Executive Summary

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Energy storage systems (storage or ESS) are essential to enabling the clean energy transition and a low-carbon electric grid. A growing number of states have adopted ambitious energy and climate targets that will require them to implement a wide spectrum of well-designed policies, from market-based incentives to encourage investment in distributed energy resources (DER), to effective DER interconnection procedures that enable the rapid, efficient, and cost-effective integration of large amounts of DERs onto the grid.

Storage is a foundational tool in this transition. As renewable generation grows, storage will become an increasingly important asset for the energy management services it provides.

For example, when paired with solar, storage can provide more control over the timing and amount of energy imported from and exported to the electric grid, and can support the integration of renewables through several means, including by providing frequency regulation. Utility-scale storage can provide better resource management in states with high wind and solar deployment by mitigating the intermittency of renewable generation. And behind the meter storage can serve as a resilience resource, reduce energy costs for customers, and reduce the need for infrastructure investments necessary to serve peak demand.

These capabilities present both opportunities and challenges for storage interconnection. In order to ensure the continued safe and reliable operation of the grid, utilities must be able to trust that storage will operate as described in interconnection agreements, which allows utilities to anticipate and respond to any potential grid impacts. At the same time, interconnection customers must have access to a fair, efficient, and cost-effective interconnection process that gives them maximum freedom to interconnect their storage assets in a manner that meets their needs (*e.g.*, having the flexibility to respond to price signals).

Most states' existing DER interconnection procedures are not designed with storage in mind, which can create unintended time, cost, and technical barriers to storage integration. As one example, most interconnection rules either permit or require utilities to evaluate the impacts of storage on the grid with the assumption that storage systems will export their full nameplate capacity at all times. In reality, this assumption is extreme for several reasons and doesn't reflect how storage is typically operated, thus creating an unnecessary—but solvable—barrier to storage interconnection.

In addition, interconnection procedures that aren't tailored to serve a jurisdiction's DER market conditions—such as when the speed of DER deployment outpaces the grid's existing hosting capacity or utilities' ability to process applications—can lead to serious queue backlogs or high grid upgrade fees that become barriers to interconnection.

Several states have recognized the importance of storage in supporting DER growth and achieving climate and energy goals and have updated, or are currently in the process of updating, their interconnection rules to address the unique characteristics of storage. However, a great deal of work remains, not just in the number of states that still have to integrate storage into their interconnection rules, but in developing solutions to the complex technical and procedural challenges of storage interconnection.

In response to the need for solutions, the Building a Technically Reliable Interconnection Evolution for Storage (BATRIES) project provides recommendations and best practices for eight critical storage interconnection challenges. The BATRIES project team selected the barriers to address through a stakeholder engagement process that included the input of utilities, DER developers, public service commission regulatory staff, smart inverter manufacturers, and others. The partners also drew upon their experience engaging in research on storage interconnection and participating in related state regulatory proceedings.

The storage interconnection barriers addressed in the *Toolkit and Guidance for the Interconnection of Energy Storage and Solar-Plus-Storage* (Toolkit) include:

- Lack of inclusion of storage in interconnection rules, and the lack of clarity as to whether and how existing interconnection rules (and related documents, such as application forms and agreements) apply to storage systems (addressed in Chapter II)
- Lack of inclusion of acceptable methods that can be used for controlling export of limited-and non-export systems in interconnection rules (addressed in Chapter III)
- Evaluation of non- and limited-export systems based on unrealistic operating assumptions that lead to overestimated grid impacts (addressed in Chapter IV)
- Lack of clarity regarding the impacts of inadvertent export from limited- and non-export systems and the lack of a uniform specification for export control equipment response times to address inadvertent export (addressed in Chapter V)
- Lack of information about the distribution grid and its constraints that can inform where and how to interconnect storage (addressed in Chapter VI)
- Lack of ability to make system design changes to address grid impacts and avoid upgrades during the interconnection review process (addressed in Chapter VII)
- States that have not incorporated updated standards into their interconnection procedures and technical requirements (addressed in Chapter VIII)
- Lack of defined rules and processes for the evaluation of operating schedules (Chapter IX)

The below sections provide the key takeaways from each chapter. The recommendations are necessarily shortened here. Within the chapters themselves, they include model language and other resources, as well as sub-recommendations and nuances that go beyond the key takeaways described below.

A. Chapter II Key Takeaways

The Toolkit begins with *Chapter II: Updating Interconnection Procedures to Be Inclusive of Storage*, which lays the foundation for integrating storage in interconnection procedures. This chapter identifies the fundamental elements required for ESS integration into interconnection procedures. This includes a discussion of how to include storage in the terms used to describe the types of projects that will be reviewed, and recommended definitions for the concepts that are necessary to ensuring adequate review of ESS, which are further discussed in later chapters.

Recommendations for Updating Interconnection Procedures to Be Inclusive of Storage:

1. Interconnection procedures should define the term ESS and clearly state that the procedures apply to the interconnection of new standalone ESS, and ESS paired with other generators, such as solar.

2. Interconnection procedures should define and describe the requirements and use of Power Control Systems (PCS), which are essential to capturing the advanced capabilities of storage.

3. Because DERs paired with ESS often limit their output using a PCS or other means, interconnection procedures should include defined terms that describe the maximum amount of output that takes into account acceptable export control methods ("Export Capacity"), which can be contrasted with the DER's maximum rated power output ("Nameplate Rating").

4. Interconnection procedures should include definitions of the terms "operating schedule" (reflecting the fact that DERs with energy storage can control their import and export according to a fixed schedule), and "operating profile" (describing the maximum output possible in a particular hour based on the DER's operating schedule or resource characteristics).

5. In addition to integrating storage into the interconnection procedures, states should also require utilities within their jurisdiction to update related interconnection documents, including application forms, study agreements, and interconnection agreements.

B. Chapter III Key Takeaways

Next, the Toolkit provides recommendations to ensure that the method a storage system uses to control export is safe and reliable. This can be done by updating interconnection procedures to recognize the ability of ESS to control and manage export in a way that can mitigate or avoid grid impacts. *Chapter III: Requirements for Limited- and Non-Export Controls* provides background on the different methods available for controlling export and pays particular attention to Power Control Systems. The chapter discusses how PCS work and the current standards development process for them (UL 1741 Certification Requirement Decision for Power Control Systems). The chapter also provides recommendations on how to recognize acceptable export control means in interconnection procedures. It proposes options for doing so in a manner that supports safety and reliability, while also increasing certainty for customers and minimizing the need for time-consuming and potentially costly customized reviews by the utility.

Recommended Requirements for Limited- and Non-Export Controls:

1. Relying on customized review of the export controls for every interconnection application is a significant barrier for ESS deployment. Non-standard types of export control equipment will continue to need customized review, but interconnection procedures should be updated to identify a list of acceptable methods that can be trusted and relied upon by both the interconnection customer and the utility. The recommended model language establishes that if an applicant uses one of these export control methods, the Export Capacity specified in the application will be used by the utility for evaluation during the screening and study process.

2. For Power Control Systems specifically, in order to recognize the controllable nature of ESS in interconnection review, PCS should be included in the list of eligible export controls, and the limits set by the PCS should be considered as enforcing the Export Capacity specified in the application.

3. The chapter provides six different acceptable export control methods, and a seventh export control option that allows for the use of any other method so long as the utility approves its use.

C. Chapter IV Key Takeaways

Once a project's means of safely and reliably controlling export have been established, as described in Chapter III, the project can be screened and/or studied with the assumption that it will control export as specified. However, because most interconnection procedures have been drafted without export controls in mind, this means that the screening and study processes need to be updated to specify how limited- and non-export projects will be reviewed. In *Chapter IV: Evaluation of Non-Export and Limited-Export Systems During the Screening or Study Process*, the Toolkit provides background on the typical interconnection technical review process today, explains how the technical review of export-controlled systems can change, and provides recommendations for how interconnection screening and study processes can be updated to recognize these controls.

Recommendations for Evaluating Non-Export and Limited-Export Systems During the Screening or Study Process:

1. When an interconnection application is submitted, interconnection rules provide the utility with a period of time to review the application for completeness and verify the screening or study process that the application will be first reviewed under. Interconnection application forms should be updated to include information about the ESS and, where export controls are used, the type of export control and the equipment type and settings that will be used. During its completeness review and once screening or study commences, the utility should verify that the equipment used is certified, where necessary, and/or is otherwise acceptable for the intended use. The utility should also verify that the export control methods used meet the criteria identified in the export control section of the rule, as discussed in Chapter III.

2. In determining eligibility limits for Simplified and Fast Track processes, interconnection procedures should reflect Export Capacity, not just Nameplate Rating, in the screening thresholds.

3. Interconnection applicants should be permitted to use the Simplified process for screening purposes for certain inverter-based projects if the Nameplate Rating does not exceed 50 kilowatts (kW) and the Export Capacity does not exceed 25 kW.

4. Some interconnection screens may need to be modified to distinguish between the Nameplate Rating and the Export Capacity of a project in order to accurately evaluate the distribution system impacts of export-controlled systems. Each interconnection screen is designed to evaluate whether there is a risk that a proposed project will cause a particular type of impact on the

distribution system. Some of these screens evaluate a project's likely impacts based upon the "size" of the project, which is generally assumed to refer to the Nameplate Rating of the project. In the case of limited-export storage systems, using Nameplate Rating instead of Export Capacity can result in an overestimation of the project's impact. Chapter IV identifies screens in which Export Capacity is appropriate to use when assessing impacts, including in a new inadvertent export screen, as well as screens where evaluation is not impacted by export controls.

5. As with interconnection screens, interconnection studies must take into account the manner in which a project has limited export when they assess impacts in the system impact study. If a proposed project is using one of the acceptable means of export control described in Chapter III, the utility should evaluate impacts to the distribution system using the project's Export Capacity, except when evaluating fault current effects.

6. In order for the interconnection process to fully recognize the ways ESS projects can be designed and controlled to avoid grid constraints, utilities should consider operating profiles (which can include operating schedules) in their feasibility studies and system impact studies.

Note: Chapter IV includes extensive model language in support of the above recommendations.

D. Chapter V Key Takeaways

The recommendations provided in Chapters III and IV are based upon the BATRIES project's research on the potential impacts to the grid of inadvertent export, which are laid out in *Chapter V: Defining How to Address Inadvertent Export*. Inadvertent export is power that is unintentionally exported from a DER when load drops off suddenly, such as when an electric water heater switches off, before the export control system responds to the signal to limit or stop export. Inadvertent export events generally occur in behind-the-meter systems. As ESS deployment grows and more systems use export control means, utilities need to understand whether these inadvertent export events could impact the grid, and if so, how they should be accounted for when evaluating export-controlled ESS. Chapter V surveys how current standards treat inadvertent export and provides research findings based on modeling and analysis conducted by the BATRIES team to test the potential impacts of these events. To understand the range of worst-case impacts, the team conducted time-series analysis of an urban feeder and a rural feeder with exporting solar photovoltaic (PV) systems and non-exporting storage distributed along the feeders.

Research, Modeling, and Analysis Findings Related to Defining How to Address Inadvertent Export:

1. Testing indicates that open loop response times in a number of PCS products are significantly faster than the 30 seconds required by the UL Certification Requirement Decision (CRD) for PCS. These response times support the assertion that thermal impacts are unlikely to be a limiting factor for inadvertent export because both their level (110% maximum) and duration (typically 2-10 seconds) are below any known thresholds for concern.

2. Inadvertent export is a Root Mean Square (RMS) voltage event and fits into an Institute of Electrical and Electronics Engineers (IEEE) defined event category. Therefore, it is appropriate to use the short-term RMS event limit of 110% instead of the steady-state limit of 105%. This creates more headroom for inadvertent export in most feeders.

3. Time-series modeling is an effective way to evaluate RMS voltage impacts caused by inadvertent export.

4. Feeders can host more DER capacity if the DER is export-controlled. This can be viewed as increasing the feeder's available hosting capacity for nameplate DER or as a more efficient use of existing feeder capacity for DERs. While both the urban and rural feeder assessments supported this finding, the extent to which hosting capacity can be increased will depend on feeder characteristics, as well as the location and size of the exporting DER.

5. DER capacity on the urban feeder could be doubled with export limiting (inadvertent export) compared to steady export, without exceeding RMS voltage rise limits.

6. The rural feeder's capacity for inadvertent export is very location dependent. The capacity to support DER drops off more steeply in the longer rural feeder. The main limiting factors were found to be coordination of voltage regulator equipment operations and maintaining voltage balance between phases (not seen in the urban feeder).

7. The value of faster control response was more apparent on the rural feeder than the urban feeder. This observation is based on the interactions of line voltage regulators with inadvertent export events. Regulators lead to more step changes in voltage and voltage unbalance. This may be a limiting factor for export-controlled energy storage in long feeders (not seen in the urban feeder).

8. The impact of smart inverter functions such as volt-var and volt-watt is unclear as these functions were not activated during simulation. This needs further investigation in the future.

E. Chapter VI Key Takeaways

In *Chapter VI: Improving Grid Transparency Through Hosting Capacity Analyses and Other Tools*, the Toolkit focuses on how grid transparency tools such as pre-application reports and hosting capacity analysis (HCA) can enable applicants to access information prior to submitting an interconnection application. Chapter VI also discusses how the HCA might be used in the interconnection process itself to help evaluate interconnection requests.

Recommendations for Improving Grid Transparency Through Hosting Capacity Analyses and Other Tools:

1. Utilities should provide data on the state of the distribution system at the Point of Interconnection through pre-application reports and basic distribution system maps. Chapter VI provides a list of the information fields most commonly requested by developers. This information includes, for example, existing and queued generation, load profiles, and distribution system lines maps. Chapter VI also describes how customers can use distribution system data to help inform project site selection and ESS system design and installation.

2. HCA can serve as an informational tool to guide ESS design. For example, developers can use HCA results to design their ESS systems to avoid contributing to grid constraints by limiting charging during existing net peak load hours. To enable such use of HCA, regulators, developers, and utilities must take several important considerations into account. These include the fact that hosting capacity values on a map provide a snapshot in time and often correspond to a specific DER technology and associated control, and that they may not capture the latest grid or DER queue data because projects in the queue are considered tentative until interconnected.

3. HCA can also serve as a decision-making tool in the interconnection review process for ESS. For example, California has required the use of HCA (called Integration Capacity Analysis in California) results instead of the 15% screen, which evaluates if total generation on a feeder exceeds 15% of a line section's peak load. Current HCA methods implemented by utilities cannot by themselves replace the entire screening process. However, they could help enable ESS to be designed in ways that address specific grid constraints and enable more efficient and cost-effective DER interconnection. To unlock such benefits, HCAs would need to provide hourly information about grid constraints. Potential benefits would need to be weighed against the limitations of such an analysis to lock in an ESS design as well as the costs to develop and maintain these complex analyses of hourly grid constraints.

F. Chapter VII Key Takeaways

Storage interconnection faces a key barrier when it comes to project modifications. As projects go through the interconnection process, utilities may identify system impacts that require distribution system upgrades. But the interconnection review process is not designed to allow a customer to undertake project design changes to avoid those impacts without forfeiting their place in the interconnection queue. *Chapter VII: Pathways to Allow for System Design Changes During the Interconnection Review Process to Mitigate the Need for Upgrades* describes this barrier and provides recommendations on how rule language can be changed to accommodate the type of project modifications that an ESS system could make to avoid the need for upgrades during the interconnection process.

Recommended Pathways to Allow for System Design Changes During the Interconnection Review Process to Mitigate the Need for Upgrades:

1. Interconnection procedures should be revised to provide more data on the reasons for which a project fails screens. To ensure that the customer has enough information to make design decisions, the interconnection procedures should give as specific guidance as possible on what information results should convey to the interconnection applicant, including the specific screens that the project failed and the technical reason(s) for failure, as well as details about the specific system threshold or limitation causing the failure.

2. Screening results should provide relevant and useful data, to enable the customer to ascertain exactly what changes to the DER system could allow it to pass the screen and avoid the need for upgrades. Chapter VII includes a list of preferable screen results data.

3. Impact study results should provide an analysis of potential changes to the DER system that could eliminate or reduce the need for upgrades. Utilities should provide, at a minimum, a limited analysis of alternative DER configurations, ideally during the normal timeframe of the study process (rather than requiring restudy after study results are delivered).

4. Interconnection procedures should have well-documented sections that provide guidance on whether and how design changes can be accommodated, in order to allow an interconnection applicant to undertake design modifications to mitigate impacts without submitting a new interconnection application.

5. During the Supplemental Review process, additional screens are applied that may provide further detail on whether system upgrades are required and provide an opportunity to identify if modifications could address the

constraints. Interconnection procedures should allow for a short period of design change and review, as necessary, to help projects move forward quickly with minimal effects on the queue.

6. Design changes should also be permitted within the full study process. If the utility has already studied alternative configurations during the impact study process, as described above, the utility and developer would have the necessary information to discuss design changes. During a scoping meeting, the developer and utility should agree to evaluate up to three different options, one being the original design and the other two containing system changes.

7. If the utility and developer have already evaluated design options and major design modifications require further study, they can be addressed through post-results modifications. Due to high interconnection cost estimates, even with the options studied per the previous recommendation, modifications to the DER system beyond those alternate options may be desired. As such, interconnection rules should include an explicit process for modifications after study results are delivered.

G. Chapter VIII Key Takeaways

Interconnection standards and guidance documents, such as the suite of Institute of Electrical and Electronics Engineers (IEEE) 1547™ standards, play a crucial role in ensuring that devices are interconnected to the grid safely and reliably. They also ensure that they can be reviewed efficiently, since the standards process enables utilities to trust device performance on the grid and minimize the amount of customized review that is required. *Chapter VIII: Incorporating Updated Interconnection Standards Into Interconnection Procedures* takes a comprehensive look at the existing standards and identifies which standards are relevant to ESS operation. Chapter VIII also provides recommendations on how to incorporate those standards and associated documents into interconnection procedures so that the procedures contain the latest and most relevant technical guidance on ESS design and performance. The project team reviewed eighty-six different standards and related documents for the BATRIES project. Of the eighty-six, the project team found only the IEEE 1547 series, UL 1741 and the Certification Requirement Decision (CRD) for Power Control System, and IEEE C62.92.6 to be relevant to ESS interconnection.

Note: Because the recommendations related to technical standards are deeply technical, they do not lend themselves to a high-level summary. As such, the summary below includes select recommendations only. Readers are encouraged to proceed directly to Chapter VIII to access the full set of recommendations.

Recommendations for Incorporating Updated Interconnection Standards Into Interconnection Procedures:

UL 1741 Certification Requirement Decisions for Power Control Systems:

1. Interconnection applications should be revised to ask whether or not a PCS is included in the DER system design, and if so, require its identification.
2. To ensure PCS controls are appropriately addressed, any performance capability should align with or reference UL 1741. Since PCS testing requirements are yet to be published, requirements should note that, in the interim, listing and certification can be fulfilled per the UL CRD for PCS.
3. When interconnection procedures require certified equipment, they should require PCS to be certified.

IEEE 1547-2018 4.2 Reference Points of Applicability:

1. IEEE 1547 defines Reference Point of Applicability (RPA) so that it is clear at what physical point in the configuration of the system the requirements of the standard need to be met for testing, evaluation, and commissioning. It is

crucial that the utility and developer agree on the location of the RPA as early as possible to determine the DER system design, equipment, and certification needs. A question should be added to the interconnection application allowing the customer to designate a preferred RPA, which the utility should review.

2. The RPA could be reviewed within the Initial Review timeline along with the screens and, for efficiency, the screening process should be completed concurrently with any necessary RPA corrections being made.

3. To ensure the RPA is appropriately addressed by technical requirements, any stated selection criteria or commissioning tests should align with or reference IEEE 1547-2018.

IEEE 1547-2018 4.6.3 Execution of Mode or Parameter Changes

1. To ensure DERs are appropriately addressed by technical requirements, any stated execution of mode or parameter change performance requirements should align with or reference IEEE 1547-2018.

2. If technical requirements specify the execution of mode or parameter changes, include a note stating that those requirements do not apply during islanded operations.

3. If technical requirements exist that require control capabilities, include a note stating that those controls do not apply during islanded operation.

4. Revise the interconnection application form to include language to help the utility understand if the project plans islanded operation.

IEEE 1547-2018 4.7 Prioritization of DER Responses:

1. The interconnection evaluation process should include an understanding of any interactions between storage system use cases and export or import limits or other functions. Given the wide range of possible energy storage operating modes, supported modes can be prioritized and documented in the interconnection agreement.

2. Manufacturers should list relevant provisions in equipment documentation to enable the above recommendation.

IEEE 1547-2018 10 Interoperability, Information Exchange, Information Models, and Protocols:

1. To ensure interoperability of ESS is appropriately addressed by technical requirements, any interoperability requirements should align with or reference IEEE 1547-2018.

2. When an ESS uses additional parameters beyond those mentioned in IEEE 1547, manufacturers are encouraged to make those setpoints interoperable.

3. If IEEE 1547 parameters and setpoints, such as the power factor setpoint and operational state, are needed for ESS in charging mode, they should be specified as applicable to the charging mode in technical requirements.

For subclauses IEEE 1547-2018 4.5 Cease to Energize Performance Requirement, 4.6.2 Capability to Limit Active Power, 4.10.3 Performance During Enter Service, 4.13 Exemptions for Emergency Systems and Standby DER, 5.4.2 Voltage-Active Power Mode, and 8.2 Intentional Islanding, either or both of the following are recommended:

1. To ensure the issue is appropriately addressed by technical requirements, any related performance requirement should align with or reference IEEE 1547-2018.

2. Revise the interconnection application form to give the utility specific information related to the issue.

Grid Services:

1. To provide certain grid services, ESS may need to provide functionality disallowed by or unaccounted for by IEEE 1547-2018. If specific grid services are allowed, related technical requirements may note all exceptions for IEEE 1547-2018 in a technical requirements document or a grid services contract.

2. The interconnection application form should be revised to add a question to flag whether or not grid services will be utilized.

Effective Grounding:

1. To ensure inverter-based resources are appropriately addressed by technical requirements, any effective grounding requirements for inverter-based resources should align with or reference IEEE C62.92.6, IEEE 1547.2 (once published), and IEEE 1547-2018 subclause 7.4.

2. If there are references to grounding reviews in the description of the interconnection studies or related agreements, then interconnection procedures should require the use of IEEE C62.92.6, IEEE 1547.2 (once

published), and the test data from IEEE 1547.1-2020 for the review of inverter-based resources.

3. If the utility requires supplemental grounding, relevant guidance should be provided in the technical requirements document or interconnection handbook.

4. Revise the line configuration screen (SGIP 2.2.1.6) to include new penetration criteria to screen for overvoltage risk.

5. Introduce a new Supplemental Review screen or use a tool to determine if supplemental grounding is required. Additionally, an HCA that incorporates evaluation of temporary overvoltage risk for inverters may be used in lieu of the screen mentioned in recommendation 4 above.

Referencing Recent Standards in Interconnection Procedures:

1. Interconnection procedures should use the most recent versions of the standards discussed in Chapter VIII. Updates to the procedures should account for the timelines associated with the adoption of new or revised standards established by regulatory proceedings.

H. Chapter IX Key Takeaways

Energy storage can operate according to a predetermined schedule that includes both the total amount of power imported and exported as well as when the import or export occurs. This capability is not yet adequately addressed by interconnection standards or procedures. *Chapter IX: Defining Rules and Processes for the Evaluation of Fixed-Schedule DER Operation* discusses what steps need to be taken to establish the capability of devices to reliably control import and export according to a schedule. Chapter IX also discusses how those schedules should be communicated to the utility and how they can be evaluated.

Recommendations for Defining Rules and Processes for the Evaluation of Fixed-Schedule DER Operation:

1. Standards should be developed that describe the scheduling of energy storage operations, especially time-specific import and export limitations. UL 1741, the primary standard for the certification of inverter functionality, should be updated to address scheduled operations. In addition, it may be desirable to update the testing procedures specified by IEEE 1547.1 or other standards to validate operation in compliance with scheduling requirements for non-inverter or non-PCS systems. Other standards could potentially be developed as necessary to support scheduling apart from IEEE 1547 and 1547.1.

2. Although regulators do not have direct control or authority over the standards development bodies or processes, regulators can create a sense of urgency and expectation, such as by beginning to incorporate scheduling functionality into interconnection rules with implementation dates set based upon standard publication. Regulators can also allow the use of equipment that conforms to proposed or draft standards. Finally, regulators can support the development of standards by convening working groups to discuss the use of DER schedules and the associated interconnection rules and requirements.

Because standards often take years to be developed, Chapter IX recommends several interim measures:

3. Regulators could actively develop or encourage the development of field test programs to validate the performance of a deployed system to a fixed operating schedule or profile.

4. Regulators can also help to inform the standards development process, while creating a more immediate pathway for scheduled operation of ESS in their state, by developing their own interim testing protocol that can be

applied while national standards are under development.

5. With or without any of the verification strategies described in Chapter IX, monitoring for compliance with a schedule can be achieved with equipment that is commonly available today. Chapter IX describes several such monitoring mechanisms.

6. While standards are being developed, vendor attestations may be an avenue to provide utilities with some performance assurance. This is the simplest method of verification and manufacturers that have compliant products can likely turn around signed attestations in much less time than typical certifications through national testing labs, although there are risks associated with this approach.

Chapter IX also discusses the development of methodologies for the efficient evaluation of storage with proposed operating schedules:

7. To start studying complex fixed operating profiles in the context of time-specific feeder conditions, it will be necessary for some utilities to collect granular feeder load data for comparison with the proposed operating profile. The data can come from many sources, including advanced metering infrastructure, substation metering, Supervisory Control and Data Acquisition (SCADA), distribution transformer metering, billing departments, or other sources.

8. In addition to addressing utility data needs, the techniques for screening and studying projects with operating schedules require further development. In order to enable storage to provide valuable time-specific grid services, regulators should either proactively convene working group discussions or encourage others to do so in order to work through the various issues with utility and DER stakeholders.

Finally, Chapter IX discusses establishing standardized formats for communicating operating schedules:

9. Regulators should convene a process to establish a standard template for the communication of operating profiles. They will need to consider which data points are necessary based upon the ways utilities will actually study projects. Chapter IX includes a sample template that can serve as a starting point.

BATRIES is led by the Interstate Renewable Energy Council (IREC), in collaboration with a team of partners[1]—collectively, the Storage Interconnection Committee (STORIC)— which includes:

1. Electric Power Research Institute
2. Solar Energy Industries Association
3. California Solar & Storage Association
4. New Hampshire Electric Cooperative, Inc.
5. PacifiCorp
6. Shute, Mihaly & Weinberger, LLP

The BATRIES project team looks forward to continuing to engage with stakeholders to implement the solutions recommended in this Toolkit.

[1] Note: The Energy Storage Association (ESA) was a partner on the BATRIES project through December 2021, before merging with the American Clean Power Association (ACP) in January 2022. ACP is not a BATRIES partner.