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# Updating Distribution Interconnection Procedures to Incorporate Energy Storage

## Summary:

Effective interconnection standards are a critical policy component for policymakers looking to grow the energy storage market in their state. Without the ability to interconnect systems in a timely and affordable manner, no policy stimulus – be it a procurement target or incentive program – will result in robust deployment. This white paper serves as a guide to policymakers looking to update distribution interconnection rules to incorporate energy storage technology. The white paper includes an overview of the types of distributed energy storage systems customers are likely to adopt, addresses the main interconnection hurdles facing energy storage systems, and proposes a set of recommendations on how to address those challenges in interconnection standards.

## Key Takeaways:

- Energy storage is capable of both injecting and withdrawing electricity from the system, is highly controllable, and capable of fast response to system needs and near instantaneous ramp to full capacity in either charge or discharge mode.
- The ability to inadvertently export for a short period of time is critical for customer's ability to load follow large percentage of their energy needs, and rules governing inadvertent exports should be included in interconnection standards.
- Interconnection standards should reflect the ability of customer to control and modify the use of their energy storage system through operational controls to prevent onerous and unnecessary study timelines and potentially steep upgrade costs for unlikely system behavior.
- Considering the unique ability of customers to control the profile of their energy storage systems, studying the “worst case” scenario (the aggregate nameplate capacity in particular) is inappropriate.
- A net system capacity approach is more appropriate than the aggregated nameplate capacity, with limited exceptions, for an interconnection study of energy storage.

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# INTRODUCTION

While policymakers often look to energy storage procurement targets, incentive program and non-wires alternatives solicitations to grow the energy storage market, without effective interconnection standards that allow a customer or developer to connect energy storage systems to the grid, energy storage deployment will be stagnant. Developing effective interconnection procedures, therefore, is an equally important tool in a policymaker's toolbox to open the storage market in their state.

Advanced energy storage has a unique set of qualities. It is capable of both injecting and withdrawing electricity from the system, is highly controllable, and capable of fast response to system needs and near instantaneous ramp to full capacity in either charge or discharge mode. The wide variety of applications of energy storage is what makes the technology so attractive to customers and what makes energy storage capable of providing immense grid benefits. Yet the variation between customer uses requires thoughtful consideration in interconnection procedures to ensure that projects do not face onerous study timelines or trigger steep upgrade costs.

Unfortunately, the interconnection rules and procedures currently in place in most states were created without energy storage in mind. Significant progress has been made to identify and define best practices both for updating distribution interconnection rules, as well as streamlining interconnection application processes. The Interstate Renewable Energy Council (IREC) offers many interconnection guidelines that ESA adopts and advocated for in this white paper.<sup>1</sup> A number of states have begun the important task of updating their distribution interconnection procedures to ensure that storage devices are able to interconnect to the utility distribution grid. While California<sup>2</sup> and Hawaii<sup>3</sup> are leading the way with newly developed interconnection standards, other states -- namely Nevada<sup>4</sup>, Minnesota<sup>5</sup>, Maryland<sup>6</sup>, and North Carolina<sup>7</sup> -- are making good progress, and Arizona<sup>8</sup> and New York<sup>9</sup> have recently initiated a process to review their standards. As the standards are updated

and behind-the-meter systems are interconnected, the storage industry, electric utilities and regulators are undoubtedly expected to improve their understanding of how to refine the distribution interconnection process. As such, this white paper represents a first iteration of what is surely to be a document that evolves as learning continues.

This white paper aims to provide a set of recommendations for policymakers on how to develop effective interconnection rules that ensures fair treatment of storage devices. The focus here is on distribution interconnected systems behind the customer's meter. The first section of this white paper focuses on the type of configurations regulators should consider for interconnection standards. The second section discusses interconnection study assumptions and timelines for energy storage systems to ensure accurate, timely and fair interconnection process. The final section proposes additional definitions related to energy storage that should be included in interconnection rules. An appendix at the end of the document provides policymakers with a set of questions to consider when engaging stakeholders in interconnection standard updates to include energy storage.



# TYPES OF CUSTOMER ENERGY STORAGE CONFIGURATIONS

This section reviews the various storage configurations that customers may choose to install. It is by no means an exhaustive list and is likely to evolve as the technologies and available utility program and market offerings evolve. Understanding system configurations that customers may choose to deploy not only helps define which customers require an interconnection application but also helps animate what types of studies are appropriate. While each utility may outline different types of storage uses in their interconnection standards depending on the rules that govern its service territory, ESA maintains that most configurations fall into three behind-the-meter categories: (1) non-exporting and non-parallel storage system (paired with on-site generation),

(2) non-exporting and parallel storage system (either paired with on-site distributed generation or standalone), and (3) a storage device that discharges electricity to the grid (either paired with on-site distributed generation or standalone). Exporting systems could choose to export to the grid either in response to a utility program or to participate in the wholesale market. In some states, systems exporting for wholesale market purposes may be subject to different interconnection rules.

Table 1 below provides an overview of these system configuration and provides recommendations on how the systems should be studied and charged for interconnection application.

**TABLE 1: BEHIND-THE-METER ENERGY STORAGE COMMUNICATIONS**

System Structure	Definition	Recommended Study Level	Fee Costs
Non-exporting, non-parallel operations	Intended to serve as backup for customer and not interconnected to the grid; charges from non-parallel on-site generation.	Notification only. No study needed, no interconnection agreement.	Waived application fee.
Non-exporting parallel operations (inadvertent exports)	Connected to the grid, charging from either on-site DG or grid, for use on-site to manage customer load	Fast tracked study, possible that load study is needed.	Customer may pay application fee.
Exporting storage device not participating in wholesale market	Capable of charge from on-site DG or grid, and discharge to the grid in response to utility program.	Study load, generation, and export.	Customer may pay application fee.
Exporting storage device participating in wholesale market	Capable of charge from on-site DG or grid, and discharge to the grid in order to participate in wholesale market.	Study load, generation, and export.	Customer pays application fee.

The first category of storage systems operates as a backup system for a customer. This system is coupled with on-site generation and does not rely on the utility's distribution system. Since systems that do not operate in parallel with the grid are not visible to the utility, as a practical matter it would be reasonable to argue that they should not be required to go through the utility interconnection process. However, utilities may request that such systems still submit an interconnection application/notification for the sake of visibility into what resources are on the grid for planning purposes. ESA recommends that if a utility requests that non-exporting, non-parallel systems submit an interconnection notice for visibility purposes, then approval of those systems would be automatic and would not include an application fee or study timeline.

The second system is one that runs parallel -- or tied -- to the grid infrastructure. This system may draw from on-site generation or charge from the grid. Its primary purpose is generally to help the customer manage on-site load. This system does not export electricity onto the grid for compensation in a utility program or the wholesale

market. These systems should be eligible under certain conditions and requirements to inadvertently export without compensation during times where a sudden fluctuation of load occurs (see non-exporting section below for more detail). It is ESA's recommendation that this type of customer application should -- at minimum -- be fast tracked, since the impact on the distribution system is similar to load reduction from energy efficiency measures.

For the last two types of configurations, the storage system can charge from on-site generation or the grid but also export electricity onto the grid, either for participation in a utility program (such as demand response or a rate time of use tariff), or for participation in the wholesale market. For purposes of this white paper we will not dive into issues related to wholesale market interconnection process nor evolving best practices for coordination between the retail energy provider and energy markets. ESA's recommendation that this type of customer application would follow the normal interconnection process, but that this process will likely need updating to ensure the system is evaluated accurately.

### **System Configurations: DC vs. AC Coupling**

Understanding how energy storage and solar PV systems are combined is critical to ensuring that systems are studied accurately and fairly. There are two primary ways storage is currently integrated with behind-the-meter solar PV systems: AC- or DC-coupled. There are a number of considerations for developers and customers when choosing between the two configurations. For DC-coupled systems, the developer creates a direct connection between the PV system and the battery with a solar controller in between the two. The battery charges the DC power from the solar generation and an inverter on the other end of the battery converts that DC power to AC. DC-coupled systems therefore only have one inverter. Since solar panels produce DC and batteries store DC this is an efficient method of charging a battery from solar.

AC-coupled configuration is currently the most commonly deployed system configuration in the US for storage systems that are coupled with a PV generator on customer sites. If a developer chooses to employ an AC-coupled system, they will have two separate inverters, one for the PV system and one for the storage device. AC-coupled systems are useful in particular for installing a battery where a PV system already exists. But there are additional reasons developers often opt for AC-coupled systems even if both the PV and storage system are new, in particular their ability to provide more flexibility to the customer.

## NON-EXPORTING SYSTEMS

As applications of behind-the-meter storage expand and energy storage systems become an integral part of the load management strategy for customers, additional modifications of the rules for non-exporting systems are necessary. Energy storage systems have historically been deployed to serve as a backup system for extreme conditions, and as such the system was small relative to the customer's load. As energy storage becomes more widely used as a means of managing and offsetting significant portions of on-site consumption needs, the systems being deployed are much more closely aligned with the size of the customer's load. This evolution holds enormous potential benefits to the grid in terms of peak shaving, enhancing hosting capacity and potential for aggregated grid services. However, aligning storage systems more closely with load creates a new dynamic that – if not addressed through interconnection rules – will prevent customers from deploying systems that are optimally sized for self-consumption.

As an example, a residential customer may choose to install an energy storage system that charges from on-site generation such as a photovoltaic system, where the primary use of the battery is to support a customer's load behind the meter. Inadvertent export is situations where the customer's load drops unexpectedly, and the on-site generation or battery cannot ramp down quickly enough to adjust to the new load. In this situation there will be a few seconds of production that cannot be used on-site because the load is no longer there. In those situations, the ability to rely on inadvertent exports for those few seconds is critical for maintaining the balance of the system. In these situations, the battery system functions as a non-exporting system, but the ability to inadvertently exports in these rare occasions provides the customer with the ability to install systems that help them manage their on-site needs more effectively and potentially reduce the stress on the system.

The ability to inadvertently export for a short period of time is critical for customer's ability to load follow large percentage of their energy needs. It is important to note that inadvertent exports are very different from planned

grid exports. Because of the spontaneous nature of these fluctuations in load as a result of customer behavior patterns, these instances of inadvertent export have a zero-coincidence factor and therefore claims that inadvertent exports propose a unique stress on the system because of their potential to happen coincidentally along the same portion of the grid are unfounded.

Drawing on interconnection standards in California and Hawaii, as well as draft interconnection standards in other states, ESA recommends that regulators enable non-exporting systems to inadvertently export so long as they meet certain requirements proposed below. Incorporating a definition for inadvertent exports for systems that are non-exporting also enables the utility to study a more realistic operational profile for the storage device while creating safeguards in the interconnection agreement that those systems maintain a safe and reliable grid. ESA proposes the following definition for consideration, but notes that whatever definition is ultimately developed, it is critical that the process involve a robust stakeholder engagement (including manufacturers, developers and utility engineers) to ensure that the requirements are effective. The definition below leans on existing language adopted in interconnection standard. The 30-second limit was developed through a multi-stakeholder processes that involves storage manufactures as well as utility engineers.

**Definition of Inadvertent Export:** *The unscheduled export of real power from the small generating facility in any single event for a duration exceeding 30 seconds and of a magnitude no more than the generating facility's gross nameplate rating multiplied by 0.1 hours per day over a rolling 30-day period (e.g., for a 100 kVa gross nameplate generator facility, the maximum energy allowed to be exported for a 30 day period is 300 kWh).*

# HOW TO STUDY STORAGE SYSTEMS FOR INTERCONNECTION

Customer-sited storage systems are unique in that the project owner is able in large part to control the system's operational profile. Given the fact that these systems are highly controllable, study processes that assume maximum export of the battery at times when the grid is most constrained will not accurately capture the expected behavior of the battery and will result in undue cost burdens and lengthy study timelines. This problem is particularly pronounced for AC-coupled systems, where the aggregate nameplate capacity of the two inverters -- the PV and storage system -- is too rudimentary a method for studying the system.

A study that assumes a customer will discharge their PV system and energy storage system at the same time during peak hours is not based on any realistic behavior of a customer, and in some cases, might be technically impossible. The aggregated nameplate capacity can be used for short circuit analysis within the technical review process, but is not a valid sizing method for hosting capacity analysis unless the aggregated system was designed to export to the grid. Export potential across the utility meter is likely missing from most interconnection applications, but is a key piece of information to properly assess the generator. Load offset, generation export, and aggregated nameplate rating must all be used in conjunction to properly analyze an energy storage project.

There are several ways regulators and utilities can reform their interconnection rules and procedures to better capture the operational profile of an energy storage system while still maintaining the safe and reliable operation of the grid. This will require understanding for each project what the customer intends to do with the system and the unique configuration of the system ("Proposed Use"). Considering the unique ability of customers to control the profile of their energy storage systems, studying the "worst case" scenario -- the aggregate nameplate capacity in particular -- is inappropriate and would lead to longer study timelines and unnecessary and costly upgrades. A customer's proposed use of the system,

therefore, is a critical component of the interconnection application and should be incorporated into the utility's determination of the interconnection study assumptions.

ESA underscores the need to update interconnection standards to reflect the ability of customer to control and modify the use of their energy storage system through operational controls. To prevent onerous and unnecessary study timelines and potentially steep upgrade costs for unlikely system behavior, adoption of net system (or net nameplate) capacity is needed. A version of this language exists in the NV Energy Rule 15 update and is being considered in a few other proceedings:

**Definition of Net System Capacity:** *Net System Capacity means the Nameplate Capacity of a Small Generating Facility or the total of the Nameplate Capacities of the generating units comprising a Small Generating Facility, as designated by the manufacturer(s) of the generating unit(s), minus the consumption of electrical power of the generating unit(s), and, if applicable, as limited through the use of a control system, power relay(s), or other similar device settings or adjustments. The utility review shall be based on Net System Capacity specified by the applicant in the interconnection request, based on the Proposed Use of the Small Generating Facility, provided the utility agrees that the manner in which the customer proposes to limit the maximum capacity that the facility is capable of injecting will not adversely affect the safety and reliability of the system, and provided the utility may use Nameplate Capacity or aggregate Nameplate Capacities for any short circuit analysis. The Net System Capacity and Proposed Use will subsequently be contained in the interconnection agreement between the customer and utility.*

**Definition of Proposed Use:** *The operational characteristics of a Small Generating Facility upon which the applicant's technical review is based and under which the Small Generating Facility is bound to operate upon the execution of the interconnection agreement. The Proposed Use for a Small Generating Facility may include a combination of electric generators and/or energy storage devices operating in specified modes during specified time periods including but not limited to export, load management, backup, and/or market participation.*

ESA believes this language strikes the right balance between the consideration of responsibilities of the utility to ensure system reliability and safety on the one hand, and recognizing the wide variety of applications of energy storage that customers may want to employ on the other hand. Specifically, the language enables the utility to study net nameplate capacity if it is believed that studying net nameplate capacity (or net system

capacity) would “adversely affect the safety and reliability of the system.” Additionally, the operational controls (or Proposed Use) agreed upon by the customer and the utility would be memorialized in the interconnection agreement and a customer would have to maintain those operational controls for the agreement to be valid. UL1741SA allows for inverter manufactures to certify capabilities that limit export, so there should be no concerns with developers specifying operational constrains if the inverter has been tested to manage export though the UL1741SA process.

Lastly, because customers can exert control over their energy storage systems and modify its operational profile, if a study results in significant upgrade costs, the project applicant may be able to modify the operating characteristics to mitigate some -- or all -- of the anticipated upgrade needs. In that case, the developer should be able to return to the utility with the proposed modification to the performance characteristics of the system, and the changes should be reflected in the utility's anticipated upgrades.

## **Operational Controls**

We discuss in this paper the unique ability of advanced energy storage system owners to exert operational controls on their device in order to control not only when the system discharges onto the grid but also magnitude of the injection, and therefore, the effective size of the energy storage system. Operational controls of energy storage devices can be either native to the system (physical) or an external auxiliary device (non-physical). For larger commercial and industrial (C&I) customers, the operational control might take the form of an energy management system and/or physical relay as is generally the practice with other large distributed generation systems installed behind a customer's meter based on utility requirements. The relay is able to enforce an export limitation, creating a physical separation between the system and the grid to ensure the system does not exceed the thresholds designated by the customer and/or the utility. These relays are a crude, but effective tool to ensure no export to the utility, but constrains behind the meter resources and in many cases the need is technical unreasonable.

For residential systems and other C&I customer, a physical relay is more likely to be cost prohibitive, limit a customer's ability to meet their energy needs, and is not needed with advanced inverter controls. Instead, native controls within the Power Conditioning Systems (PSC) or plant controller software used to manage the smart inverter can serve the same purposes as a physical relay and are just as dependable. Inverters certifying to UL-1741SA may elect to be tested by a Nationally Recognized Testing Laboratory (NRTL) to manage any level of export from 0-100%. For inverters with these capabilities, the NTRL certification provides an independent testing to validate capabilities.



## ADDITIONAL CONSIDERATIONS FOR STREAMLINING STUDY TIMELINES

In addition to studying energy storage systems in a way that reflects the proposed use of the system through the development of a net system capacity process, regulators should consider ways to streamline the study process to ensure that studies are conducted in a timely manner. Distributed interconnection studies have historically been conducted to determine the impact of the additional generator or generating unit on the utility's ability to ensure the safe and reliable operation device and the part of distribution system where the device is located. The incorporation of storage systems onto the distribution system can require an additional study process if the system is charging from the grid, since there is a separate set of rules that govern changes to load.

ESA recommends that in cases where both generation and load studies are required, that interconnection rules be updated to require that both studies are done in tandem to ensure timely interconnection process. This is not only beneficial for the customer by reducing the study timelines, but also more reasonable from a technical perspective. Since the technical review process for load and generation is very similar, there is a technical justification for running the two studies in parallel. California serves as a good case study for this. In Decision 16-06-052, California's Public Utilities Commission called for streamlining the review process of energy storage systems. Any associated costs still handled according to the respective rules that govern each.

# ADDITIONAL DEFINITIONS

In addition to the modifications proposed in the section above, ESA notes that there are two basic and straightforward definitions that should be added to existing interconnection standards to enable energy storage systems to interconnection. The following proposed modifications and additions explicitly add energy storage systems to the list of qualifying systems and devices.

The most immediate issue when updating an interconnection rule to include energy storage is to modify the definition of generator (or generating unit). This is an important modification considering energy storage technology can serve as a generation, distribution or transmission asset. Several stakeholders in proceedings to update interconnection standards have worked to reach consensus on the following definition:

**Definition of Generator or Generating Unit:** *A device that converts mechanical, chemical or solar energy into electrical energy, including all of its protective and control functions and structural appurtenances. An Energy Storage Device can be considered a Generator.*

In addition, the definition of energy storage device below provides greater clarity on what devices are considered in the interconnection rules.

**Definition of Energy Storage Device:** *A device that captures energy produced at one time, stores that energy for a period of time, and delivers that energy as electricity at a future time, including, but not limited to, a battery.*



# CONCLUSION

The recommendations proposed in this white paper serve to ensure that interconnection standards are updated in a way that provide timely and affordable interconnection for customer-sited energy storage systems while ensuring the safety and reliability of the grid. As noted in the introduction of this white paper, ESA's experience with interconnection standards continues to develop as more states update their interconnection standards and energy storage systems are deployed. This white paper is intended to be a starting point for regulators and stakeholders undertaking the important task of incorporating energy storage into interconnection standards.

Table 2 below provides an overview of interconnection standards where the concepts discussed in the white paper are either included or under consideration. While the language used in each of the interconnection standards below differs slightly in wording from ESA's recommended definitions, we believe that the underlying concept and approach are the same.

**TABLE 2: KEY DEFINITIONS IN EXISTING AND DRAFT INTERCONNECTION STANDARDS**

Topic	California Rule 21 <sup>10</sup>	Hawaii Rule 22 <sup>11</sup>	FERC Small Generator Interconnection Procedure (SGIP) <sup>12</sup>	Xcel Guidelines Colorado <sup>13</sup>	Nevada Rule 15 <sup>14</sup>	Arizona Draft Rules <sup>15</sup>
Inadvertent exports	X	X		X	X	X
Net nameplate capacity <sup>16</sup>			X	X	X	
Proposed use						
Generator definition	X	X	X	X	X	X

# APPENDIX

## KEY QUESTIONS FOR REGULATORS TO USE TO ENGAGE STAKEHOLDERS IN INTERCONNECTION REVIEWS

In this section, ESA developed a list of questions that any regulator spearheading an effort to update interconnection standards should review with stakeholders. The list includes a more comprehensive set of questions than were covered in this white paper, and some apply to broader questions that impact other technologies. This list of questions is not exhaustive but rather reflects some of the lessons learned from existing working groups in the states that are undergoing, or have recently completed, updates to their interconnection standards.

Below is a list of discussion questions to help guide regulators through key issues that should be discussed and agreed upon through a stakeholder process to update distribution interconnection rules.

### System Configuration and Applicability

What are the range of system configurations that the interconnection rules should apply to? How should export systems be addressed in utility distribution interconnection?

Do non-parallel systems need to report to the utility even if they aren't interconnecting to the grid? If so, what kind of guarantees can the utility provide in terms of reduced costs (waiving interconnection application fee) and timelines (automatic approval)?

### Study Timelines and Assumptions

How should the utility study these systems? Is the worst-case scenario needed or are there ways that the utility can study a different, more realistic profile without putting reliability and safety needs at risk?

How will the utility review AC-coupled systems? What kind of modeling assumptions are appropriate?

### Inadvertent Exports

What standards should be put in place to govern inadvertent exports?

### Definitions

What is the appropriate definition for generator or generating unit?

What is the appropriate definition for energy storage device?

### Costs

What is a reasonable interconnection application fee? Can the utilities provide cost data to justify the application fee?

What kind of cost assurance is most appropriate? Is a cost envelope appropriate? A cost cap?

### Interconnection Queue and Purging

Is the interconnection queue visible to customers? If not, is it possible to make it visible?

What is the length of time that projects should be allowed to wait in the interconnection queue after receiving an Interconnection Agreement?

# ENDNOTES

1. IREC *Priority Considerations for Interconnection Standards*, August 2017 edition (see [http://www.irecusa.org/wp-content/uploads/2017/08/IREC-Interconnection-2017\\_8-10-17.pdf](http://www.irecusa.org/wp-content/uploads/2017/08/IREC-Interconnection-2017_8-10-17.pdf)).
2. Pacific Gas and Electric's Rule 21 (See [https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC\\_RULES\\_21.pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_RULES_21.pdf))
3. Hawaiian Electric's Rule 22, Customer Self-Supply (See [https://www.hawaiianelectric.com/Documents/my\\_account/rates/hawaii\\_electric\\_light\\_rules/22.pdf](https://www.hawaiianelectric.com/Documents/my_account/rates/hawaii_electric_light_rules/22.pdf)).
4. Public Utilities Commission of Nevada is reviewing proposed updates to Rule number 15 in dockets number 17-06014 and 17-06014. Stakeholders provided input on modifications to the interconnection standards through docket number 16-01013.
5. Minnesota Public Utilities Commission is reviewing existing interconnection standards through docket number 16-521 (See <https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=eDocketsResult&docketYear=16&docketNumber=521#{ED452683-3E99-4CD9-955D-66DC28B42266}>).
6. Maryland Public Service Commission's Public Conference 44 Interconnection Working Group is reviewing modifications to the distribution interconnection regulations COMAR 20.50.02 and COMAR 20.50.09.
7. North Carolina Utilities Commission is currently reviewing the interconnection standards through a working group process in docket number E-100, Sub 101 (See <http://starw1.ncuc.net/NCUC/PSC/DocketDetails.aspx?DocketId=b8c5f6f2-943d-4504-8cdf-718f5ca434de>).
8. Arizona Corporation Commission is currently reviewing updates to its distribution interconnection standards through docket number RE-00000A-07-0609 (See <http://edocket.azcc.gov/Docket/DocketDetailSearch?docketId=14454#docket-detail-container2>).
9. New York Department of Public Service's Interconnection Technical Working Group is currently reviewing modifications to distribution interconnection standards (See <http://www3.dps.ny.gov/W/PSCWeb.nsf/All/DEF2BF0A236B946F85257F71006AC98E?OpenDocument>).
10. Pacific Gas and Electric's Rule 21 (See [https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC\\_RULES\\_21.pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_RULES_21.pdf))
11. Hawaiian Electric's Rule 22, Customer Self-Supply (See [https://www.hawaiianelectric.com/Documents/my\\_account/rates/hawaii\\_electric\\_light\\_rules/22.pdf](https://www.hawaiianelectric.com/Documents/my_account/rates/hawaii_electric_light_rules/22.pdf))
12. Federal (See <https://www.ferc.gov/industries/electric/indus-act/gi/small-gen.asp>)
13. Xcel Guidance for the Interconnection of Electric Storage as Stand-Alone Sources, Parallel Operation for Customers without Generation, and in Parallel with Self-Generation, No. 1, 2, and 3 (See <https://www.xcelenergy.com/staticfiles/xcel-responsive/Programs%20and%20Rebates/Residential/CO-solar-residence-Storage-Guidance-1.pdf>, <https://www.xcelenergy.com/staticfiles/xcel-responsive/Programs%20and%20Rebates/Residential/CO-solar-residents-Storage-Guidance-2.pdf>, and <https://www.xcelenergy.com/staticfiles/xcel-responsive/Programs%20and%20Rebates/Residential/CO-solar-residence-Storage-Guidance-1.pdf>)
14. NV Energy proposed revisions to Rule 15, Public Utilities Commission of Nevada, Docket No. 17-06014, June 2017 (See [http://pucweb1.state.nv.us/PDF/AxImages/DOCKETS\\_2015\\_THRU\\_PRESENT/2017-6/21671.pdf](http://pucweb1.state.nv.us/PDF/AxImages/DOCKETS_2015_THRU_PRESENT/2017-6/21671.pdf))
15. Proposed revisions to Interconnection of Distributed Generation Facilities Rules, Arizona Corporation Commission, Docket No. E-00000A-07-0609, September 2017 (See <http://images.edocket.azcc.gov/docketpdf/0000182532.pdf>)
16. For additional background on net nameplate capacity, please see Solar and Storage Industries Perspectives on Storage, presented to the New York Interconnection Technical Working Group, September 2017 (See [http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/def2bf0a236b946f85257f71006ac98e/\\$FILE/Solar%20and%20Storage%20Industry%20Presentation%20-%20NY%20ITWG%209.27.17%20Final.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/def2bf0a236b946f85257f71006ac98e/$FILE/Solar%20and%20Storage%20Industry%20Presentation%20-%20NY%20ITWG%209.27.17%20Final.pdf))

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