[162]

Similarly, ISO-NE also proposed to exempt Electric Storage Resources from transmission charges, in part, based on its existing rate structure.[163] ISO-NE contended that unlike other resources, Electric Storage Resources, including those that self-schedule, are always providing a service when charging for later resale in the wholesale markets because these resource types (1) are subject to central dispatch by ISO-NE and can at any time be instructed to address a reliability concern, (2) are providing economically based real-time balancing of supply and demand, and (3) are obligated at all times under ISO-NE's interconnection procedures to provide the services of voltage control and reactive support.[164] In the alternative, ISO-NE proposed that its existing rate structure exempted all Electric Storage Resources from transmission charges because the manner in which these charges were assessed, by monthly peak usage, was incompatible with the interval-by-interval basis that Electric Storage Resources operate.[165] ISO-NE suggested that it

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156. *Id.* at 10, 27.

157. Order on CAISO Compliance Filing, *supra* note 153, at P 138.

158. Initial NYISO Compliance Filing, *supra* note 82, at 21 n.40.

159. Request for Rehearing of New York Independent System Operator, Inc., *New York Independent System Operator, Inc.*, FERC Docket Nos. ER19-467-000, ER19-467-001, and ER19-467-002, at 7-9 (Jan. 21, 2020).

160. *Id*. at 6-7.

161. *New York Independent System Operator, Inc.*, 172 FERC ¶ 61,119 at P 21 (2020).

162. *Id.* at P 20.

163. Transmittal Letter of ISO New England, Inc*., Revisions in Compliance with the Order No. 841 on Compliance* at 4-5, FERC Docket No. ER19-470-000 (Feb. 10, 2020) [hereinafter *Transmittal Letter of ISO New England*].

164. *Id.*

165. *Id.* at 6-7.

would be unreasonable to require a restructuring of the transmission rates in New England, which would also necessitate the creation of a new system to associate market systems and transmission load values.[166] While FERC accepted ISO-NE's proposal that transmission charges do not apply to energy withdrawn by an Electric Storage Resource centrally dispatched, FERC disagreed that all Electric Storage Resources are always providing a service when charging for later resale.[167] Specifically, regarding self-scheduling resources, FERC indicated that only a portion of charging withdrawals by the resources could be dispatched to provide a service like voltage support or reactive control and that it would be more appropriate to only exempt from transmission charges the megawatts associated with providing a service.[168] FERC also declined to accept that ISO-NE's existing rate structure always exempted an Electric Storage Resource from transmission charges, finding that there were alternatives to converting its existing rate structure that had not been demonstrated to be unfeasible.[169]

IV. ACCOMMODATIONS TO PROMOTE WIDER MARKET INTEGRATION OF ENERGY STORAGE RESOURCES

Today's electric market looks different in ways that were not imaginable even just a decade ago, thanks in part to monumental advancements in science and policy changes that together have served to accelerate the pace at which the energy industry is implementing new technologies. This phenomenon is especially evident when surveying the sources of electric generation. As the affordability of renewables has increased and the public becomes more attuned to environmental impacts, the electric industry has seen a spike in solar and wind generation. Accompanying this paradigm shift though are new challenges that must be resolved. Harnessing the full capabilities of energy storage, and more broadly, distributed energy resources, could be part of the solution to safeguard the continued reliability and efficiency of the electric grid.

Since the issuance of FERC Order No. 841, energy storage capacity has continued to grow, with projected levels expected to nearly triple by the end of 2023.[170] Although this expansion is noteworthy, energy storage still only represents a fraction of total capacity,[171] and we have not yet realized all the benefits that can be provided by energy storage resources. FERC's recent rulings, specifically in Order Nos. 841 and 845, have set the stage for expanded use of energy storage within the wholesale markets, but the existing marketplace and system processes may be unintentionally limiting broader adoption and preventing the industry from pursuing the most efficient use of such resources. Overcoming these

166. *Id.*

167. *Id.* at 7.

168. *Independent System Operator New England*, 172 FERC ¶ 61,125 at P 50 (2020).

169. *Id.* at P 51.

170. U.S. Energy Info. Admin., *U.S. Utility-Scale Battery Storage Power Capacity to Grow Substantially by 2023* (July 10, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40072.

171. As of 2020, there was 23.2 gigawatts of energy storage capacity deployed on the grid, representing approximately 2% of the 1,100 gigawatts of total installed generation capacity. UNIV. OF MICH. CTR. FOR SUSTAINABLE SYSTEMS, U.S. GRID ENERGY STORAGE FACTSHEET 1 (Sept. 2020).

barriers will require a mix of industry innovations, regulatory policymaking, and the creation and utilization of best practices to guide the implementation and use of stand-alone energy storage as well as energy storage as a distributed energy resource.

A. Development of a Technology-Neutral Grid Services Framework

While the supply of electricity is what first comes to mind when thinking about meeting energy demand, our bulk power grid is actually dependent on an array of grid services[172] in order to reliably and efficiently deliver electricity. Obtaining these services from distributed energy resources which are technologically able to respond in a swifter manner than other more traditional resources could shorten response times when an issue arises in grid operations, introducing added flexibility and new efficiencies in grid management. Further, the capability of energy storage resources to not only inject and withdraw energy from the grid but also store that energy until a later point in time make these resource types well suited for providing a number of grid services. For instance, grid operators rely on a service known as black start from resources that can self-generate electricity to help restore normal operations following a blackout or other catastrophic failure.[173] Although energy storage cannot self-generate, these resource types, with their ability to store power for periods of time and then, at a later point, inject that power onto the grid as electricity, could be a prime candidate for procurement of black start services.

Per recent guidance issued by NERC,[174] systems planners should be ensuring that energy storage resources, particularly BESS units, can provide essential grid services once deployed on the grid.[175] To better enable the procurement of services from energy storage and other distributed energy resource types, it may be beneficial to develop a widely applicable, technology-neutral framework that describes grid services by the market or reliability function to be fulfilled. While each grid operator would likely still need to define its market specific needs for actual procurement, a common framework focusing on the technical capabilities a resource must possess would create a better understanding of which resource types could

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172. "Grid services" is a catch-all term that refers to all types of services and functions that must be obtained in order to ensure reliable operations of the electric grid. Historically, these services have been referred to as "ancillary services," which FERC describes as the services needed to maintain electric reliability and support the transmission of electricity and fall within four broad categories: regulation, operating reserves, black start, and reactive power. *See* FERC, ENERGY PRIMER: A HANDBOOK FOR ENERGY MARKET BASICS 56-57 (2020).

173. *Id.* at 57.

174. NERC is a not-for-profit regulatory authority that oversees the reliability of the bulk power system for North America along with six regional reliability entities: Midwest Reliability Organization, Northeast Power Coordinating Council, Reliability First, SERC Reliability Corporation, Texas Reliability Entity, and WECC. Together, these entities comprise the Electric Reliability Organization Enterprise. Within this framework, NERC is responsible for developing and enforcing reliability standards, periodically assessing reliability, and monitoring the bulk power system for North America. *See*, NERC, *About NERC*, https://www.nerc.com/AboutNERC; NERC, *ERO Enterprise: Regional Entities*, https://www.nerc.com/AboutNERC/keyplayers.

175. NORTH AMERICAN. ELEC. RELIABILITY CORP., ENERGY STORAGE: IMPACTS OF ELECTROMECHANICAL UTILITY-SCALE BATTERY ENERGY STORAGE SYSTEMS ON THE BULK POWER SYSTEM 5 (2021).

be used to provide each grid service. This information could be especially practical in promoting the implementation of energy storage, as these resources cannot self-produce generation and are thus reliant on grid service revenue streams.

A helpful starting point may be a 2012 study that resulted from the Hawaii Public Utilities Commission's effort to evaluate how the state's grid could produce a greater amount of generation from renewable energy while still maintaining high reliability. A collaboration between the Hawai'i Natural Energy Institute at the University of Hawai'i and GE Energy Consulting, the study sought to ascertain which types of grid services would be needed to more widely incorporate new resource types, such as energy storage, onto the grid.[176] To assist in this effort, the study identified eight types of services that help to ensure reliable grid management that, at the time, were being procured by grid operators in various locations across the globe: (1) frequency response reserve, (2) regulation, (3) load following, (4) spinning reserve, (5) non-spinning reserve, (6) replacement reserve, (7) black start, and (8) voltage support.[177] For each service type, the study included an accompanying technology-neutral definition.[178] Although the study was specifically focused on the requirements of the bulk power system for the Hawaiian Islands, the grid service definitions are performance-based and describe the functional role of each service, not how the service is attained within the Hawaiian market or by the type of resource that could provide the service.[179] Thus, the descriptions should be adaptable for use within any market and could serve as a basis for developing high-level standardized definitions that would be broadly applicable.

B. Grid Services for a Modern Market

In order to ensure the market is fully capitalizing on energy storage, distributed energy, and other novel resource types deployed on the grid, the industry may need to consider new types of grid services that make use of the full technological capabilities of these resources. New grid services, especially those particularly tailored to the capabilities of fast-responding resources like energy storage, could not only foster greater participation within the market by these resource types but also provide innovative tools to support grid modernization efforts. One area primed for the development of new grid services is frequency response.

Within the wholesale markets, RTOs and ISOs are responsible for ensuring that their systems maintain a frequency of 60 hertz by continually balancing electricity production (generation) and consumption (load).[180] To assist in this, RTOs and ISOs are reliant upon a class of grid services known as frequency response that are used to help maintain frequency through signals that automatically increase generation output from certain resources to accommodate instances of short-term changes in demand.[181] As part of a recent study, Lawrence Berkley

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176. GE ENERGY CONSULTING, ANCILLARY SERVICES DEFINITIONS AND CAPABILITY STUDY 1 (2012).

177. *Id.* at 8

178. *Id.* at 3-4.

179. *Id.* at 10.

180. FERC, Energy Primer: A Handbook for Energy Market Basics 55 (2020).

181. *Id.* at 56.

National Laboratory recommended that, in order to enhance reliable operations within each interconnection, frequency response services be provided by as many resource types as technically possible.[182] FERC paved the way for this through Order No. 842 by requiring all new generating facilities, including energy storage, have equipment that allows these facilities to provide primary frequency response as a prerequisite for interconnection.[183]

Traditionally, frequency response services have been categorized as primary, secondary, and tertiary based on response times, with providers of primary frequency response able to react within tens of seconds.[184] However, there is a growing need for a new type of frequency response service, fast frequency response, to counter a projected future decrease in system inertia[185] within interconnections as a result of increased reliance on renewable generation resources.[186] While there is no standardized timeframe for the concept of fast frequency response within the United States, the service is categorized by the near instantaneous ability to inject or absorb power from the electric grid in response to signals indicating frequency deviations.[187] Given these characteristics, energy storage resources, especially BESS units, are aptly suited to provide this type of grid service.

Several entities have already taken steps to expand their grid services to include fast frequency response and could serve as models for others in the electric industry. In 2018, the Hawaiian Public Utility Commission approved a request by Hawaiian Electric Companies[188] to modify its Demand Response Portfolio Tariff to, in part, establish a technology-neutral framework by which resources can provide four grid services: fast frequency response, regulating response, regulating reserve, and capacity.[189] The following year, Hawaiian Electric Companies issued

182. JOSEPH H. ETO ET AL., FREQUENCY CONTROL REQUIREMENTS FOR RELIABLE INTERCONNECTION FREQUENCY RESPONSE 82 (2018).

183. Order No. 842, *Essential Reliability Services and the Evolving Bulk-Power System–Primary Frequency Response*, 162 FERC ¶ 61,128 (2018).

184. Joseph H. Eto et al., *supra* note 182, at 88-89.

185. System inertia refers to the kinetic energy stored within conventional generators (such as fossil fuel fired power plants) that operate using rotating machinery. In instances of sudden generation loss, the kinetic energy stored within any conventional generator causes the rotating machinery of any generator still online to autonomously and instantaneously increase, helping to momentarily maintain grid frequency and serve as a stopgap until primary frequency response services respond. *See* PAUL DENHOLM ET AL., INERTIA AND THE POWER GRID: A GUIDE WITHOUT THE SPIN (May 2020).

186. NORTH AMERICAN. ELEC. RELIABILITY CORP., FAST FREQUENCY RESPONSE CONCEPTS AND BULK POWER SYSTEM RELIABILITY NEEDS, at iv (Mar. 2020).

187. *Id.* at 7, 17.

188. Hawaiian Electric Companies is the name by which Hawaiian Electric Company (HECO) and its subsidiaries Maui Electric Company (MECO) and Hawaii Electric Light Company (HELCO) are collectively known. Together, Hawaiian Electric Companies provide power for about 95% of the population of Hawaii. *See*, Hawaii State Energy Office, *Utility Resources*, https://energy.hawaii.gov/developer-investor/utility-resources (last visited Sept. 17, 2021).

189. *Hawaiian Elec. Co.*, Pub. Util. Comm'n of Haw., Decision and Order No. 35238 at 20, Docket No. 2015-0412 (Jan. 25, 2018).

a request for proposal specifically seeking fast frequency response[190] and capacity[191] grid services from distributed energy resources, including energy storage.[192] In May of 2020, Hawaiian Electric announced the selection of winning bids that are expected to add almost three gigawatt hours of electric storage across the islands of Oahu, Maui, and Hawaii, including thirteen solar-plus storage projects.[193]

While not subject to FERC jurisdiction, ERCOT recently developed a new category of frequency response service. In the early 2010s, ERCOT began exploring how its ancillary services market could be redesigned to shift from services that were tailored to the characteristics of large steam generators in order to be more accommodating of emerging technologies, including generation by renewable resources and battery storage.[194] These efforts resulted in ERCOT introducing a new ancillary service identified as fast frequency response and, with it, the creation of technology-neutral service procurement requirements.[195] The redesign is aimed at removing barriers to entry for newer resource types, like energy storage, improving market efficiencies, and addressing the changing resource mix within the Texas Interconnection.[196] In 2019, ERCOT began the first implementation phase for the fast frequency response service with procurement of the service specifically from resources classified as battery storage.[197] In the short time that ERCOT has been obtaining fast frequency response from battery storage, there already may be immediate impacts on the use of the resource within its footprint. A 100 megawatt battery storage system began construction in 2020 and is expected to begin commercial operations this year.[198] Giving credence to the adage that everything is bigger in Texas, once fully online, this unit will not only be the largest battery storage facility within ERCOT's market but also "one of the largest in the world."[199]

Utilizing energy storage systems to provide grid services could also potentially provide cost savings. In a project funded by the U.S. DoE, Green Mountain

190. Hawaiian Electric Companies defined fast frequency response as "a local discrete response at a specified frequency trigger . . . [which] acts to limit the frequency drop resulting from a frequency disturbance, such as the loss of a generator . . . [and] assists in arresting the decline in frequency as a result of a contingency event." *See*, Hawaiian Elec. Companies Request for Proposal No. 103-119-02, *Delivery of Grid Services from Customer-sited Distributed Energy*, Exhibit A at 79 (Aug. 22, 2019).

191. *Id.* (identifying generation resources, energy storage, and controlled load as capacity resources).

192. *See*, Hawaiian Elec. Companies Request for Proposal No. 103119-02, *Delivery of Grid Services from Customer-sited Distributed Energy Resources* (Aug. 22, 2019).

193. Press Release, Hawaiian Elec., Hawaiian Electric Selects 16 Projects in Largest Quest for Renewable Energy, Energy Storage for 3 Islands (May 11, 2020), https://www.hawaiianelectric.com/documents/about_us/news/2020/20200511_RFP_selections_announced.pdf.

194. ERCOT, FUTURE ANCILLARY SERVICES IN ERCOT 8-9 (Draft Version 1.1, 2013).

195. ERCOT, TECHNICAL ADVISORY COMMITTEE REPORT NPRR 863: CREATION OF ERCOT CONTINGENCY RESERVE AND REVISIONS TO RESPONSIVE RESERVE 3-4 (Jan. 30, 2019).

196. *Id.*

197. ERCOT, TECHNICAL ADVISORY COMMITTEE REPORT NPRR 960: PHASED APPROACH AND CLARIFICATIONS FOR NPRR863 1-3 (Sept. 25, 2019).

198. Andy Colthorpe, *'Largest Standalone Battery Storage Project' in Texas' ERCOT Market Begins Construction*, ENERGY STORAGE NEWS (Aug. 25, 2020), https://www.energy-storage.news/largest-standalone-battery-project-in-texas-ercot-market-begins-construction/ (last visited Sept. 17, 2021).

199. *Id.*

Power operated a microgrid powered by 2.5 megawatts of solar generation with an integrated 4 megawatt battery storage system in central Vermont.[200] When the microgrid was operating in connection with the electric grid (i.e. not islanded), Green Mountain Power was able to generate renewable energy from the solar panels and store that power in the battery system for use during peak demand.[201] The output from the microgrid saved Green Mountain Power approximately $200,000 in annual capacity charges as well as cut "monthly transmission peaks, general peak shaving, and frequency regulation."[202] In total, Green Mount Power estimated that its energy storage network reduced customer costs by approximately $3,000,000 between January and September 2020.[203] Building on this project, Green Mountain Power is now operating a pilot program that aggregates residential batteries in order to provide frequency regulation service within ISO-NE.[204]

Although Order No. 841 focused on the participation of electric storage as a generation resource, energy storage is also capable of operating as a transmission asset. Developing market rules to treat energy storage as a transmission facility while simultaneously acting as a generation resource can provide a financial incentive that would likely serve to encourage greater participation. Under established FERC rules, the rate at which a resource earns revenue differs depending upon the type of service the resource is providing. Resources providing capacity and ancillary services can recover costs at the market-based rate established in the tariffs of RTOs and ISOs while those that provide transmission services are eligible to recover at a cost-based rate, which includes compensation for the services provided by the resource as well as the recoupment of capital investments.[205] However, energy storage resources operating as transmission assets would not just be a financial boon to resource owners. The ability of energy storage to rapidly absorb electricity from the grid means that these resources could provide relief in areas of high congestion without having to build new transmission lines.[206] Additionally, the strategic deployment of energy storage along the grid can serve to extend the life of aging transmission infrastructure, reducing the need for RTOs and ISOs to take on often costly upgrades to transmission lines and transformers.[207] The market has already started to capitalize on this possibility with the installation of a battery storage system by National Grid on Nantucket Island to

200. SUSAN SCHOENUNG ET AL., GREEN MOUNTAIN POWER (GMP): SIGNIFICANT REVENUES FROM ENERGY STORAGE 8-9 (May 2017).

201. *Id.* at 9.

202. *Id.* at 7.

203. Press Release, Green Mountain Power, GMP's Energy Storage Programs Deliver $3 Million In Savings for All Customers During 2020 Energy Peaks (Sept. 29, 2020), https://greenmountainpower.com/gmps-energy-storage-programs-deliver-3-million-in-savings/.

204. Press Release, Green Mountain Power, GMP's Pioneering Network of Powerwall Batteries Delivers First-in-New-England Benefit for Customers & Grid, Cutting Carbon and Costs (May 13, 2021), https://greenmountainpower.com/network-of-powerwall-batteries-delivers-first-in-new-england-benefit-for-customers/.

205. FERC, ENERGY PRIMER: A HANDBOOK FOR ENERGY MARKET BASICS 59-61 (2020).

206. *See e.g.*, Sharon Thomas, *Storage as a Transmission Asset is Gaining Traction in Many RTOs/ISOs*, ENERGY STORAGE ASSOCIATION (Dec. 15, 2020), https://energystorage.org/storage-as-a-transmission-alternative-is-gaining-traction-in-many-rtos-isos/.

207. U.S. DEP'T OF ENERGY, GRID ENERGY STORAGE 8 (Dec. 2013).

help meet demand during the summer months when the island's electricity usage dramatically increases, ensuring continued reliability and deferring the need to build out additional infrastructure between Nantucket Island and the mainland grid.[208]

In 2017, FERC provided guidance through the issuance of a policy statement to clarify that energy storage resources are simultaneously eligible to recover fees for providing market-based services (such as capacity and ancillary services) as well as transmission and other grid support services that are compensated at a cost-based rate.[209] There are obstacles that must be overcome in the development of market rules to implement such participation,[210] but several RTOs and ISOs are in the process of examining the participation of energy storage as a transmission asset. In August 2020, FERC accepted, subject to additional revisions, MISO's proposal to modify its tariff to allow energy storage resources to provide services to resolve identified transmission issues.[211] Although MISO's revised tariff focuses on the singular participation of an energy storage resource as a transmission asset, it is engaging with its stakeholders to develop processes for how to allow storage resources to simultaneously provide transmission and market services.[212] The August 2020 Order marked the first ruling from FERC on energy storage as transmission assets but this could be a growing industry trend as RTOs and ISOs strive to meet FERC's policy goal of maximizing efficiencies in the implementation of energy storage resources within the wholesale markets.[213]

C. Hybrid Resource Participation

One emerging, but important hurdle to be addressed is the integration of hybrid resources within the wholesale markets – particularly hybrid resources that utilize energy storage facilities. Over the past several years, there has been a rising interest in the use of hybrid resources that incorporate energy storage. This is likely attributable to the rise of renewable generation and the decreased cost of batteries which has made the added value of coupling batteries with renewable generation more lucrative.[214] Additionally, co-locating batteries with generation

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208. *See*, Press Release, National Grid, Two National Grid Projects Selected as Energy Storage North America 2019 Innovation Award Winner, (Nov. 7, 2019), https://www.nationalgridus.com/News/2019/11/Two-National-Grid-Projects-Selected-as-Energy-Storage-North-America-2019-Innovation-Award-Winner-/.

209. Policy Statement*, Utilization of Electric Storage Resources for Multiple Services When Receiving Cost-Based Rate Recovery*, 158 FERC ¶ 61,051 at P 158 (2017).

210. *See e.g.*, *id.* at P 1 (identifying three areas which RTOs and ISOs would need to address: (1) "protections against the potential for double-recovery of costs from cost-based ratepayers," (2) protections against potential "adverse market impacts," and (3) protections to ensure the RTOs and ISOs remain "independent[t] from market participants").

211. *Midcontinent Independent System Operator, Inc.*, 172 FERC ¶ 61,132 (2020).

212. *Midcontinent Independent System Operator, Inc.*, Proposed Tariff Revisions for Storage as a Transmission Only Asset, FERC Docket No. ER20-588-000, at (Dec. 12, 2019).

213. Policy Statement*, Utilization of Electric Storage Resources for Multiple Services When Receiving Cost-Based Rate Recovery*, 158 FERC ¶ 61,051 (2017).

214. *See e.g*., Will Gorman et al., *Hybrid power Plants Are Growing Rapidly: Are They a Good Idea?*, UC BERKELEY ENERGY & RESOURCES COLLABORATIVE (Aug. 30, 2020), https://berc.berkeley.edu/news/hybrid-power-plants-are-growing-rapidly-are-they-good-idea. For utility-scale solar generation facilities, the addition

resources represents cost-saving opportunities through shared expenses associated with equipment and the interconnection and permitting processes.[215]

At the end of 2019, within the United States, there were approximately 125 hybrid resources in use representing 14 gigawatts of capacity, of which more than half are generation facilities co-located with energy storage.[216] While there are hybrid facilities that combine fossil fuel and solar or energy storage facilities, the dominant hybrid resource configurations are energy storage co-located with wind or solar generation.[217] Although hybrid resources are just a small fraction of the total resource mix, there are approximately 102,000 gigawatts of solar hybrid capacity and 11,000 gigawatts of wind hybrid capacity, most of which are co-located with batteries, in interconnection queues.[218] The majority of projects in the interconnection queue are proposed in the western portion of the United States, including on parts of the grid overseen by CAISO.[219] The popularization of hybrid resources appears to be growing. At the end of 2020, one estimate identified hybrid projects in interconnection queues as nearly two-thirds of the proposed battery projects within CAISO and over a third of proposed battery projects in ERCOT and SPP.[220]

While all seven of the U.S. RTOs and ISOs are engaged in discussions regarding the participation of hybrid resources within their respective footprints,[221] CAISO has been particularly focused on issues related to hybrid resources. In 2019, approximately 41% of CAISO's generator interconnection queue consisted of hybrid resource configurations.[222] In 2020, this totaled over 30,000 megawatts of energy storage combined with solar or wind resources in various stages of development, on top of an additional 30,000 megawatts of standalone energy storage resource projects in the queue.[223] By July 2021, CAISO had approximately 147,800 megawatts of energy storage capacity in its interconnection queue with 49% of that "capacity associated with hybrid or co-located projects."[224]

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of a four-hour battery resource costs approximately $4 - $14/megawatt hour but can generate between $13 - $31/megawatt hour in added value in a region like CAISO that operates an energy and capacity market. Comparatively, a developer in the ERCOT region, which only operates an energy market, can only expect to add between $1 - $9 of value.

215. *Id.*

216. RYAN WISER ET AL., LAWRENCE BERKELEY NATIONAL LABORATORY, HYBRID POWER PLANTS: STATUS OF INSTALLED AND PROPOSED PROJECTS 5 (2020).

217. *Id.* at 6.

218. *Id.* at 15.

219. *Id.* at 17.

220. JOSEPH RAND ET AL., LAWRENCE BERKELEY NATIONAL LABORATORY, QUEUED UP: CHARACTERISTICS OF POWER PLANTS SEEKING TRANSMISSION INTERCONNECTION AS OF THE END OF 2020, at 19 (2021).

221. *See*, ENERGY STORAGE ASSOCIATION, STATUS OF HYBRID RESOURCE INITIATIVES IN U.S. ORGANIZED WHOLESALE MARKETS 1 (2020).

222. CALIFORNIA INDEPENDENT SYSTEM OPERATOR, HYBRID RESOURCES ISSUE PAPER 3 (2019).

223. *Cal. Indep. Sys. Operator Hybrid Res. Phase 1 Amendment,* Docket No. ER20-2890-000, at 1 (Sept. 16, 2020).

224. *Hybrid Res. Informational Report Cal. Indep. Sys. Operator Corp.*, FERC Docket No. AD-9-000, at 5 (July 19, 2021) [hereinafter *CAISO Hybrid Res. Info. Report*].

As a result of anticipated future growth of hybrid and co-located resources interconnecting within its footprint, CAISO identified a number of technical questions regarding the market participation, operation, configuration, and settlement of hybrid resources along with operational and forecasting challenges that would need to be resolved in order to better integrate such resource types.[225] These include charging considerations for hybrid resources with storage, the interconnection process, how hybrid resources should be incorporated into forecasting models, and participation in the ancillary services market.[226] In 2020, FERC approved revisions to CAISO's tariff intended to support participation by hybrid resources, including new market rules for the modeling of co-located resources that operate separately and data requirements for hybrid resources that include wind or solar generation facilities.[227]

FERC, recognizing the rise in hybrid resources, initiated proceedings to explore their participation within the wholesale market. In July 2020, FERC held a technical conference to explore the technical and market issues surrounding the growth of generation resources paired with energy storage as a hybrid resource.[228] As highlighted by the issues raised during the technical conference, there are a number of foundational elements regarding the participation of hybrid resources that will likely need to be addressed:

1. A consensus on terminology regarding hybrid resources and the differentiation between generation resources that are co-located at the same facility with energy storage resources but operating separately versus generation resources and energy storage resources that are operating as a singular, hybrid resource;

2. The interconnection process, including modeling and the addition of an energy storage resource to an existing request in the queue;

3. The different types of participation models and market rules applicable to hybrid resources within an ISO or RTO;

4. How the capacity values of such resources are calculated and if new or modified methods are needed; and

5. Metering best practices for hybrid resources participating in wholesale markets.[229]

Following the technical conference, FERC directed the six RTOs and ISOs within its jurisdiction (CAISO, ISO-NE, MISO, NYISO, PJM, and SPP) to submit reports regarding the participation of hybrid resources within their respective markets.[230] These reports showed the ISOs and RTOs are all in various stages of developing definitions for hybrid and co-located resources as well as market rules to effectuate hybrid resource participation.

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225. *Id*. at 4.

226. *Id*.

227. *California Indep. Sys. Operator Corp.,* 173 FERC ¶ 61,146 at PP 1-3, 6, 12 (2020).

228. Notice of Technical Conference, *Hybrid Resources*, 85 Fed. Reg. 20,493 (2020), FERC Docket No. AD20-9-000 (April 7, 2020).

229. Notice Inviting Post-Technical Conference Comments, *Hybrid Resources*, 85 Fed. Reg. 49,647 (2020), FERC Docket No. AD20-9-000 (Aug. 10, 2020).

230. *Hybrid Resources*, 174 FERC ¶ 61,034 at PP 1, 3, 10 (2021).

CAISO is the only entity that has defined both hybrid and co-located resources within its tariff. Within CAISO, hybrid resources are considered mixed-fuel resources (a generating facility that utilizes more than one fuel source or technology) that are located at a singular point of interconnection, are assigned a singular identification, and are modeled as a singular resource.[231] By comparison, a co-located resource within CAISO is one or more resources situated "at the same generating facility from an interconnection perspective" but operating as independent resources.[232] As of July 2021, CAISO had, by its definition, one hybrid resource and twelve co-located resources in operation with an additional 284 hybrid or co-located projects in its interconnection queue.[233] Later this year, CAISO anticipates filing with FERC additional tariff revisions that are intended to more accurately "represent the real-time capabilities of hybrid resources," including new telemetry requirements and bid parameters.[234]

NYISO does not have any hybrid resources currently participating in its footprint,[235] but is in the process of developing a participation model for hybrid resources that will allow for multiple resources behind a common point of injection to operate as a single resource.[236] This will supplement NYISO's participation model for co-located storage resources that allows a resource participating under NYISO's Energy Storage Resource Participation Model to locate with a qualified wind or solar resource behind a common point of injection, approved by FERC in March 2021 and scheduled to be implemented during the 4th quarter 2021.[237] As currently proposed, the NYISO definition for a hybrid resource would require the combination of "storage and at least one other technology . . . located behind a single [p]oint of [i]njection [that does] not serve behind-the-meter [l]oad."[238]

As of July 2021, PJM identified one resource modeled as an integrated hybrid resource within its market.[239] However, PJM indicated that resources amounting to approximately 24,000 megawatts of capacity within its market are classified as mixed technology resources co-located at a singular point of interconnection but operated separately.[240] While PJM does not specifically define a hybrid resource, its tariff does outline requirements that are applicable to mixed technology resources, including metering and telemetry requirements.[241] Later this year, PJM plans to submit to FERC an additional tariff proposal that, pending stakeholder

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231. *CAISO Hybrid Res. Info. Report*, *supra* note 224, at 3-4.

232. *Id*. at 3.

233. *Id*. at 2.

234. *Id*. at 14-15.

235. *Hybrid Res. Report N.Y. Indep. Sys. Operator, Inc.*, FERC Docket No. AD20-9-000, at 4 (July 19, 2021).

236. *Id.* at 2.

237. *Id*. at 1-2.

238. *Id*. at 4.

239. *PJM Interconnection L.L.C. Hybrid Resources*, FERC Docket No. AD20-9-000, at 1, 4 (July 19, 2021).

240. *Id*. at 3.

241. *Id*. at 2-3.

approval, will expand the applicability of its Energy Storage Resource Participation Model to hybrid resources.[242]

Similarly, SPP does not currently define hybrid resources within its tariff but does have participation by co-located, mixed fuel resources, as well as singular resources that switch between fuel types, including resources that are paired with energy storage.[243] These types of resources can currently participate in SPP's energy and ancillary services market by registering as a singular market resource or as "separately modeled market resources that are committed and dispatched independently."[244] SPP is in the process of working with stakeholders to define "hybrid" and to develop a hybrid resource capacity accreditation methodology.[245]

Within MISO's report, it indicated that commercial operations of a registered hybrid resource that combines solar and storage were expected to commence in September 2021 and that there are thirty hybrid resource proposals in various stages of its interconnection queue representing approximately 2,100 megawatts of capacity.[246] Like PJM, MISO also anticipates making a filing with FERC later this year with proposed tariff revisions to better clarify the participation of hybrid resources within its market, including a formal definition of a hybrid resource and rules addressing resource adequacy accreditation for hybrid resources.[247]

Finally, ISO-NE also does not have a formal definition for hybrid resources but does have participation from co-located facilities within its market.[248] Under ISO-NE's interpretation, co-located facilities are "any combination of generation and energy storage connected behind a common interconnection point."[249] The majority of these co-located resources consist of solar generation and lithium-ion batteries that have a "maximum facility output of less than 5 megawatts."[250] Currently, ISO-NE is in the process of evaluating modifications to its resource capacity accreditation methodology, including those for hybrid resources.[251]

While FERC has not indicated how it plans to move forward, the informational reports produced by the RTOs and ISOs demonstrate that there is market interest in combining two or more resource types behind a singular point of interconnection. Clear distinctions between the categorization of these facilities as either a co-located resource or hybrid resource could be an important initial step in ensuring consistent, equitable market participation rules for these resource types.

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242. *Id*. at 2, 6-7.

243. *Report on Hybrid Res. of Sw. Power Pool, Inc.*, FERC Docket No. AD20-9-000, at 2-3 (July 19, 2021).

244. *Id*. at 5.

245. *Id*. at 3.

246. *Report on Hybrid Res. of the Midcontinent Indep. Sys. Operator, Inc.*, FERC Docket No. AD20-9-000, at 8-9 (July 19, 2021).

247. *Id*. at 16-17.

248. *Hybrid Res., ISO New England Inc. Response to Order Directing Reports*, FERC Docket No. AD20-9-000, at 2 (July 19, 2021).

249. *Hybrid Res., Post-Tech. Conf. Comments of ISO New England Inc.*, FERC Docket No. AD20-9-000, at 1 (Sept. 24, 2020).

250. *Id*. at 2.

251. *Id.* at 17.

D. Utilizing the Policy Tool Box

Shifts in federal and state-level policy have always been a major impetus of change in the energy industry. As exemplified by Order No. 841, federal policy mandating change can be effective, but this is not the only tool in the shed. In 2020, the U.S. DoE launched its Energy Storage Grand Challenge in a bid for the United States to become a leader in the innovation, manufacturing, and utilization of energy storage.[252] To achieve this, the U.S. DoE identified use cases addressing applications, benefits, and functional requirements for energy storage as well as devised cost targets aimed, in part, to improve commercial viability for the use of these resources to meet load during periods of peak demand as well as perform other critical reliability services.[253] This comprehensive energy storage policy developed by the U.S. DoE incorporates a holistic approach that includes strategies for technology development, strengthening the manufacturing and supply chain, workforce education, and assisting policy makers.[254] To this last point, the Energy Storage Grand Challenge seeks to provide data, tools, and analysis in an effort to support the development of energy storage policies and regulations by both federal and state governments. Specifically, the U.S. DoE aims to close identified gaps in policy and regulation development that are unintentionally thwarting growth and inhibiting the energy industry from realizing the full benefits of energy storage.[255]

Several key areas will be of initial focus:

1. Enhancing the understanding of performance characteristics of energy storage resources to assess the resource's potential contributions to system resiliency;

2. Increasing the effectiveness of the planning and operating of energy storage resources both within the energy industry and by other industrial end-users; and

3. Improving the valuation of the types of services energy storage resources can provide.[256]

In addressing these topics, the U.S. DoE anticipates being able to shape new policies and regulations that will act in concert to eliminate market barriers while also increasing market demand.[257] Additionally, the Energy Storage Grand Challenge identified key stakeholders in the policy making process, including utilities, the RTOs and ISOs, state level government officials, like governors and legislatures, and public utility commissions.[258]

Although policy decisions of individual states only directly impact the retail processes, the wholesale market is often shaped by retail activities. One prominent example is the development of renewable portfolio standards, which are used to

252. U.S. DEP'T OF ENERGY, ENERGY STORAGE GRAND CHALLENGE ROADMAP 11 (2020) [hereinafter *Energy Storage Grand Challenge*].

253. *Id*. at 11.

254. *Id*. at 13.

255. *Id*. at 55.

256. *Id*.

257. *Id*.

258. *Id*. at. 57-58.

foster the growth of renewables by utilities through the establishment of procurement goals for generation from renewable resources. Since the turn of the century, renewable electric generation within the United States has grown exponentially, with some estimating that almost half of this increase can be attributed state-level renewable portfolio standard requirements.[259] Given this statistic, it is likely that state level policies supporting energy storage could also spur further integration of storage in the marketplace.

Currently, approximately half the states within the United States have enacted some type of energy storage policy, from specific regulatory requirements and procurement targets to financial incentives.[260] Recently, Connecticut became the eighth state to pass an energy storage procurement target or mandate legislation, setting a goal of establishing 1,000 megawatts of storage deployed by the end of 2030.[261] However, over the past several years, Massachusetts has emerged as a leader in energy storage policymaking. In 2015, the state launched its Energy Storage Initiative, an effort to advance energy storage, in part, through policy and regulation changes.[262] Shortly thereafter, Massachusetts passed the Act to Advance Clean Energy, establishing a 1,000 MWh energy storage target for electric distribution companies by the year 2025, which, as of February 2021, resulted in 179 MWh of installed storage and another 874 MWh of storage in production.[263] While the establishment of target capacity goals is a proven method to increase resource deployments, Massachusetts innovated its policymaking through the passage of the nation's first clean peak standard. As a play on traditional renewable portfolio standards, a clean peak policy mandates that a specified level of electricity used to meet customer demand during peak periods be sourced from renewable generation.[264] With the ability to harvest electricity at the moment of generation and store it until a later time, energy storage resources, especially those that are co-sited with solar generation, have a key role to play in helping utilities meet clean peak goals. The Massachusetts Clean Peak Energy Portfolio Standard took effect on August 7, 2020, requiring electric utilities to obtain generation from qualified resources to cover a certain percentage of its total market obligation through the purchase of clean peak energy certificates.[265] Under the new regulation, energy storage resources can qualify as a clean peak resource if their system is (1) co-located with a renewable resource, (2) contracts with a renewable resource to store

259. GALEN BARBOSE, U.S. RENEWABLE PORTFOLIO STANDARDS: 2018 ANNUAL STATUS REPORT 3 (2018).

260. PAC. NW. NAT'L LAB., ENERGY STORAGE POLICY DATABASE, U.S. DEP'T OF ENERGY (last updated Mar. 2020), https://energystorage.pnnl.gov/regulatoryactivities.asp.

261. Andy Culthorpe, *Connecticut looks to join seven other US states in setting energy storage target*, ENERGY STORAGE NEWS (May 25, 2021), https://www.energy-storage.news/connecticut-looks-to-join-seven-other-us-states-in-setting-energy-storage-target/.

262. MASS. DEP'T OF ENERGY RES., ESI GOALS & STORAGE TARGET (last visited Sept. 15, 2021),https://www.mass.gov/info-details/esi-goals-storage-target.

263. *Id*.

264. LON HUBER & EDWARD BURGESS, EVOLVING THE RPS: A CLEAN PEAK STANDARD FOR A SMARTER RENEWABLE FUTURE 3 (2016).

265. 225 MASS. CODE REGS. 21.07 (2020).

and discharge renewable energy, and/or (3) primarily charges from renewable generation.[266]

Another area in which policy decisions can influence the adoption of energy storage is integrated resource plan (IPR) requirements. Utilities engage in integrated resource planning to identify the resource mix that will be needed in the upcoming years to meet the anticipated demand for electricity.[267] For a majority of the country, this process is guided by state legislatures or public utility commissions, which typically establish requirements to meet identified policy goals, such as reducing emissions and renewable energy generation targets. While several individual utilities incorporate energy storage as part of their individual IPRs, the establishment of state-level IPR rules and regulations that include guidance on energy storage can help to ensure all utilities are appropriately considering the benefits that can be provided by these resources. This can be achieved through legislation, like in California, where the state legislature passed a bill requiring publicly owned utilities, as part of the IPR process, to consider energy storage as a resource to help meet periods of peak demand.[268] Elsewhere, some public utility commissions have chosen to develop guidance regarding the utilization of energy storage resources within existing regulatory frameworks addressing the IPR process. For instance, the Washington Utilities and Transportation Commission (UTC) issued a policy statement that required all utilities within its jurisdiction to consider energy storage as part of resource planning and procurement processes.[269] Guidance provided by the Washington UTC included direction on how energy storage resources should be modeled within the IPR process and encouraged utilities to consider a range of storage mediums.[270] Additionally, the commission established clear regulatory expectations for the resource procurement process with the intent of helping to resolve uncertainty and hesitancy regarding investments in energy storage technologies among its jurisdictional entities.[271]

E. Industry-Wide Standardization Efforts and Benefits of Broad Adoption

With any new technology, there is typically a lag between introduction and high levels of market penetration. This is especially true in the energy industry, where utilization of new technologies, such as energy storage and other distributed energy resources, can carry an unknown level of risk until there is a common understanding of functionality and how the new technology will be adopted by the market. One important step to minimize these risks is the development of commonly accepted, industry-wide standards. Through standardization, regional and

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266. *Id*.

267. State & Local Energy Efficiency Action Network, Using Integrated Resource Planning to Encourage Investment in Cost-Effective Energy Efficiency Measures, at vi (2011).

268. CAL. PUB. UTIL. CODE § 454.52 (West 2021).

269. WASH. UTIL. & TRANSP. COMM'N, DOCKETS UE-151069, U-161024, REPORT AND POLICY STATEMENT ON TREATMENT OF ENERGY STORAGE TECHNOLOGIES IN INTEGRATED RESOURCE PLANNING AND RESOURCE ACQUISITION PP 1, 34, 58 (2017).

270. *Id*. at PP 40-48.

271. *Id*. at PP 49-50, 52.

even nationwide uniformity can be established, creating cohesiveness in the market. This consistency improves transparency and lowers participation costs, in turn promoting wider adoption of new technologies by market participants. In recognition of this, the U.S. DoE has long touted standardization as an important tool to remove barriers to the implementation of energy storage.[272]

The initial implementation of energy storage by early adopters has been guided by several existing industry standards as well as other best practice type documentation generally applicable to any distributed energy resource type. For instance, the Institute of Electrical and Electronics Engineers (IEEE) has long-maintained standards addressing the interconnection of distributed energy resources to the power grid,[273] and NERC has issued a series of reliability guidelines covering these resource types.[274] Yet there are still a number of areas critical to supporting wider integration that have not yet been addressed or are only in the infancy stages. In exploring standardization, the industry should make conscious decisions to continue to capitalize upon the similarities between energy storage and other distributed energy resources. Although there certainly may be instances in which narrowly tailored standards are appropriate to address characteristics unique to energy storage, siloed development of standards for each type of distributed energy resource is likely to prove inefficient and redundant. While certainly not an exhaustive list, three important areas that may be of greatest benefit to concentrate immediate efforts in order to jump start more expansive integration of electric storage and distributed energy resources as a whole are (1) model interconnection practices, (2) guidelines advising the modeling and planning processes, and (3) standards defining common communication protocols.[275]

Between 2014 and 2019, utility-scale battery storage capacity more than quadrupled, and by 2023, is expected to exceed 2,500 megawatts.[276] However, a number of states do not have a clear path for how batteries and other energy storage resources connect to the grid. For example, some state-level interconnection procedures for generation facilities may be too narrow in terminology, which can cause ambiguity regarding if energy storage, with its ability to act as generation and load, qualifies to participate as a generation facility.[277] This results in uncertainty for both resource owners and utilities that could be resolved through a spec-

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272. U.S. DEP'T ENERGY, GRID ENERGY STORAGE 9, 52 (2013).

273. *See* INST. OF ELEC. & ELEC. ENG'RS STANDARDS ASS'N, IEEE 1547-2003 – IEEE STANDARD FOR INTERCONNECTING DISTRIBUTED RESOURCES WITH ELECTRIC POWER SYSTEMS (2008).

274. *See* N. AM. ELEC. RELIABILITY CORP., RELIABILITY GUIDELINE: DER DATA COLLECTION FOR MODELING IN TRANSMISSION PLANNING STUDIES, at vi (Sept. 2020); N. AM. ELEC. RELIABILITY CORP., RELIABILITY GUIDELINE: DISTRIBUTED ENERGY RESOURCE MODELING 1 (Sept. 2017); N. AM. ELEC. RELIABILITY CORP., RELIABILITY GUIDELINE: MODELING DISTRIBUTED ENERGY RESOURCES IN DYNAMIC LOAD MATERIALS 1 (Dec. 2016).

275. Elec. Power Research Inst., The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources 3-5, 32-33 (2014).

276. Patricia Hutchins, *U.S. utility-scale battery storage power capacity to grow substantially by 2023*, U.S. ENERGY INFO. ADMIN. (July 10, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40072.

277. KELSEY HOROWITZ ET AL., AN OVERVIEW OF DISTRIBUTED ENERGY RESOURCE (DER) INTERCONNECTION: CURRENT PRACTICES AND EMERGING SOLUTIONS 54, 57 (2019).

ified energy storage interconnection process. Standardized interconnection procedures for energy storage would also add a level of transparency and help to ensure equitable treatment between resource owners. Moreover, as previously discussed, the industry is experiencing an increase in the pairing of hybrid or co-located resources that utilize energy storage. While there are only a handful of hybrid resources today, the interconnection process for these types of facilities is likely an issue that regulators will be facing with more frequency in the coming years.

Although revising state-level interconnection standards requires action by legislatures and regulatory agencies, the development of industry best practices can set the stage for swift adoption by regulators, while also creating uniformity between jurisdictions. Several industry standard developers have recently released new documentation that could furnish guidance in this area. In 2018, the IEEE released a much-anticipated update to its standard that provides technical guidance on the interconnection of and interoperability for distributed energy resources, including energy storage, with electric power systems.[278] To continue the effort to provide interconnection best practices for energy storage, the U.S. DoE is supporting the Building a Technically Reliable Interconnection Evolution for Storage or BATRIES Project.[279] This effort seeks to bring together industry stakeholders to identify and develop solutions that will streamline the interconnection process for energy storage, as well as storage co-sited with solar generation.[280] This three year effort, which began in 2020, will focus on the development of a solutions toolkit intended to provide guidance to state regulators in the adoption of new energy storage interconnection practices.[281]

Another equally important subject for standardization, given the rising number of energy storage resources deployed on the grid, are best practices to guide the assessment of the impact of these resource types in system operations and planning. The bulk power grid is highly interconnected, meaning that the possibility exists for a singular failure to cause a cascading effect if the grid is not properly managed.[282] Thus, the use of accurate modeling that properly reflects the ability of energy storage to serve as load and generation, as well as provide grid services, is vital to ensuring continued reliability and operational continuity of the electric system. Further, improper accounting for high levels of energy storage penetration

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278. INST. OF ELEC. & ELEC. ENG'RS STANDARDS ASS'N, IEEE 1547-2018 – IEEE STANDARD FOR INTERCONNECTION AND INTEROPERABILITY OF DISTRIBUTED ENERGY RESOURCES WITH ASSOCIATED ELECTRIC POWER SYSTEMS INTERFACES (2018).

279. INTERSTATE RENEWABLE ENERGY COUNCIL, BATRIES: STORAGE INTERCONNECTION REFORM (last visited Sept. 15, 2021), https://irecusa.org/regulatory-reform/interconnection/building-a-technically-reliable-interconnection-evolution-for-storage/#Key-tasks.

280. *Id.* This effort is supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy and is a partnership between the Interstate Renewable Energy Council, the Electric Power Research Institute, the Solar Energy Industries Association, the U.S. Energy Storage Association, the California Solar & Storage Association, the New Hampshire Electric Cooperative, Inc., PacifiCorp, and Shute, Mihaly & Weinberger, LLP.

281. *Id.*

282. Ning Kang, Ravindra Singh, James T. Reilly & Nicole Segal, Impact of Distributed Energy Resources on the Bulk Electric System 3-4 (2017).

as part of system modeling and planning may result in demand forecasting errors, causing resource adequacy issues or the building out of unnecessary and costly infrastructure upgrades.

In developing new system modeling and planning tools for the bulk power system, there may need to be a shift from traditional approaches to properly accommodate the impact of energy storage and other distributed energy resources on transmission systems. Currently, in many transmission modeling and planning processes, distribution systems are considered static load, an assumption that fails to account for the dynamic capabilities of distributed energy resources deployed on those systems.[283] Modeling, which combines transmission and distribution factors, will likely improve upon the understanding of the true reliability impact on the bulk power system of energy storage and other distributed energy resources.[284] This can be achieved through increased information sharing or the development of new software that combines transmission and distribution system modeling in a singular platform.[285] Regardless, uniform industry guidelines in this area will be an important tool for bulk power system owners and operators to reliably integrate energy storage.[286]

For FERC jurisdictional entities, NERC maintains mandatory reliability standards that, in part, help guide the wholesale modeling and planning processes. Recently, NERC released new guidance that recommends system planners begin preparing for a critical mass of energy storage resources, like BESS units, by conducting studies that will adequately determine the impact of these resources on the bulk electric system so that the size, location, and operating characteristics of these resources can be properly accounted for within the planning process.[287] This was shortly followed by the issuance of a reliability guideline addressing the performance, modeling, and simulations of batteries and hybrid resources connected to the bulk power system.[288] In light of the spike in the utilization of distributed energy resources, like energy storage and other non-traditional generation resources, such as renewables, NERC has also identified five potential areas within its reliability standards for which the need for modifications should be investigated, including changes that will better assist in data reporting requirements for system modeling and transmission planning.[289]

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283. *Id.* at 1, 3.

284. *Id.* at 17.

285. *Id*. at 2.

286. N. AM. ELEC. RELIABILITY. CORP., DISTRIBUTED ENERGY RESOURCES: CONNECTION MODELING AND RELIABILITY CONSIDERATIONS, at iv (Feb. 2017).

287. N. AM. ELEC. RELIABILITY. CORP., ENERGY STORAGE: IMPACTS OF ELECTROCHEMICAL UTILITY-SCALE BATTERY ENERGY STORAGE SYSTEMS ON THE BULK POWER SYSTEM, at vi (Feb. 2021) [hereinafter *Energy Storage: Impacts 2021*].

288. N. AM. ELEC. RELIABILITY. CORP., RELIABILITY GUIDELINE: PERFORMANCE, MODELING, AND SIMULATIONS OF BPS-CONNECTED BATTERY ENERGY STORAGE SYSTEMS AND HYBRID POWER PLANTS, at vii (Mar. 2021).

289. ENERGY STORAGE: IMPACTS 2021, *supra* note 287, at 23-24.

As discussed earlier in this article, energy storage and other distributed energy resources are uniquely suited to provide an array of grid services.[290] However, in order to be able to procure services from these new resource types, RTOs and ISOs will need to obtain from a resource owner certain critical information about the resource, such as physical location and metering type. Establishing standardized communication protocols for this data would create consistency and common nomenclatures that can be uniformly relied upon by market participants. This should enable wider participation of distributed energy resources by eliminating the complexity of having to navigate multiple sets of procedures to communicate the same datasets.

Relatedly, the U.S. DoE has identified a need for energy storage resource performance metrics.[291] Without a uniform system of measurement and verification, market participants are often dependent on resource manufacturer performance claims, which can create uncertainty around if a given resource can actually supply a needed grid service and may lead to hesitation in use of these types of resources by the more risk averse. However, identifying an industry-wide categorization of resource performance can create a baseline benchmark, resulting in a clear and consistent method for the evaluation of resources. Together, commercial best practices such as data communication protocols and performance metrics can create a standards architecture to assist with the integration of energy storage resources within the wholesale markets.

Currently, the North American Energy Standards Board (NAESB) is undertaking standard development activities intended to support the wholesale electric industry and the participation of energy storage, and more broadly, distributed energy resources in the wholesale markets.[292] As a consensus-based standards development body accredited by the American National Standards Institute, NAESB has a long history of successfully developing business practices for the energy industry, many of which have gone on to become federal[293] or state[294] regulations.

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290. FERC, ENERGY PRIMER: A HANDBOOK FOR ENERGY MARKET BASICS 52 (2020).

291. ENERGY STORAGE GRAND CHALLENGE, *supra* note 252, at 62-65, 146 app. 5.

292. Press Release, N. Am. Energy Standards Bd., NAESB to Address Battery Storage/Distributed Energy Resources and Renewable Natural Gas in 2021 (Feb. 17, 2021), https://www.naesb.org//pdf4/021721press_release.pdf.

293. *See, e.g.*, Order No. 587-Z, *Standards for Business Practices of Interstate Natural Gas Pipelines*, 176 FERC ¶ 61,015 at P 1 (2021); Order No. 676-J, Standards for Business Practices and Communication Protocols for Public Utilities, 175 FERC ¶ 61,139 at P 1 (2021). The federal government, through the National Technology Transfer Act and the Office of Management and Budget Circular No. A-119, are required to use standards developed or adopted by voluntary, consensus-based bodies to carry out agency policy objectives or goals whenever possible. To date, FERC has adopted through the incorporation by reference process all of the business practice standards NAESB has developed applicable to the wholesale gas and wholesale electric industries with only a few noted exceptions. *See* NAT'L INST. STANDARDS & TECH., KEY FEDERAL LAW AND POLICY DOCUMENTS: NTTAA & OMB A-119 (May 31, 2016), https://www.nist.gov/standardsgov/what-we-do/federal-policy-standards/key-federal-directives.

294. Upon the release of a new publication of business practices applicable to the retail gas and electric markets, NAESB makes the standards available to the National Association of Regulatory Utility Commissioners. Several NAESB Business Practice Standards have been adopted by state commissions or served as the basis for regulatory action – mostly in customer choice states including New York, Pennsylvania, and Texas. See, e.g., N.Y. PUB. UTIL. COMM'N, CASE 12-M-0476, PROCEEDING ON MOTION OF THE COMMISSION TO ASSESS

The NAESB standards development process ensures that all interested parties have a seat at the table, and uniquely situates the organization to address commercial issues spanning wholesale and retail interests, such as energy storage and distributed energy resources. On this topic, NAESB is considering the development of standards in three areas to support the industry's integration of energy storage and distributed energy resources: (1) business practices that define an index or registry for these resource types participating in the wholesale markets; (2) information and reporting requirement business practices; and (3) business practices that establish performance metrics.[295] The initial focus of these discussions has been information exchange interactions and the data that will need to be communicated by various parties in a transaction, such as between resource owners, resource aggregators, and RTOs and ISOs.[296]

V. CONCLUSION

In just the few short years since FERC passed its historic ruling in Order No. 841, the use of energy storage within the wholesale marketplace has significantly increased. It is possible that the energy storage industry is likely to see a similar boost resulting from another landmark FERC Order. As part of Order No. 2222, FERC established a path for all distributed energy resource types to participate in the wholesale electric market through their own participation model.[297] Similar to Order No. 841, to partake in the participation model, minimum size requirements of 100 kilowatts must be met, but as part of Order No. 2222, a market participant can aggregate distributed energy resources to meet the size requirement.[298] Not only does Order No. 2222 pave the way for smaller energy storage resources to participate in the wholesale marketplace, but it also underscores the importance of the need for the electric industry to ensure its market framework can accommodate widespread usage of all distributed energy resources.

Attributable in part to advances in technology that have greatly decreased the costs of BESS units,[299] the majority of new, large-scale energy storage units that

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CERTAIN ASPECTS OF THE RESIDENTIAL AND SMALL NON-RESIDENTIAL RETAIL ENERGY MARKETS IN N.Y. STATE (Dec. 23, 2015); PA. PUB. UTIL. COMM'N, 52 PA. CODE CH. 62, PROPOSED RULEMAKING BULLETIN § 62.185 (Oct. 17, 2009); TEX. PUB. UTIL. COMM'N, 16 TAC 2.25.I.25.214, ADOPTED RULE NOTICE (June 27, 2014); *see also*, N. AM. ENERGY STANDARDS BD., NAESB OPERATING PRACTICES 5, 21 (Sept. 11, 2015), https://www.naesb.org//pdf/operating_procedures.pdf.

295. *See* N. AM. ENERGY STANDARDS BD., NORTH AMERICAN ENERGY STANDARDS BOARD: 2021 ANNUAL PLAN FOR THE WHOLESALE ELECTRIC QUADRANT 4 (Sept. 2, 2021), http://www.naesb.org/pdf4/weq_2021_annual_plan.docx.

296. Informational Status Update on NAESB Standards Development Efforts to Support FERC Order Nos. 841 and 2222, FERC Docket No. RM05-5-000, at 2 (June 21, 2021).

297. Order No. 2222, Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators, 172 FERC ¶ 61,247 at P 1, 85 Fed. Reg. 67,094 (2020) (to be codified at 18 C.F.R. pt. 35).

298. *Id*. at P 171.

299. Alex Mey, Vikram Linga & Patricia Hutchins, *Utility-scale battery storage capacity continued its upward trend in 2018*, U.S. ENERGY INFO. ADMIN. (Aug. 10, 2020), https://www.eia.gov/todayinenergy/detail.php?id=44696.

are coming online are batteries.[300] While there are unique risks associated with batteries that should be taken into consideration, especially in regard to safety and cost, there are steps that can be taken to mitigate these risks. One risk consideration that must be accounted for is overall safety of the energy storage system and any potential liability for system failures. Over the past several years, there have been several high-profile incidents involving batteries – most recently Australia's Victorian Big Battery site fire in July 2021.[301] However, both existing and emerging technologies are likely to improve overall battery safety. Arizona Public Service's analysis, following the 2019 McMicken Li-ion battery facility accident, determined the initiating cause of the explosion was attributable to a battery cell internal failure that triggered a "cascading thermal runaway event" with one contributing factor being a lack of ventilation for concentrated flammable gases.[302] As found in the analysis report, there are new developments regarding cascading thermal runaway event testing and research that can be included in applicable technical standards and codes, as well as "cost effective and commercially viable" solutions that can "limit or prevent" cascading thermal runaway events.[303] Battery fire safety and prevention is also an area of active research by the DoE through its national laboratories. Earlier this year, Pacific Northwest National Laboratory, in an effort supported by the DoE's Office of Electricity, invented a new sensor system that can be installed in existing battery storage cabinets and will automatically open doors in response to "smoke, heat, or gas alarms . . . to prevent buildup of flammable gases."[304] By being proactive in employing the use of new and innovate technologies in the installation and operation of BESS units, the safety risks can be mitigated.

While the average capacity costs of BESS units have declined in recent years,[305] the ability to recoup costs associated with the utilization of an energy storage system is another important area of consideration, with resource owners needing reliable information to conduct a cost-benefit analysis. Pacific Northwest National Laboratory, as part of the DoE's Energy Storage Grand Challenge, is developing an energy storage technology "cost and performance database" that seeks to:

> 1) provide a detailed analysis of the all-in costs for energy storage technologies, from basic storage component to connecting the system to the grid; 2) update and increase

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300. U.S. ENERGY INFO. ADMIN., BATTERY STORAGE IN THE UNITED STATES: AN UPDATE ON MARKET TRENDS 8 (July 2020), https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery-_storage.pdf.

301. Lora Kolodny, *Tesla Megapack Caught Fire at Victorian Big Battery Site in Australia*, CNBC (July 30, 2021), https://www.cnbc.com/2021/07/30/tesla-megapack-caught-fire-at-victorian-big-battery-site-in-australia.html.

302. ARIZ. PUB. SERV., NO. 10209302-HOU-R-01, MCMICKEN BATTERY ENERGY STORAGE SYSTEM EVENT TECHNICAL ANALYSIS AND RECOMMENDATIONS 1-2 (July 18, 2020).

303. *Id.* at 46.

304. Nick Hennen, *PNNL Invention Reduces Risk of Battery Explosions*, PAC. NW. NAT'L LAB. (May 18, 2021), https://www.pnnl.gov/news-media/pnnl-invention-reduces-risk-battery-explosions.

305. Between 2013 and 2018, the average capacity cost for BESS units fell from $2,152/kilowatt-hour in 2013 to $625/kilowatt-hour in 2018. See Sara Hoff & Alexander Mey, Utility-scale battery storage costs decreased nearly 70% between 2015 and 2018, U.S. ENERGY INFO. ADMIN. (October 23, 2020), https://www.eia.gov/todayinenergy/detail.php?id=45596.

> fidelity of the individual cost elements comprising a technology; 3) provide cost ranges and estimates for storage cost projections in 2030; and 4) develop an online website to make energy storage cost and performance metrics easily accessible and updatable for the stakeholder community.[306]

Utilization of industry tools, such as this database, will improve understanding of needed capital expenditures and return on investments for energy storage systems, allowing industry participants to make fully informed decisions regarding the deployment of storage technologies.

Although there are inherent risks that must be properly accounted for in the integration of the use of energy storage resources, the possible benefits, especially given the rise in use of renewable generation, are likely to outweigh a large number of concerns if mitigated properly. To be able to realize the full potential of energy storage, the industry should continue to take steps to ensure that these resources are utilized by the market to the fullest extent possible. These efforts, combined with the continued pursuit of market reforms by regulatory authorities, should further incentivize wider integration of energy storage resources.

306. KENDALL MONGIRD ET. AL., PUB. NO. DOE/PA-0204, 2020 GRID ENERGY STORAGE TECHNOLOGY COST AND PERFORMANCE ASSESSMENT 1 (Dec. 2020).