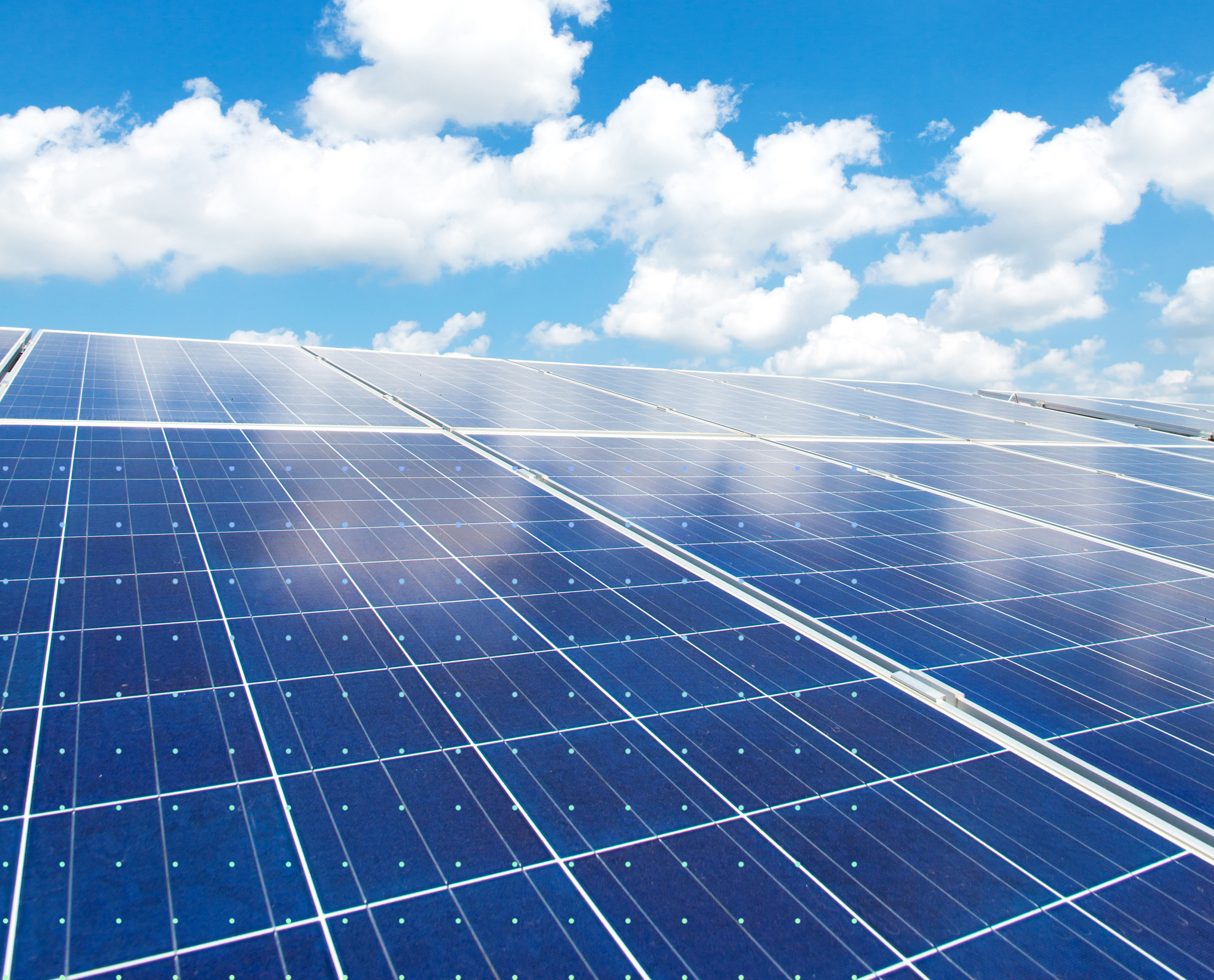
stem

# Battery Energy Storage Solutions for Electric Cooperatives

How to maximize energy storage benefits for co-ops and their members

**May 2021**



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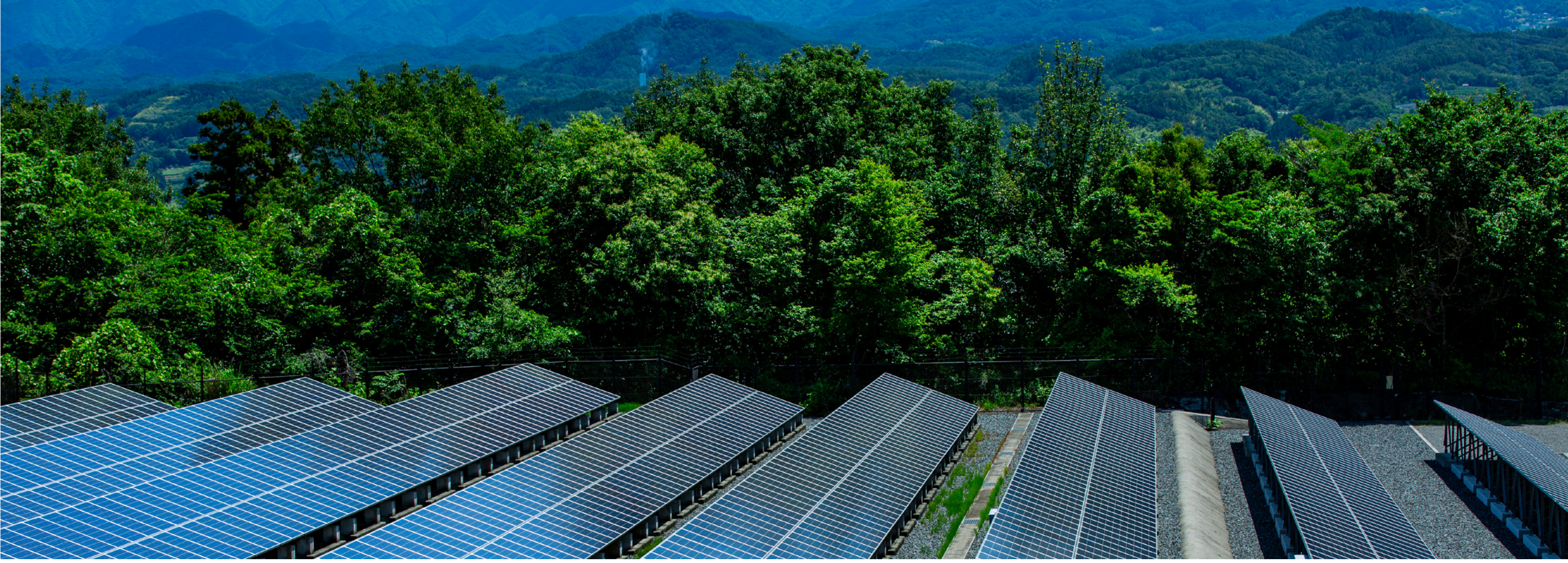


# Introduction

Electric cooperatives have long utilized energy storage and renewable energy to benefit their members. In recent years, steep cost declines in both solar PV and battery storage have led to renewed interest and catalyzed greater numbers of deployments. The National Rural Electric Cooperative Association (NRECA), for example, reports that co-op solar capacity has tripled in the last three years.[1]

Energy storage and renewable energy are becoming increasingly prevalent in the resource portfolios of electric cooperatives and other utilities. These complementary resources can help co-ops reduce costs and build resilience for members, while also responding to burgeoning member interest in clean energy and supporting local economic growth.[2]

Battery energy storage is a unique and extremely versatile resource. It is simultaneously key to maximizing benefits from variable renewables like solar and wind, while also offering capabilities more commonly associated with traditional dispatchable technologies. And with its recent cost declines, battery storage is now more cost effective in more applications and in more locations than ever before.

**To help electric cooperatives realize maximum benefits from energy storage for their members,** Stem has developed the following overview and best practices guide. Our recommendations are based on more than a decade of pioneering experience in designing, deploying, and operating hundreds of successful energy storage systems for a wide range of clients including businesses, project developers, and utilities including electric cooperatives.

[1] "Solar," National Rural Electric Cooperative Association (NRECA), accessed March 3, 2021, https://www.electric.coop/wp-content/Renewables/solar.html.

[2] Erin Kelly, "'Creative agreements': Co-ops attracting new business through renewables," Rural Electric (RE) Magazine, February 1, 2021, https://www.cooperative.com/remagazine/articles/pages/co-ops-attracting-new-businesses-through-renewables-creative-agreements.aspx/.

# Battery Energy Storage

## Use cases for co-ops

NRECA, in a recent report, provided an overview of battery energy storage use cases for electric cooperatives.[3] Building on that important resource, we briefly summarize our perspective on the different types of value that battery energy storage systems can provide to co-ops and their members, now and over the course of a project's 10- to 20-year lifetime.

### Peak shaving to lower energy costs

Battery energy storage can discharge during times of peak demand, helping both members and distribution cooperatives significantly reduce costs by avoiding expensive demand charges. This use case is also referred to as "coincident peak mitigation" (or "management").

### Resilience and backup power

"Energy resilience" refers to the ability to reduce or eliminate power outages by installing battery energy storage for backup power at substations or member sites, often in combination with solar PV. With U.S. outages growing in both frequency and duration, resilience has become an increasingly compelling use case for energy storage.

### Renewable energy integration

Battery energy storage is the primary solution for integrating variable renewable resources like solar and wind into the grid. As a firming resource, storage can smooth renewable output and compensate for any differences in forecasted vs. actual supply (e.g., as a result of changing weather conditions).

In recent years, it has become increasingly common to pair battery storage with solar PV (both large-scale and distributed solar) in order to "time-shift" solar generation to late afternoons and evenings, when it is often more valuable. Storage can also capture solar oversupply that would be otherwise "clipped," enabling larger and more efficient solar projects.

Finally, storage is eligible to receive the federal investment tax credit (ITC) when it is charged from a paired solar resource.[4] This further enhances solar plus storage project economics. Smart storage software can both ensure solar ITC compliance and manage to a desired solar charging target.

### Grid stabilization

Battery energy storage can provide ancillary services such as frequency regulation (up or down), spinning and non-spinning reserves, voltage support, and black start. A key advantage of energy storage in these applications is its near-instantaneous availability.

### Transmission and distribution (T&D) deferral

Battery energy storage installed at any point on the electricity grid – on the transmission system, distribution system, or at member sites – can help co-ops defer T&D infrastructure investments. In this case, the battery serves as a "non-wires alternative" (NWA).

### Wholesale market participation

Depending on a co-op's specific situation of ownership and applicable regulations, some battery energy storage projects can earn revenues from providing energy, capacity, and/or ancillary services in organized wholesale electricity markets.

[3] National Rural Electric Cooperative Association (NRECA), "The Value of Battery Energy Storage for Electric Cooperatives: Five Emerging Use Cases," Business & Technology Report, January 2021, https://www.cooperative.com/programs-services/bts/Documents/Reports/Battery-Energy-Storage-Use-Cases-January-2021.pdf.

[4] The solar ITC was recently extended to provide a 26% credit in 2021 and 2022, and a 22% credit in 2023. As things stand, in 2024 the solar ITC will drop to 10% for commercial and utility-scale projects and 0% for residential projects. For more, see https://www.seia.org/initiatives/solar-investment-tax-credit-itc.

**Battery technology will inevitably be part of the solution for managing the grid impacts of variable power sources like solar and wind, and as an asset in the various approaches that cooperatives might take to increase system resiliency and operational efficiency.**

– National Rural Electric Cooperative Association

# Energy Storage

## Multiple interconnection options

As the number of use cases demonstrates, battery energy storage is a versatile asset. That versatility also extends to how it is deployed, with the ability to interconnect to the transmission grid, distribution grid, or "behind the meter" at member sites.

Transmission- and distribution-connected storage operate similarly to a traditional power plant, injecting energy into the grid to provide grid stabilization or reduce wholesale energy charges.

Storage interconnected at member facilities provides the unique ability to directly benefit the host site, in addition to benefiting the co-op. Member-sited storage can be aggregated to provide system-level value for the utility (e.g., through a demand response program) to address any of the use cases previously mentioned. When not being used specifically for the benefit of the distribution co-op, the retail member is able to recognize resilience benefits and other utility bill savings mechanisms.

# How Parties Come Together to Deliver Energy Storage Projects for Co-ops

While approaches vary, there are generally five key roles to be filled in delivering successful energy storage systems (ESS) for electric cooperatives, as described below. Because storage is often paired with solar, that configuration is assumed throughout.

### 1. Co-op.

Ultimate decision maker and client. Selects projects based on prospective benefits to members and in response to member priorities and needs. Often will not own the project but instead will receive contracted services from it.

### 2. Developer.

Leverages solar deployment expertise to generate project ideas that are customized to a co-op's specific goals and needs. Oversees project execution and often provides solar and storage services to the co-op.

### 3. Energy storage provider.

Contributes storage-specific design, procurement, deployment, and operational expertise to extract maximum value from the project. Designs optimal ESS in collaboration with the developer and co-op, and operates it in collaboration with the co-op.

### 4. Financier.

Provides project financing to the developer.

### 5. Engineering, procurement, and construction firm (EPC).

Installs the project. Many developers also serve as EPCs.

**The relationship between the co-op, developer, and energy storage provider is especially important,** as they will continue to collaborate over the lifetime of the project. Below are three examples of solar plus storage projects Stem is currently supporting to help electric cooperatives capture energy storage value streams tailored to their specific circumstances and needs.

# Case Study One

## Holy Cross Energy

Holy Cross Energy, which serves more than 44,500 members across five western Colorado counties, has set a goal to deliver 100% clean energy by 2030. For this project, it has partnered with Stem and Ameresco, an independent energy solutions provider with operations across the U.S. and United Kingdom. The project consists of a 5MW solar facility paired with a 5MW / 15MWh ESS (which is to say, a 5MW battery of three hours' duration).

This battery is designed primarily to reduce Holy Cross Energy's coincident peak charges. But the co-op already has a significant amount of renewables online, and at times it risks oversupply; consequently, the battery will also be used to capture oversupply that otherwise would have been curtailed. By providing direct bill savings to the co-op while enabling a higher penetration of low-cost renewable energy, the battery will reduce costs for co-op members while facilitating the achievement of clean energy goals.

Stem will provide the project's turnkey smart storage solution, including both battery hardware and Athena™ smart energy software, and operate the ESS in collaboration with Holy Cross Energy.

### At-A-Glance

**Location**
Glenwood Springs, CO

**Solar PV System**
5MW

**Energy Storage System (ESS)**
5MW / 15MWh

**ESS Use Cases**
Coincident peak mitigation, renewable energy integration

**Commercial Operation Date**
Early 2022

# Case Study Two

## Confidential Cooperative

For this project, a distribution co-op located in Arkansas is collaborating with Stem and a confidential partner that develops, owns, and operates assets on behalf of co-ops and other clients. The 2.7MW solar park, paired with a 7MW / 14MWh ESS, will provide savings to co-op members over the 20-year contract term.

The battery's primary use in this project will be to reduce wholesale demand charges for co-op members. Stem will provide the user interface to allow the co-op to coordinate the charge and discharge signals and schedules for the ESS, with the goal of discharging the battery into system peaks. Additionally, Stem will provide performance reporting of the system and ensure its availability for dispatch signals from the co-op.

### At-A-Glance

**Location**
Arkansas

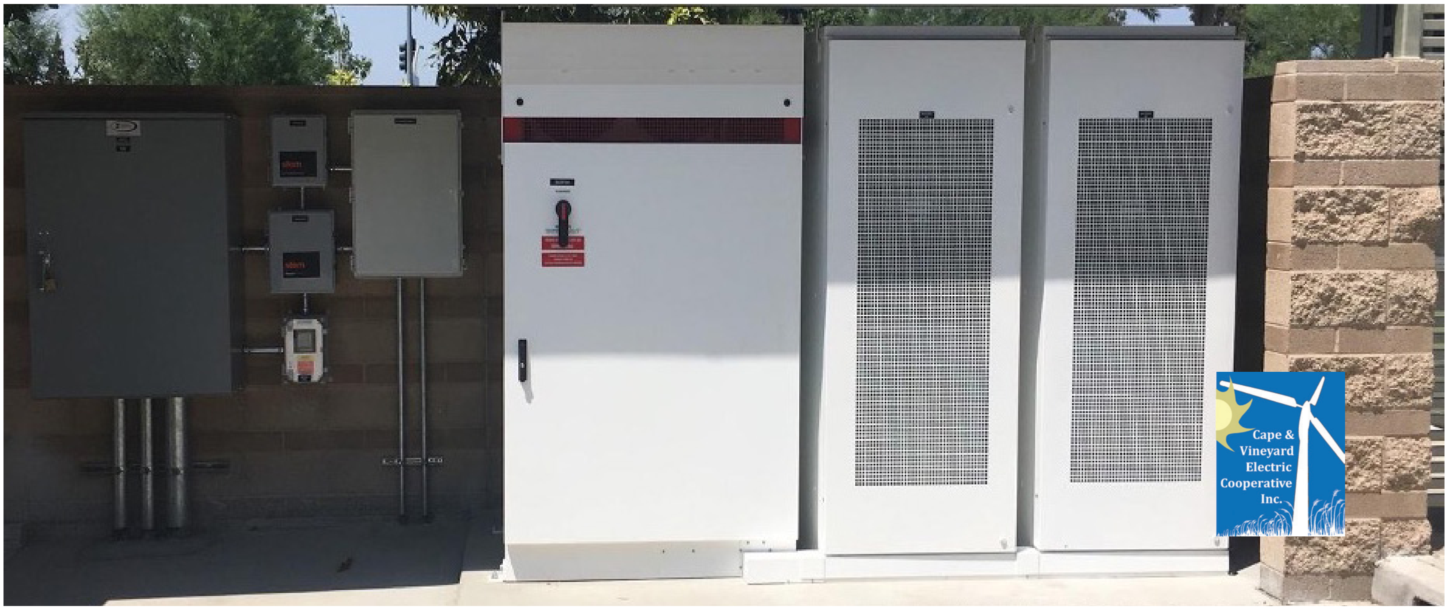
**Solar PV System**
2.7MW

**Energy Storage System (ESS)**
7MW / 14MWh

**ESS Use Cases**
Coincident peak mitigation, renewable energy integration

**Commercial Operation Date**
Summer 2021

# Case Study Three




## Cape and Vineyard Electric Cooperative

The Cape and Vineyard Electric Cooperative (CVEC) currently serves two dozen municipalities in southeastern Massachusetts. For this project, it has partnered with Stem and Greenskies Clean Energy to install a 272kW solar PV system paired with a 58kW / 232kWh ESS at an elementary school in Oak Bluffs, Mass. The solar PV is part of a portfolio of projects that will double CVEC's existing renewables capacity and help lower costs for members.

In addition to providing the turnkey storage solution, Stem's Athena smart storage software will operate the solar asset in compliance with the solar ITC and an important state incentive, the Solar Massachusetts Renewable Target (SMART) program. In the event of a grid outage, the battery will also provide the school with backup power for up to four hours.

### At-A-Glance

**Location**
Oak Bluffs, MA

**Solar PV System**
272kW

**Energy Storage System (ESS)**
58kW / 232kWh

**ESS Use Cases**
Resilience and backup power, renewable energy integration, MA SMART incentive management

**Commercial Operation Date**
Fall 2021

# 7 Best Practices for Realizing Successful Energy Storage Projects for Co-ops

Always on the lookout for innovative ways to serve their members and reduce costs, many co-ops are increasingly turning to battery energy storage. As energy storage costs continue to decline and wholesale transmission and capacity charges continue to increase, many co-ops are finding energy storage to be an effective way of delivering savings to their members.

To help co-ops maximize member benefits from energy storage, Stem has assembled the following best practices guide. These recommendations extend across the design, deployment, and operational phases (Fig. 1) and are based on more than a decade of experience in spearheading hundreds of successful projects for a wide range of clients including businesses, project developers, and electric cooperatives.

| Design | Deploy | Operate |
|---|---|---|
| **1.** Right-size energy storage system (ESS)<br>**2.** Consider multiple value streams | **3.** Develop a clear project financial and operating model<br>**4.** Minimize ESS procurement risks | **5.** Prioritize seamless ESS integration and operating visibility<br>**6.** Ensure warranty and ITC compliance<br>**7.** Optimize ESS operations |

*Fig. 1. 7 best practices for realizing successful co-op energy storage projects*

**A battery's ability to realize economic benefits is wholly dependent on the software that operates it. In the end, the value a battery creates will be determined by thousands of real-time decisions made by the software based on terabytes of data over a 10- to 20-year timeframe.**

## 1. Right-size energy storage systems (ESS).

Reducing demand charges via coincident peak (CP) management may be the primary use case distribution co-ops are interested in today. Demand charges for distribution co-ops are calculated in many different ways, and tariff structures vary. When considering cost-effective energy storage, it is important to understand not only the mechanism by which peak rates are set, but also the characteristics of the peak and the amount of energy needed to shoulder expected peaks. Because batteries deliver a finite amount of energy, selecting one with the right duration (MW / MWh ratio) for your needs is essential to balancing ESS size with its costs and benefits.

## 2. Consider multiple value streams.

Battery energy storage can provide several value streams beyond coincident peak management. A "value stream" is simply the ability to realize economic value from any one of the energy storage use cases described above, at any point over a project's lifetime. Near-term value streams for co-ops may also include resilience or grid stabilization services. Note that the size of the battery does not necessarily need to increase in order to realize additional value streams; rather, the software that operates the battery must be capable of realizing secondary value streams without compromising the primary one (see No. 7, "Optimize storage operations"). The more value the software captures, the more value co-op members will receive.

## 3. Develop a clear financial and operating model for the project.

It's essential to understand the financial benefits that the energy storage facility will provide over time. This requires modeling avoided costs as well as revenues from all current and future value streams, including any "value stacking" that may occur to extract more value from the battery. For projects that will be owned and operated by third parties to the utility, prospective lenders often require detailed forecasts of the project's long-term value over the course of the contract term.

## 4. Minimize ESS procurement risks.

Battery purchasing contracts are complex and can affect the long-term value of the asset, and consequently Terms and Conditions (T&Cs) must be reviewed and negotiated carefully. Buyer protection mechanisms include availability guarantees (to ensure battery availability during coincident peak events and assign fault if not); capacity guarantees (to ensure battery performance over the full duration of a long-term contract); and delivery liquidated damages (to protect the buyer from financial harm in the event of a delay). Efforts to reallocate risk back onto battery OEMs can be aided by an expert storage partner with significant contractual expertise and buying power.

## 5. Prioritize seamless ESS integration and operating visibility.

Although energy storage may be a new technology for many co-ops, it doesn't have to be a black box. Utility operators should have the ability to dispatch the ESS, view operating status in real time, and easily report on system performance. Experienced storage partners can provide simple, standardized integrations based on SCADA/DNP3 protocols that most utilities are already using. Web-based user interfaces are additional tools that can improve visibility and overall understanding of ESS operations.

## 6. Ensure compliance with solar ITC charging and battery warranty requirements.

As with the other operational best practices, compliance is accomplished by smart storage software. When an ESS is paired and charged from solar, the software must control it to comply with ITC charging requirements and prevent any manual ESS dispatches from unintentionally compromising compliance (via too much grid charging). The software must also ensure the battery is operated within warranty throughput specifications, which are typically based on charge and discharge cycles, average resting state of charge (rSOC) and other parameters as appropriate in order to preserve asset health. The software's ability to adhere to these parameters and document performance over time protects the asset from undue operational degradation and supports the co-op in any warranty claims.

## 7. Optimize storage operations to get the most value from the ESS.

This is "first among equals" of all best practices. A battery's ability to realize economic benefits for co-op members is wholly dependent on the software that operates it. In the end, the value a battery creates will be determined by thousands of decisions made by the software – including when to charge and discharge, at what rate (in MW) and for how long – based on terabytes of data over a 10- to 20-year timeframe. Consequently, energy storage providers should be scrutinized for the excellence of their software and the real-world results that software has achieved for customers.

## About Stem, Inc.

### A global leader in artificial intelligence (AI)-driven clean energy storage systems

Stem delivers and operates smart battery storage solutions that maximize renewable energy generation and help build a cleaner, more resilient grid. Our customers include Fortune 500 corporate energy users, project developers and installers, and utilities and independent power producers.

Stem's market-leading Athena™ software uses advanced artificial intelligence and machine learning to automatically switch between battery power, onsite generation and grid power. Athena™ helps lower energy costs, stabilize the grid, reduce carbon emissions, and solve renewable intermittency across the world's largest network of distributed energy storage systems.

## Contact Us

Stem is committed to helping electric cooperatives and project developers realize successful energy storage projects. To learn more about how energy storage can benefit co-ops and their members and how Stem can help, contact us today:

stem.com/contact-us

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