
2021 Five-Year Energy Storage Plan

*Recommendations for the
U.S. Department of Energy*

April 2021



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Introduction

This report fulfills a requirement of the Energy Independence and Security Act of 2007 (EISA). Specifically, Section 641(e)(4) of EISA directs the Council (i.e., the Energy Storage Technologies Subcommittee, through the Electricity Advisory Committee) to:

Every five years ... in conjunction with the Secretary [of Energy] ... develop a five-year plan for integrating basic and applied research so that the United States retains a globally competitive domestic energy storage industry for electric-drive vehicles, stationary applications, and electricity transmission and distribution.

The Electricity Advisory Committee (EAC) submitted its last five-year energy storage plan in 2016.¹ That report summarized a review of the U.S. Department of Energy’s (DOE) energy storage program strategies and activities, and included recommendations for DOE’s consideration as DOE continued to develop and implement its energy storage program.

In January 2020, DOE launched the Energy Storage Grand Challenge (ESGC). The ESGC is “a comprehensive program to accelerate the development, commercialization, and utilization of next-generation energy storage technologies and sustain American global leadership in energy storage.” The ESGC calls for concerted action by DOE and the National Laboratories to accomplish an aggressive, yet achievable, goal to develop and domestically manufacture energy storage technologies that can meet all U.S. market demands by 2030.

In July 2020, DOE released a draft Energy Storage Grand Challenge Roadmap (the Roadmap) for accomplishing this goal, along with a request for information (RFI) to solicit stakeholder input. The EAC provided a set of recommendations in response to this RFI that drew attention to high-level issues and offered specific recommendations across the five tracks of the Roadmap—technology development, manufacturing and supply chain, technology transition, policy and valuation, and workforce development.² DOE reviewed comments from the EAC and other stakeholders, and in December 2020 published a final version of the Roadmap.³

While individual DOE offices have historically established their own goals and targets, the Roadmap represents DOE’s first-ever comprehensive energy storage strategy. The Roadmap is not only a plan for coordinated research and development (R&D) activities, but also provides an approach for accelerating

¹ The EAC’s 2016 5-year plan is available on the EAC’s website at <https://www.energy.gov/sites/prod/files/2017/06/f34/2016%20EAC%20Storage%20Plan%20Assessment%20Recommendations%20for%20the%20U%20S%20Department%20of%20Energy%20%28September%202016%29.pdf>

² The EAC’s *Recommendations Regarding the Energy Storage Grand Challenge* are available at https://www.energy.gov/sites/prod/files/2020/08/f77/Final%20EAC%20Recommendations%20on%20ESGC_Aug%2026_0.pdf

³ DOE’s Energy Storage Grand Challenge Roadmap can be found at <https://www.energy.gov/energy-storage-grand-challenge/downloads/energy-storage-grand-challenge-roadmap>

the transition of technologies from laboratory to market, and developing competitive domestic manufacturing of energy storage technologies at scale.

The EAC has reviewed the finalized Roadmap and offers the recommendations included below. These recommendations reinforce and amplify certain parts of the Roadmap and offer ways that DOE can further strengthen its energy storage efforts. The EAC believes that the Roadmap, coupled with the recommendations outlined below, should serve as DOE's 5-year energy storage plan pursuant to the EISA.

Approach

In August 2020, the EAC submitted its Recommendations Regarding the Energy Storage Grand Challenge to DOE. These recommendations were EAC's response to the Energy Storage Grand Challenge RFI, published in July of the same year. The EAC had previously been briefed on the ESGC by DOE staff during its February 2020 meeting, and EAC members also attended several DOE-sponsored workshops intended to educate stakeholders about the ESGC technology tracks. The EAC's recommendations addressed all Roadmap tracks, in addition to providing high-level feedback. After reviewing the finalized Roadmap, in its current report, the EAC offers additional recommendations intended to reinforce and amplify certain parts of the Roadmap and offer ways that DOE can further strengthen its energy storage efforts.

Findings

The EAC has identified the following findings:

Finding 1: The EAC finds that the Roadmap presents a good strategy for DOE to pursue. The Roadmap is comprehensive and focuses on the most important issues that need to be solved. It identifies use cases that are appropriate given current conditions and, for the most part, identifies appropriate technologies.

Finding 2: The EAC finds that a holistic and strategic view of future grid storage needs, types, functions, and locations has not been clearly elucidated. Predictive modeling and analysis that takes into consideration the possible drivers for storage needs can be helpful in guiding the execution of the Roadmap.

Finding 3: The EAC finds that the following points, made in the EAC Recommendations Regarding the Energy Storage Grand Challenge referenced above, require particular emphasis because they contribute directly to energy storage being developed and deployed in a way that maximizes its value to the electric grid:

- **Technology Development Track**
 1. DOE needs to ensure that the use cases and technologies that it develops respond to real system needs, both current and future.
 2. DOE needs to always take reliability and resilience into account.
- **Technology Transition Track**
 3. DOE needs to further promote the deployment of demonstration projects.

4. DOE needs to focus on modeling and helping the industry make a business case for energy storage.
- **Policy and Valuation Track**
 5. DOE needs to focus on planning tools, processes, and data.
 - **Workforce Development Track**
 6. Use cases should comprehensively map the needed changes to business processes.

Finding 4: The EAC finds that the real challenge will be implementing the Roadmap in a way that is consistent with the electric power sector’s transition toward a cleaner and more sustainable system while ensuring safety, resilience, reliability, and affordability, and utilizing cradle-to-grave life cycle evaluation of energy storage technologies.

Recommendations

The EAC finds that the Roadmap and its implementation could benefit from adopting the following recommendations:

Recommendation 1 (DOE action):

DOE has developed sound use cases; however, it is likely that additional use cases will appear in the future that require integration into DOE’s programs and analyses. When existing use cases are modified and refined, and new ones are identified, DOE should continue to look holistically at needs, costs, benefits, and stakeholders involved, and clearly identify the problems to be solved.

Recommendation 2 (DOE action):

DOE should increase the use of demonstration projects in all ESGC areas to more rapidly evaluate the performance of technologies and use cases under real-life conditions, and to better assess what options are technically and economically viable to achieve targets and political goals in the desired timeframes.

Recommendation 3 (DOE action):

The Roadmap includes a wide range of technologies. It seems, however, to inadvertently stress some technologies over others. Although there is great emphasis on batteries, for example, electrothermal technologies seem to receive less emphasis. DOE should ensure that it considers the potential of all existing technologies in its execution of the Roadmap and ensuing R&D strategy, and does not appear to predetermine research or adoption outcomes.

Recommendation 4 (DOE action):

DOE should continue to adopt a balanced approach to innovation and cost control, and prioritize technologies and programs that have a clear present or future cost advantage and/or would directly benefit consumers. New technologies should be pursued while also improving the levels of safety, resilience, reliability, security, and affordability of already proven technologies.

Recommendation 5 (DOE action):

DOE should enhance coordination and collaboration with the U.S. Department of Transportation and any other agencies working on energy storage technologies and uses in electrified transportation,

including not only batteries but also, for example, energy carriers such as hydrogen and synthetic fuels for use in ships and planes. DOE should also consider pursuing crossover opportunities that extend the technology for electric vehicle batteries to stationary consumer-level, pad-mounted energy storage.

Recommendation 6 (DOE action):

DOE R&D should not only specify targets related to the cost per megawatt-hour, but should also create specific goals related to reducing the lifetime greenhouse gas (GHG) emissions of all proposed technologies from cradle to grave. Technology solutions must not only be competitive in terms of cost per megawatt-hour, but in terms of GHG emissions per megawatt-hour as well, and DOE should have standardized metrics to be able to compare technologies against each other on these terms.

Recommendation 7 (DOE action):

DOE should perform an analysis to determine a strategic view of future grid storage needs. While there have been reports published detailing expected growth in energy storage deployments, a comprehensive analysis outlining energy storage requirements to meet U.S. policy goals is lacking. Such an analysis should consider the role of energy storage in meeting the country’s clean energy goals; its role in enhancing resilience; and should also include energy storage type, function, and duration, as well as optimal locations for storage deployment. This analysis should integrate, as appropriate, individual operator or local/state planning models. It should also take into account projected population growth and national security needs over significant time horizons.

Conclusion

The Roadmap, coupled with the recommendations outlined above, should serve as the five-year energy storage plan pursuant to the EISA.

To ensure that the execution of the Roadmap provides the industry with the appropriate technical solutions to solve existing and future challenges, and does so while maintaining and enhancing safety, resilience, and social justice, DOE should adopt the same practical principles it used to develop the Roadmap (Finding 3).