Utility-scale lithium ion BESS installation at Fort Carson. Using REopt™ energy optimization and modeling software, NREL verified the batteries' potential economic savings and helped Fort Carson characterize technology risk. *Photo by Dennis Schroeder / NREL56342*

Behind-the-Meter to Front of the Line: Prioritizing Battery Storage Opportunities across a Portfolio of Sites

Prioritizing battery energy storage system (BESS) opportunities across a large real estate portfolio can be complex. The National Renewable Energy Laboratory (NREL) used a phased approach to efficiently identify the most cost-effective projects across 80 U.S. Army installations.

In 2019, the Army successfully deployed a behind-the-meter (BTM) BESS at Fort Carson through an energy savings performance contract. The battery, along with an existing solar photovoltaic (PV) system, is dispatched to reduce demand charges and is projected to shave an estimated $500,000 off Fort Carson's utility bill each year, which is used to repay the capital investment in the battery. Interested in replicating this success, the Army tasked NREL with identifying additional opportunities across 80 U.S. installations.

Behind-the-Meter Battery Storage Can Yield Significant Savings with Careful Consideration

As economic considerations for distributed energy resources (DERs) become more complex, traditional metrics like levelized cost of electricity are no longer sufficient to evaluate project potential. This is particularly true for BESS which provide savings by shifting rather than reducing electricity usage. To evaluate the savings potential of BESS, detailed techno-economic assessments are typically conducted. These assessments require site-specific information including 15-minute electricity usage, utility rate structure detail, and information about other value streams such as demand response programs and incentives.

Collecting and maintaining information to evaluate BESS potential can be cumbersome, especially for those with real estate portfolios that span vast geographic regions. Electricity usage can be recorded in 15-minute, 30-minute, or hourly intervals, and typically must be requested from the utility. Rate structures can be complex and subject to frequent updates, with energy and demand charges often varying by time of day, season, and monthly usage. Additionally, even when data is available, conducting detailed techno-economic assessments can be costly and time consuming for many organizations.

A Phased Approach to Prioritize Projects Across a Large Portfolio

To efficiently prioritize sites with high potential for cost-effective deployment of BTM BESS without conducting an in-depth assessment at each one, NREL developed a phased approach to identifying where additional efforts should be focused. This methodology could be applied by other federal agencies and organizations interested in identifying BESS opportunities across a large number of sites to focus additional, more detailed assessments.

Indicators for Identifying Optimal Sites for BTM BESS

Site Blended Electricity Cost. A high blended rate can indicate opportunity to deploy DERs, but not specifically BESS.

Nationwide Utility Rate Analysis. National-scale analysis can indicate areas of the country with high potential for BESS deployment, but not necessarily specific buildings.

State Storage Policy Environment. A strong policy environment (determined by number and type of policies) indicates lack of barriers to deployment but does not indicate economic opportunity.

Statewide Levels of BTM BESS Deployment. State-level BTM BESS deployment can be driven by policies and economics; historic deployment does not always indicate current or future opportunities.

In the first phase, four indicators were used to prioritize sites: blended cost of electricity, savings from nationwide analysis of BESS opportunities, state storage policy environment, and historic statewide levels of BTM BESS deployment.

The only site-specific indicator used for the screening was the **blended cost of electricity** (the site's total electricity cost divided by the total kilowatt-hours consumed). While a high blended cost of electricity can indicate opportunities to deploy DERs, it does not specifically indicate good opportunities for BESS. Low blended cost of electricity can, however, be used as an indicator to rule out sites that are likely to have low demand charges or time-of-use rates—making them unlikely candidates for cost-effective BESS.

Next, NREL utilized a previously conducted study that assessed **BESS (and solar PV) economics across the United States**. The study used the most common utility rate in each service territory (including detailed time-of-use energy and demand charges), simulated load profiles, and solar resource values. The specific location of each site was overlaid with the results of the analysis. While this does not factor in the specific rate of the site, the results of the national-scale analysis account for the sites' utility provider cost structures and solar resource.

NREL also identified **policies and incentives** associated with BESS including mandates, pilot programs, permitting, and net energy metering policies. The policies were aggregated at the state level to help characterize each state's BESS-related policy environment. 26 states were identified with at least one relevant distributed battery storage policy. The number of policies per state ranged from one to 27, with an average of four policies.

Finally, **BTM BESS deployment by state** was used to indicate where the technology has been installed to date.

For each of the four indicators, sites were scored high, medium, or low.[1] The total score was used to prioritize sites for completion of a more detailed techno-economic assessment.

For sites that scored well in the first phase of screening, 15-minute load profile data and utility bills were used for a detailed REopt analysis.

Site Scoring

Indicator	High	Medium	Low
Blended cost of electricity ($/kWh)	≥$0.15	$0.08–$0.15	<$0.08/kWh
Nationwide BESS analysis	Regions where BESS alone modeled as cost-effective	Regions where BESS + PV modeled as cost-effective	Regions where model indicates BESS is not cost effective
State storage policy environment	≥5 state policies (AZ, CA, HI, MA, NJ, NV, NY)	1–4 state policies	0 identified state policies
Statewide level of BTM BESS deployment	California (contains 89% of BTM BESS deployment to date)	8 states (plus PJM service territory) where a significant amount of BTM BESS has been deployed to date	Sites in remaining states

[1]Installations were ranked from highest to lowest Phase One score. Five sites scored a perfect 8. An additional 14 sites scored 4 or above. Ten sites did not score in any of the four categories.

The successful battery energy storage system project at Fort Carson inspired the Army to evaluate additional opportunities at U.S. installations with assistance from NREL. *Photo by Dennis Schroeder, NREL 56333*

Results Indicate Significant Opportunities for BESS at Army Installations

Of the 10 installations selected for REopt analysis, stand-alone BESS (without solar PV) appeared to be cost effective at five sites and BESS coupled with PV appeared to be cost effective at seven sites. These "success rates" compare favorably to results from the nationwide screening of BESS opportunities which concluded BESS is cost effective for 21% of U.S. locations, and BESS with PV is cost effective for 27%.

Methodology Limitations

There are some limitations to this methodology. For one, the site's specific utility rate structure is not considered in the initial screening. While a high blended rate and opportunity for cost-effective BESS based on the servicing utility's most common rate are good indicators, that does not guarantee the site-specific rate allows for the same level of savings. Additionally, the number of BESS-related policies is an imperfect metric for ranking the state's policy environment. A state or local government could adopt one comprehensive policy that targets all aspects of the industry, while another entity may adopt similar policies in a piecemeal fashion, such that one policy has the same effect as five or more policies. Finally, the historic deployment of BESS does not necessarily indicate where current or future opportunities may exist. However, for organizations interested in identifying BESS opportunities across a portfolio of geographically diverse sites, this methodology could serve as an efficient first step to prioritize and focus efforts.

Learn More

Read more about Fort Carson's load-shaving battery system at *reopt.nrel.gov/projects/case-study-ft-carson.html*.

Learn about NREL's nationwide assessment of BESS and PV economics at *nrel.gov/docs/fy21osti/77112.pdf*.

See an example of a detailed REopt analysis of the economics of PV plus BESS at a military base in California at *reopt.nrel.gov/projects/case-study-military-base.html*.

Learn more about partnering with NREL at *nrel.gov/workingwithus/defense-partnerships.html*.

Access the REopt Lite web tool at *reopt.nrel.gov/tool*.

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