Title
Revamping Battery Storage Policies to Bolster U.S. National Security

Author
Jackson, Christopher T

Publication Date
2021-02-02

Revamping Battery Storage Policies to Bolster U.S. National Security

Christopher Jackson
Department of Chemistry, University of California, Berkeley, Berkeley, CA

As the United States (U.S.) shifts towards more intermittent energy sources such as solar and wind, it is increasingly reliant on battery energy storage technologies. Current reliance on foreign supply chains and manufacturing, coupled with a growing military need for reliable battery technology, should prompt leaders to consider this urgent issue through a national security lens. To this end, the U.S. should establish a National Battery Storage Initiative to increase research and development of new battery technologies, spur investment in commercialization, and drive demand for domestic manufacturing.

I. The Growing Need for Battery Storage

The urgent threat of climate change, driven by the burning of carbon fuels, requires bold and drastic action on a global scale. Communities in high-risk areas that are increasingly subject to natural disasters such as wildfires and flooding must adapt and relocate. Food supply chains are struggling as increased drought or volatile weather reduce crop yields and force the agriculture sector to rethink how they operate. As the world's largest cumulative emitter of carbon dioxide, the U.S. must lead the effort to decarbonize and shift towards more sustainable energy sources.

Given the U.S.'s struggles to deploy new large-scale nuclear power sources, it is clear that renewable energy sources such as wind and solar will drive these decarbonization efforts. In 2020, wind and solar are expected to account for 76% of new electric generating capacity additions. The intermittency of these new electricity sources means that this deployment must be accompanied by a significant amount of grid-scale battery storage. By 2030, battery demand for energy storage in the U.S. is expected to increase 110-fold over 2018 levels. In addition, increasing deployment of electric vehicles (EVs) to reduce carbon emissions from the transportation sector are expected to increase demand for U.S. electricity consumption by as much as 38%. In June 2020, California Air Resources Board passed the Advanced Clean Truck Regulation, requiring more than half of all trucks solid in the state to be zero-emissions by 2035. This year, compared to 2018, the U.S. will see a 17-fold increase in battery demand for electric mobility.

Battery storage is critical for U.S. energy independence and national security. In 2019, the U.S. imported 9.10 million barrels per day of petroleum, a gasoline precursor, from nearly 90 countries. While recent increases in domestic petroleum production have reduced reliance on foreign oil producers, finding, producing, and moving crude oil can have significant negative effects on the environment. A continuing reliance on carbon-based energy exacerbates damage to our changing climate, necessitating adaptations that will cost billions of dollars and that the United States is not prepared for. A secure energy future for the U.S. means domestic, clean energy production – a future that requires a massive scale-up in battery technology and deployment.

II. Shortcomings of the U.S. Battery Enterprise

The U.S. is woefully unprepared to meet the manufacturing quotas required to produce enough batteries to support a changing energy landscape. The chemistry behind modern lithium-ion batteries was developed during the 1970-1980s, with several iterations developed by Stanley Whittingham, John Goodenough, and Akira Yoshino. However, while the U.S. initially led in the research and development of battery technology, it adopted a free market approach to production has left it behind on the world stage. This decision stood in stark contrast to other countries such as China, who heavily subsidized its domestic market for lithium-ion battery products.

In 2015, the Office of Management and Budget estimated that approximately $300 million was spent on energy storage R&D that year. ARPA-E, an agency founded in 2009 to focus on early-stage energy technologies in the Department of Energy, has dedicated about 10-15% of its budget into energy storage over the past decade. Existing projects range widely in scope and tackle critical problems; for example, the ARPA-E DAYS (Duration Addition to electricitY Storage) program funds multiple projects working to extend the discharge time of batteries to create long-lasting power sources. A 2017 evaluation of ARPA-E by the National Academies found that the department was highly successful at accelerating commercialization. While these investments should continue, they fail to directly address the deployment issues and lack of market that plague the U.S. battery industry.

Today, only about 10% of the world's lithium-ion batteries are produced in the U.S., with most of the batteries used in U.S. products shipped in from foreign suppliers. By 2024, research firm Benchmark Mineral Intelligence expects the U.S. to have only 8.2% of the world's lithium-ion battery-making capacity compared to China with 72.8% and Europe with 14.2%. The U.S. reliance on foreign producers for both raw battery materials (i.e. lithium) and manufacturing should be particularly concerning for the U.S. military, which increasingly uses lithium-ion batteries in its weapon and other systems. Unlike other battery customers, the military typically requires a higher performance specification to ensure troop safety. Without domestic production capability, the U.S. may be unable to guarantee quality or secure supplies to meet an unexpected surge in battery demand in times of conflict.

III. Policy Recommendations

To preserve U.S. national security, particularly energy security in both civilian and military applications, domestic development and manufacturing of batteries must significantly increase. The need for large, grid-scale electricity storage, as well as the policies to develop these resources, have been well documented. To ensure that small and medium-scale battery storage are not left behind, the federal government should establish a National Battery Storage Initiative to pursue the following goals.

First, the U.S. can increase research and development funding for new batteries that use raw materials available in the United States. This should include batteries that go beyond lithium-ion chemistry, including (but not limited to) sodium-ion, potassium-ion, and redox flow

technologies. Furthermore, designs ranging from large stationary storage to electric vehicles to smaller, personal electronics should be considered to accommodate a wide variety of use cases. At this time, there are not yet any commercially viable alternatives to lithium-ion batteries. While the U.S. can and should rapidly scale up the development and deployment of existing battery technology, a battery-powered future, especially one that is less reliant on foreign supply chains, will require new solutions.

At the same time, we must prepare for the large influx of batteries that will need to be retired as they reach the end of their useful life; this has been estimated to include almost 700,000 batteries by 2025. Given that this number will only grow with the increasing deployment of new batteries, funds should be directed towards the research and development of technologies for battery reuse and recycling. In particular, EV batteries typically have up to 80% capacity remaining when they are replaced; retrofitting them for use in stationary storage applications is promising, but will require investments in both technical upgrades and government support to ensure market stability. Mechanisms for these investments already exist across the federal government through programs in ARPA-E, the Defense Advanced Research Projects Agency (DARPA), and the National Science Foundation. The recently announced Energy Storage Grand Challenge represents an opportunity to strengthen early stage research and development investment, with increased efforts towards innovative, high-risk technologies that may not yet be commercially viable.

Second, U.S. investment must look beyond its traditional focus on research and development and extend funding specifically to early stage commercialization. This could be modeled after the Technology Commercialization Fund (TCF), which is currently implemented by the Office of Technology Transitions in the Department of Energy (DOE). Launched in 2016, the TCF commits 0.9% of the DOE's budget for research, development, demonstration, and commercial application towards this fund. In 2016, this represented $20 million, to be used to match 50% non-federal funds from private partners. While this represents a step in the right direction, this level of funding does not match the scale needed to drastically increase cleantech commercialization. Furthermore, this program is restricted to technologies developed within the DOE's 17 national laboratories. New policies should create more robust, well-funded programs that are also accessible to non-DOE affiliates. Considering the urgent, pervasive need for energy storage solutions across multiple sectors, the DOE should also consider a separate program specifically dedicated for battery technologies.

To spur private investment and support the growth of the battery industry, the U.S. should create an investment tax credit (ITC) for energy storage systems. At this time, battery storage is only eligible for a tax credit when integrated with an eligible solar energy system. Proposed federal legislation, such as the Energy Storage Tax Incentive and Deployment Act, would create an ITC for stand-alone energy storage. Furthermore, this mechanism allows lawmakers to broadly support the deployment of energy storage without being constrained to any one particular form of technology.

Finally, the U.S. should strategically subsidize industries that make use of battery technology to drive demand for local manufacturing. This technique, which has been proven to work in China, would allow the U.S. to develop a full supply chain of battery manufacturing, helping create new jobs and preserving other key domestic employers such as the automotive industry. Beyond traditional mechanisms such as tax incentives and strong emissions standards, the government can use its leverage as a large purchaser of batteries and electric vehicles for the military, U.S. Postal Service (USPS), and public transportation such as buses. Recent proposals to electrify the USPS fleet of mail trucks could save hundreds of millions of dollars alone while improving reliability and decreasing local air pollution. The military is also an ideal initial customer for emerging technologies; its willingness to pay premium prices for reliable and cutting-edge technology will help decrease early-stage learning and cost curves.

Implementation of these recommendations will require active coordination between research institutions, industry, and government, including interagency communication between groups such as the Departments of Defense, Energy, Transportation, and others. To ensure their success, efforts should be coordinated by a newly created National Battery Storage Initiative (NBSI), implemented by the Office of Science and Technology Policy (OSTP). The NBSI will be required to drive the goals outlined here and build coalitions of support across federal agencies, Congress, and the public.

IV. Conclusion

A comprehensive overhaul of U.S. policy centered on battery storage is necessary to ensure national security and maintain competitiveness with other nations such as China and the European Union. The benefits of this investment can be widespread, improving health outcomes from reduced local carbon pollution, creating a robust manufacturing jobs base, ensuring the security of U.S. military assets, and more. To secure a future that is clean and resilient, the U.S. must strategically commit to leading the world in research, development, and deployment of battery storage technologies now.