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August 19, 2020

U.S. Department of Energy
Research Technology Investment Committee

Alex Fitzsimmons, Deputy Assistant Secretary
Office of Energy Efficiency and Renewable Energy

Michael Pesin, Deputy Assistant Secretary
Office of Electricity

Re: Comments of Clean Energy Group on the DOE Energy Storage Grand Challenge Draft Roadmap and in Response to the Request for Information

Dear Mr. Fitzsimmons and Mr. Pesin:

Clean Energy Group (CEG), a national nonprofit organization that has worked on multiple energy storage issues over the last several years, offers these comments in response to the Energy Storage Grand Challenge Draft Roadmap ("Storage Roadmap" or "Roadmap") and to the accompanying Request for Information (RFI) the US Department of Energy (DOE) released in late July 2020. The deadline for responses to the RFI has been extended through the end of August 2020.

These comments are under 20 pages and meet the page limits as they address two of the five Draft Roadmap tracks: the **Policy and Evaluation Track** and the **Technology Transition Track**.

Clean Energy Group is a leading advocacy organization working on innovative policy, technology, and finance strategies in the areas of clean energy and climate change in the US. CEG promotes effective clean energy policies, develops new financial tools, and fosters public-private partnerships to advance clean energy markets that will benefit all sectors of society for a just transition. CEG assists states and local governments to create and implement innovative practices and public funding programs for clean energy and resilient power technologies. CEG also manages and staffs Clean Energy States Alliance (CESA), a national nonprofit consortium of public funders and agencies working together to accelerate clean energy deployment. Headquartered in Montpelier, VT, CEG is funded by major foundations as well as state and federal energy agencies. (See www.cleanegroup.org.)

Summary of Comments

In summary, CEG applauds the direction of the draft Storage Roadmap as it recognizes the critical role energy storage, especially battery storage, will have in the future transition of the electric power system. An effort on battery storage that equals or exceeds that of the agency's SunShot Initiative program—both in ambition as to targets as well as significant budget commitments—would be critical

to achieving the goals outlined in the Roadmap. This Roadmap, if improved along the lines proposed here, would be a sound starting point for new federal policy over the next several years.

Taking the DOE SunShot Initiative as a parallel framework for storage development makes a great deal of sense today. Setting a cost reduction target was the original animating goal of that solar program, which was then implemented through a series of funding programs whose purpose was to increase state-level policy implementation to achieve the federal goal. This federal-state partnership model is directly applicable to the rapid development of battery storage markets in the United States. This storage initiative would have the greatest chance of success if it adopted similar methods: develop a cost-reduction goal and implement that goal through funding state-level programs, partnerships, and policy development—and fund that process through a long-term, 10-year funding commitment.

The reason to consider this model is that the most significant actions needed to advance new and massive battery storage markets will continue to occur at the state and local levels. States control sub-national energy policy, through utility regulation and clean energy incentives, programs and policies; that is where clean energy markets develop and thrive. While the federal government does not directly control much of what occurs in the energy sector, especially in the power generator sector (coal, oil, gas and renewable power plants), intelligent federal energy policy can guide and accelerate state policy and support the development and opening of regional markets to bring battery storage to scale.

What's more, this initiative is timely. We are at the most critical new juncture in clean energy, where solar and battery storage technologies have come down dramatically in price, making them competitive with coal and even new natural gas. The challenge is to move those technologies into the mainstream through innovation, policy, tax incentives, and other market-moving measures.

Most important, battery storage is the key to the market expansion of renewable energy technologies, especially in new behind-the-meter (BTM) technology combinations that will provide the end-use customer with greater efficiency, resiliency, and energy cost reductions. Moreover, storage and other utility-scale energy technologies will provide grid resiliency, reduce expensive peak demand, and result in other economic and environmental benefits as compared to our current grid configuration.

Those market advances must be widely and equitably distributed throughout society, so that low- and moderate-income (LMI) customers and communities of color enjoy those benefits equally with others more privileged. Most early stage energy technologies tend to be adopted first by upscale, wealthy customers, leaving these beneficial technologies to trickle down years after early market adoption. More equitable distribution of these technologies through targeted policies and outreach efforts to reach LMI markets should be a high priority of any future Roadmap.

In addition to these larger points, our other comment is that the Roadmap tends to focus disproportionately on the development of utility-scale energy storage projects, somewhat to the exclusion of the burgeoning BTM battery storage market. To the same extent that solar markets moved from utility scale to distributed installations in the last decade, the battery storage market has moved in the same direction, now combining solar plus storage as a viable, customer-sited, energy resource that provides resiliency, bill reductions, and new ways to manage electric loads, including peak demand reduction through aggregation of distributed resources into a "virtual power plant." The Roadmap should pay equal attention to the multitude of market barriers and opportunities in the BTM market going forward in any new program. As a result, the majority of CEG's comments relate to the development of the BTM battery storage market.

Also, it must be said that the negative effects of COVID-19 and climate change have come together to make these technologies even more important than ever. That is, there are new market uses of these battery storage technologies in making homes—which are now serving triple duty as offices, schools, and housing—more resilient. Energy resilience from batteries provides a safety net for people with electricity-dependent, home health care equipment, making them less at risk from power outages due to storms or other causes. Resilient power systems can make entire communities more secure from extreme weather, wildfires, and the accompanying power outages. Our disaster-prone "new normal" means that battery storage technologies are now essential tools to save lives, reduce physical and economic harm, and preserve communities from disruptions due to power outages.

Our specific comments address the following points regarding battery storage:

- *Federal and State Policy Support.* Perhaps the most significant gap in the development of battery storage market acceleration is the lack of standardized, widespread, targeted, and coordinated federal and state policies to advance the technology in these early markets. For example, at the state-level, the emergence of pilot utility programs to embed customer energy storage incentives within state and utility energy efficiency programs is a revolutionary incentive for battery storage that should be expanded nationally, with federal support. Moreover, new federal and state partnerships and networks of market participants are key to advancement of storage technology, as they have been in the solar markets.

- *More Focused National Lab Attention.* At present, the energy storage research program run by DOE Office of Electricity, and implemented through Sandia National Laboratories, has done an excellent job of promoting new federal and state partnerships to support utility-scale battery storage deployment. However, there is a need for federal energy labs to step up and take on more ambitious roles as the energy storage market matures, including serving as a single, reliable, and non-commercial source of market development information, such as the current programs that Lawrence Berkeley Labs perform in the renewable energy space, while offering their expertise to states to develop their own policies and projects in the future.

- *Need for LMI Focused Efforts.* As noted, early stage energy technologies such as battery storage simply do not become accessible in LMI markets without significant policy and incentive support that are targeted to new markets such as affordable housing, critical community facilities, peaker plant replacement, and home health care. Greater attention in the Roadmap should be paid to these LMI challenges.

- *New Finance Opportunities.* There are many technological and financial risks that must be reduced for these emerging battery storage markets to flourish without interference. The burden of absorbing these risks makes it harder for the capital markets to operate and provide a seamless flow of capital to grow these markets. We offer two new finance strategies that are now emerging that should be part of the Roadmap.

Our more specific comments follow. We note specific RFI questions we attempt to answer, where appropriate; and as noted, in some cases, the issues we raise have not been addressed in the RFI.

Policy and Valuation Track

P.6.1 Are there specific federal, state, or local policies that could be enacted to help the U.S. become a leader in energy storage, and why? Please consider policies that might support storage deployment, and policies to support supply-chain development. How should these policies be prioritized? How can DOE best inform policy development?

Policy, Regulatory, and Market Considerations for US Federal Leadership on Storage
Without sound federal, state, and local policies, regulations, and market rules, the energy storage industry will face daunting barriers, and efforts to bring storage to scale will be stymied. Much of the work to date in this area has been done on the state and regional levels, but too few states have addressed these issues. The lack of coherency between different states leaves storage developers to contend with a patchwork quilt of regulations and policies, while divergent regional market rules have the effect of limiting the economic development of energy storage to a few regions where storage owners can effectively access markets and monetize the capabilities of the technology.

The federal government could and should take on a much larger role. We suggest a combination of specific federal programs and incentives, combined with a much larger role within the national laboratories, to expand storage markets and support state and regional efforts.

Specific Federal Policies and Programs
There are specific types of programs and policies that a federal effort could support; these include the following:

- *Federal energy storage tax credit***.** Currently, energy storage is eligible for the federal Investment Tax Credit (ITC) if it is paired with (and charged by) an eligible renewable generator, such as solar PV. However, the solar ITC is already in decline and will fall to zero for residential customers by 2022 (and to 10 percent for commercial customers). Storage has no independent federal tax incentive, and very few states offer a state storage tax incentive.

  Recommendation. A new federal effort to develop storage policy should include a stand-alone federal storage tax credit. As with other emerging clean energy technologies, it is important to support storage deployment while the industry is in its early growth phase. This will help battery storage to scale up faster, access new markets, and gain economies of scale.

- *Federal/state partnerships***.** Since most of the work to date in advancing storage policy and deployment has been done at the state level, it makes sense that a federal effort to advance storage would support these state efforts. As an example, the energy storage research program within DOE Office of Electricity (OE) partners with state and municipal energy agencies to jointly support energy storage deployment projects with funding, while providing technical support for these projects from Sandia National Laboratories. A relatively new effort at Sandia also provides policy and regulatory support to states.

  Recommendation. Federal-state partnerships and programs provide a model that could be expanded (and better funded) so that DOE can work with more states to create demonstration or "lead by example" energy storage projects and advance policy and regulatory development.

- *National storage capacity goal.* Some states have established energy storage procurement targets (these include California, Oregon, New York, Massachusetts, New Jersey, Virginia, and Nevada). These targets, which operate much like renewable portfolio standards, are essential for driving state policy and utility procurement, including customer incentives. However, most states have not adopted energy storage targets, and there is no national storage target.

  Recommendation. An important role for the federal government would be to set a national energy storage capacity goal, or a series of targets, and to support these targets with incentives and technical and policy support resources, for example through a national lab.

- *National storage pricing goals.* As with other new and emerging clean energy technologies, cost barriers are a primary factor that limits energy storage deployment. In the case of energy storage, many benefits of the technology that are valuable are not currently monetizable by storage owners due to market failures, while other benefits (such as resiliency) suffer from a lack of data to establish a value. Cost barriers remain a primary factor limiting deployment.

  Recommendation. A national effort is needed, as it was with SunShot, to establish battery storage pricing targets and other standards, such as energy density and round-trip efficiency, to improve the technology while driving prices down. This will expand the number of applications for which storage can provide cost-effective services and thereby grow storage markets.

- *ConnectedSolutions/BYOD utility incentives.* There are new, emerging utility models to finance BTM battery storage systems that should be promoted and supported by the federal government. In particular, the ConnectedSolutions/BYOD (bring your own device) model, pioneered in New England with CEG's technical support and advocacy, is a groundbreaking program that aligns BTM battery operations with regional grid needs while de-risking and democratizing energy storage. By incorporating battery storage into state energy efficiency programs, ConnectedSolutions gives storage access to large, well-established incentive budgets. Currently, states commit more than $6 billion/year to electric energy efficiency programs, and another $2 billion to natural gas efficiency programs. As old technologies (such as incandescent lighting) age out due to effective lighting standards (making incentives for LED lights less necessary), it makes sense for energy efficiency programs to support new technologies such as battery storage, which can shift demand peaks to achieve higher grid efficiencies, by using efficiency funds to shift demand along with traditional consumption-reducing measures. ConnectedSolutions is not a rebate plan; it is a pay-for-performance program that allows utilities to contract with customers for peak demand reduction services at competitive rates.

  Recommendation. A new federal storage effort should include support and guidance for states to adopt ConnectedSolutions or equivalent BYOD programs within their energy efficiency plans. For more on this important new funding model, see below or read CEG's report on the ConnectedSolutions model here. (This program is further explained below in connection with new financing programs.)

- *Municipal utility and rural electric cooperative storage adoption.* Although municipal utilities and rural electric co-ops do not typically administer state energy efficiency programs, they have been among the first utilities to adopt energy storage for capacity and transmission cost savings, distribution investment deferral, community resiliency, and increased renewables integration. There are more than 800 municipal utilities in the US and 900 electric cooperatives. They often

do not have the resources of the large investor-owned utilities, meaning they can suffer from a lack of technical information and support.

Recommendation. A federal effort to support energy storage deployment should include technical assistance and knowledge resources for municipal utilities and rural electric co-ops, perhaps through the national laboratories or university energy laboratories, and in collaboration with organizations like the National Rural Electric Cooperative Association and the American Public Power Association. A small-scale example is provided by University of Massachusetts' Clean Energy Extension.

National Lab Analysis and Support

The national energy laboratories have played a key role in bringing other clean energy technologies, such as solar PV and wind, to scale. These labs could and should play a similarly central role in the development and deployment of energy storage, as recommended here.

- *Storage applications, valuation and markets, and industry benchmarking and tracking.* Much of the difficulty in bringing energy storage to scale has to do with barriers to market entry and uncertainty about the value of storage applications. Together, these barriers and uncertainties result in the inability of storage owners to monetize many benefits of storage, which means these benefits are often ignored or undervalued.

  Recommendation. A federal effort is needed, led by national energy laboratories, to advance understanding of battery storage economics, particularly in the areas of quantitative valuation of storage applications, stacking of applications, and needed market reforms to enable monetization of these applications. This would then inform recommendations on market rules, regulation, and policy.

- *Storage codes and standards/best practices.* Another factor limiting storage deployment is the lack of national safety and performance codes and standards. In order to achieve economies of scale and access broad markets, new technologies need generally agreed-upon, nationally consistent codes and standards. This is evident when we think about other appliances and commodities such as cars, refrigerators, and lighting. While nongovernmental organizations such as Underwriters Laboratories and IEEE have developed some safety standards for battery storage, there is much more work to be done in this area. The same goes for municipal codes and standards, such as fire, electrical, and building codes, which frequently fail to address storage at all, leaving local officials without good guidance regarding siting and permitting. Some progress on this front has been made by Sandia and Pacific Northwest National Laboratories, but this work should be accelerated and promulgated much more vigorously.

  Recommendation. National energy labs should help to develop codes and standards for battery storage adoption as part of a national market development effort.

- *State policy and regulatory best practices.* Almost all energy storage policy and regulation to date has been developed at the state and regional levels, with the result that the US map represents a patchwork quilt of policies, regulations, programs, and standards. Energy storage markets would benefit greatly from a national effort to define and promote best practices in state and regional storage policy and regulation. Such best practices would support open and equitable markets, better access to LMI markets, a diverse range of storage ownership and

business models, and the broadest possible suite of applications. Sandia and Pacific Northwest National Laboratories have recently initiated programs in this area, but these small efforts have been overwhelmed by numerous requests for assistance.

Recommendation. A more robustly funded and staffed knowledge-sharing effort, led by the national labs, would provide policy best practices reports, establish a national policy database, offer training to state policy makers and regulators, support state energy storage program development, and otherwise assist local, state, and regional entities.

- *Battery storage for resilient power and cyber-security.* Although they are only two of many important energy storage applications, resiliency and cyber-security represent a special challenge for our nation as well as a specific opportunity for federal leadership. Given the increasing numbers of catastrophic grid outages due to extreme weather, wildfires, and other occurrences, coupled with our increasing dependence on electricity-powered home health equipment, the value of (and need for) resilient power has never been more evident. At the same time, the important role of energy storage and microgrids for enhanced cyber-security has only begun to be explored, while the risks from hacking and foreign interference are clearly growing daily. This is an area where state and local resources are simply not up to the task.

  Recommendation*.* A national program to explore and develop the role of battery storage for resilient power and cyber-security applications should be launched within the national labs.

- *Support for New State and Community Policies and Programs.* As noted, going forward, the main innovations in clean energy policy and programs will continue to come from the states and localities. To that end, the federal government has an important obligation to create new partnerships with these states and local governments to support and encourage new forms of policy innovations in these areas, and to inform the federal government of innovations that could inform federal policy making. That federal-state partnership model must be revived.

  Recommendation*.* Each federal agency with a hand in energy policymaking should create and support "Federal and State Innovation Offices" that are well-staffed and that have budgets to share with state and local governments. The offices would support multi-state partnerships, networks, and analytical capacity to develop new clean energy and battery storage policy innovations, and to bring those innovations into place at the federal level through new federal-state partnership programs.

- *Expansion of the existing program supporting joint federal/state and public/private storage deployment*. As noted, US DOE Office of Electricity has worked with the national labs to support large-scale energy storage deployment by partnering with state and municipal entities, investor-owned utilities, municipal utilities, and rural electric co-ops. This effort has been very successful in that it has enabled the deployment of numerous projects across the nation, and these projects have successfully demonstrated new technologies, applications, and business cases for energy storage. As with any new technology, it is important for people and businesses to see working examples in the field before they feel comfortable moving ahead and adopting energy storage. This effort should be expanded with increased funding.

  Recommendation*.* Increased funding should be provided to expand the US DOE-OE Energy Storage Research program that provides funding and technical support, in collaboration with the

national labs, to state and municipal agencies, for storage deployment projects that advance understanding of new technologies, applications and business cases.

Battery Storage and Resilience for Health and Social Equity

P.4.2 How can stationary or transportation-related energy storage systems improve system-level or end-user resilience?

P.4.3 Is there a certain level of resilience against a certain group or probability of threats that stakeholders should plan for?

Also addresses:

- *D.1.4.5 Critical Service Resilience*
    - *D.1.4.5.1 What kinds of emerging individual/business/local/state/regional goals could be supported by this use case?*
- *T.1.14 What other services could be part of the value stacking of combining various use cases and revenue?*
    - *T.1.14.1 Should a prioritized value list be developed, e.g. emergency services, evacuation, medical services, water, wastewater, HVAC, etc.?*

This section focuses on the importance of ensuring that those communities which could most benefit from the services energy storage can provide—low-income communities and people of color—are prioritized in the development and deployment of energy storage resources.

In the years since Superstorm Sandy knocked out power to millions of people in the New York area, especially low-income residents, CEG has focused on ways to bring the benefits of battery storage to low-and-moderate income (LMI) customers. Specifically, much of our work has focused on how economically disadvantaged communities, communities of color impacted by decades of fossil-fuel pollution, communities on the frontlines of the climate crisis, and medical vulnerable individuals should not be left behind as battery storage plays a larger role in the country's energy system.

Our bottom-line conclusion from years of this work is this: dedicated provisions must be put in place to make sure that battery storage technology is more equitably distributed to deliver economic and energy resilience benefits to those most in need. And there are a host of sub-markets where such provisions are needed to benefit these disadvantaged populations.

Battery storage systems can deliver multiple health benefits to economically disadvantaged communities. During times of crisis, battery storage can provide reliable power for a range of critical community facilities and essential services as well as keeping the power on at medically vulnerable households. Battery storage can power water pumps, lighting, medical devices, phone charging, refrigeration, and heating and cooling systems—strengthening the boundaries between safety and harm, protection and tragedy, dangerous evacuations and sheltering in place when grid outages occur. Battery storage at medical facilities, such as the 14,000 Federally Qualified Health Center sites that provide low-income and uninsured residents with low- or no-cost health care, can help facilities remain operational and able to provide services to the most vulnerable populations through an outage. In addition to protecting people from greater harm during outages, battery storage can enable significant electricity bill savings and generate revenue through participating in utility programs or providing grid services.

But to date, energy storage installations have mostly served utilities, wealthy consumers, and larger commercial customers. Existing energy storage installations have been largely economically driven, not done for societal benefit or public health reasons. With few exceptions, underserved markets in LMI communities have not yet benefited from these technologies at any significant levels, whether for reduced power bills, improved energy resilience, or decreased emissions from local power plants.

To further social equity through the *Energy Storage Grand Challenge*, key use cases that should be prioritized include the following:

- *Lowering energy burdens and increasing opportunities for community wealth creation*. Low-income communities have the highest energy burdens in the United States, with some households paying over 12 percent of their household income on energy costs. The same is true for critical community facilities operating in low-income communities, that oftentimes must contend with capacity challenges, lack of information, and limited budgets. Battery storage, particularly when combined with solar, can save low-income businesses, community services providers, and households money on their electric bills, by lowering demand for electricity during times when energy prices are highest and systemwide energy demand peaks.

  Battery storage systems in homes and business can also generate revenue by participating in utility demand response programs and providing grid services, such as resource adequacy and frequency regulation. However, these wealth-creation opportunities are not universally available, and programs often do not prioritize low-income participation. In additional to enabling greater opportunities for reduced energy burdens and revenue generation, ownership and financing models must be re-examined to allow for the participation of more economically diverse individuals and organizations.

  Recommendation. US DOE should create a new "Resilient Power" agency in the Office of Energy Efficiency & Renewable Energy (EERE) that would provide federal grants, technical assistance support, and other measures to advance LMI energy storage markets across the country. This program, along with the other federal programs proposed here, should include dedicated funding to provide low-income communities and communities of color with access to "Technical Assistance Funds" that could be used to conduct feasibility assessments and help them to analyze the costs and benefits of installing such systems in their communities and to encourage community ownership of such systems.

- *Improving health outcomes in the event of a power outage.* When severe weather strikes, outdated and inefficient energy infrastructure forces lower-income communities to contend with prolonged recovery timelines and longer duration power outages, the latter of which severely limits the ability of critical community facilities to deliver services during an emergency. Low-income households are less likely to evacuate in the event of an outage for a multitude of reasons, including economic limitations, lack of transportation, and lack of a network outside of their immediate community. For medically vulnerable populations, such as those reliant on electricity-dependent home medical equipment, hurdles to evacuation can include mobility limitations and an inability to easily travel with heavy, bulky, or electricity-dependent medical equipment.

  In the event of a power outage, these vulnerable populations rely on local critical community facilities—such as multifamily affordable housing, community centers, local nonprofits, and

schools—for support. Unfortunately, most facilities are unable to invest in backup power systems and therefore must close or significantly limit services during energy emergencies.

Behind-the-meter (BTM) battery storage systems can provide reliable backup power to critical loads at community facilities, including heating/cooling, lighting, communications, water, and kitchen spaces. Critical community facilities equipped with battery storage can also support medically vulnerable residents by powering refrigeration for temperature-regulated medication and designating outlets to charge electricity-dependent home medical equipment. For medical clinics, battery storage can maintain electronic health record databases and refrigeration for temperature-sensitive medications and vaccines.

Residential battery storage systems installed in medically vulnerable residences can further improve health outcomes in the event of an outage by providing automatic backup power to electricity-dependent medical equipment. With reliable backup power, these residents can either safely shelter-in-place through an outage or more safely and comfortably wait until help can arrive. Supportive housing and independent living communities can provide similar support by utilizing battery storage to power a central community space.

Batteries can also reduce harmful emissions during grid outages. Currently, homes and businesses with a backup power system likely have a diesel or gas generator. Diesel and gas generators emit toxic pollutants, require frequent refueling, are prone to failure, and can lead to sickness or death when operated improperly. For frail and physically disabled residents, these hurdles can be insurmountable. Battery storage can come online automatically and does not emit toxic gases, which can exacerbate some medical conditions. In one study, which analyzed the replacement of diesel generators with solar+storage systems at 15 households that rely on electricity for medical purposes, found that all participating households preferred solar+storage. Furthermore, nine of the 15 households reported that solar+storage improved their health, compared to living with a diesel generator.

Recommendation. US DOE should work with Department of Health and Human Services (HHS) to consider how to provide coverage throughout Medicare or Medicaid for battery storage as an eligible technology, chiefly through administrative rulings. HHS (perhaps in partnership with DOE) should create a new "Office of Resilient Home Health Care" that could administer such a program and offer incentives to companies to offer new technology innovations in this market. Such a program could open millions of people to life saving, clean energy technology.

- *Supporting emergency preparedness and response.* Equipping critical facilities throughout a community with battery storage builds emergency preparedness by providing safe spaces for residents to shelter and access resources during an emergency. Furthermore, access to local energy resources can alleviate the operational and capacity issues faced by first responders and medical institutions during an emergency. For example, if residents dependent on electricity for medical equipment can charge equipment at a local senior center through the duration of a power outage, hospitals can avoid an influx of patients who are looking for a place to charge medical equipment, or who are in need of emergency medical attention after medical equipment failure in homes without power.

  During a health pandemic, battery storage can reduce the risk of exposure for medically vulnerable residents by allowing them to shelter-in-place, rather than seek out support during a

grid outage. For those that must seek support outside the home, battery storage installed at multiple critical facilities throughout a community can reduce the amount of people seeking shelter/support at a single facility and alleviate the capacity challenges faced by critical facilities in delivering emergency services.

Despite the increase in power outages due to climate-induced heat and hurricanes, there is still a lack of dedicated support at the state and federal level to provide incentives and other support for pre-disaster preparedness, in addition to post-disaster recovery. In Puerto Rico, CEG helped develop a new approach to the use of Community Development Block Grant Disaster Recovery funds that can be used as incentives for new solar and storage systems in critical community facilities, which should be adopted as federal policy.

Recommendation. US DOE should work with the Federal Emergency Management Agency (FEMA) to develop a new "Resilience Funding Program" that would commit to use federal community development disaster preparedness and disaster recovery funds to install solar and storage at critical disaster recovery locations around the country, including shelters, schools and other places to provide electricity to power essential community services in the event of storms and power outage disasters. This will help communities to be better prepared for future disaster recovery efforts.

- *Replacing peaker plants to enhance public health**.*** Replacing the fossil-fueled energy infrastructure in disadvantaged communities with clean energy alternatives represents one of the most important environmental justice opportunities in the country. Declining battery storage costs are beginning to upend the country's traditional carbon-based power system, particularly when it comes to delivering energy during periods of expensive peak demand.

  There are more than 1,000 fossil-fuel peaker power plants in operation across the United States, predominantly located in low-income communities and communities of color. These inefficient peaker power plants disproportionately emit health-damaging air pollutants—mainly ozone forming chemicals like nitrogen oxide (NOx) and harmful particulates—that contribute to poor local air quality and harm public health in these vulnerable frontline communities.

  Reducing the air pollution burden on environmental justice communities has always been an urgent problem, but it is now a greater public health crisis with the COVID-19 pandemic. Recent epidemiological studies have shown that increased emissions of fine particulate matter (PM2.5) and nitrogen dioxide (NO_2) from power plants such as peakers have contributed to increased deaths from the virus in major urban areas. Reducing peaker emissions in major cities through the deployment of battery storage could be a critical strategy to alleviate the adverse health impacts of air pollution on those suffering from respiratory conditions and cardiovascular disease. Not only can batteries deliver a cleaner source of peak energy generation, they can also be distributed throughout communities, providing opportunities for increased energy resilience, decreased energy burdens, and the potential for community ownership and wealth creation—benefiting communities instead of causing them harm.

  Recommendation. With US DOE, in partnership with other agencies such as the Environmental Protection Agency (EPA), the federal government should create a new "Peaker Replacement Program" that would offer an array of federal support to phase out these peaker plants over time and replace these outdated, fossil fuel units with renewable energy and battery storage

alternatives. This would include providing federal grants to conduct analysis on the economics and environmental benefits of such replacements, explore federal roles to provide new policy support for retirement, create new roles for the federal labs to support this turnover, and bring in other federal agencies in a joint federal approach to include the Federal Energy Regulatory Commission (FERC) and other regulatory agencies to bring about this needed transition. This peaker plant replacement strategy offers one of the most compelling, immediate use cases to provide cleaner and more reliable power that can reduce local pollution in disadvantaged communities and offer economic options for battery storage technologies now, not decades from now.

- *Providing resilience at multifamily affordable housing**.*** Most private and publicly owned low-income housing units have not seen any serious introduction of solar and storage technologies, either to save money on electric bills or to provide cleaner backup power. (Hundreds of thousands of low-income residents lost power in public housing due to Superstorm Sandy.) We have done numerous studies on the economic and other benefits of solar and storage in affordable housing. What is needed is a dedicated program focused on bringing these technologies to public and private affordable housing. This could be brought about through a multi-agency collaboration involving US DOE and other federal agencies, especially the Department of Housing and Urban Development (HUD).

  Recommendation. US DOE should work with HUD to create a new "Office of Housing Resiliency" to provide grants to housing developers and owners, as well as other forms of information and analytical support, to encourage the installation of solar and battery storage in affordable housing units across the country.

- *Bring resilient power to Federal Community Health Centers**.*** There are several thousand federally qualified health centers (FQ or "330" centers) that provide medical care to underserved communities across the country. They offer medical services and store medications for patients, in the event of a disaster. During Hurricane Maria in Puerto Rico, all the health centers lost power and could not serve patients; and many lost hundreds of thousands of dollars in medications due to lack of refrigeration. The same happened to clinics in California that lost power when utilities shut off electricity in communities to prevent wildfire risks. A survey by the international aid organization Direct Relief found that fewer than half of California's health clinics had any backup power; those that did were polluting and unreliable diesel generators. An effort is needed to bring resilient solar and battery storage solutions to these FQ health clinics, which in turn would lead to better health care for the poor and vulnerable people they serve.

  Recommendation. US DOE should work with HHS and other relevant federal agencies to institute a new program to ensure its FQ health centers have 24/7 reliable electricity. It should begin a program of funding and support to guarantee that these centers have the capacity and the funding to install needed resilient power options in clinics across the country, including in Puerto Rico and other territories and commonwealths.

Technology Transition Track

T.3.1 Are there useful publicly available business and finance models for storage, similar to what is available for solar?

T.3.16 Are there scenarios or models that would lower the cost of capital for different types of storage projects, such as securitization?

New Financing Models for Energy Storage

Despite its promising success, the combination of solar plus battery storage is still a new market, and these technologies can still cost more than some alternatives. Also, there are few creditworthy financing options that can reliably be used to finance these new systems in LMI markets where low-income customers might not meet established credit limits or other financing requirements. In other words, more financing help is still needed to get to scale in this market.

In general, CEG suggests two new types of financing tools for storage developments that could be used to reduce credit risk and cost of capital for customers, especially in LMI markets. These two financing tools are (1) new use of financing "risk reduction" strategies for investors to accelerate uptake of storage in LMI and housing markets, and (2) new state-level utility incentive programs that have begun to offer buy-downs of battery storage costs for BTM applications that should be supported by new federal activities.

Our top-line comments regarding finance models reflect CEG's work over several years to develop financing initiatives to accelerate the deployment of solar+storage in LMI communities. These financing initiatives have been developed to address the following market and credit concerns:

- There is too much uncertainty regarding how project pro formas compare with actual operations, which negatively impacts financial underwriting and power purchase agreement (PPA) and energy service contract terms for these systems.
- Optimal configurations of battery storage systems with solar PV are still being worked out in different applications to meet the needs of different market segments (e.g., multifamily affordable housing, community emergency shelters, and healthcare facilities).
- One-off transactions using different energy storage technologies and system components result in higher transaction costs.
- Significantly, no integrated development finance model exists to support installations of these technologies in community or housing projects in low-income areas.

New "Risk Reduction" Finance Tools: Financing Resilient Power

Clean Energy Group produced a report—a "capital scan"—that summarized the barriers for new solar and storage technologies to reach LMI markets. In May 2016, The Kresge Foundation and Surdna Foundation (with additional support of The JPB Foundation) commissioned CEG to conduct a capital scan of grant and investment opportunities in the resilient power space. In February 2017, CEG published A Resilient Power Capital Scan: How Foundations Could Use Grants and Investments to Advance Solar and Storage in Low-Income Communities.

That report summarized several barriers and recommended several financing solutions to overcome those barriers through various "risk reduction" strategies. The report identified five market barriers to integrating solar+storage in low-income communities:

- The need for an integrated development finance model to overcome finance gaps in underserved markets.

- Lack of internal capacity of portfolio owners, advocates, and public officials to develop solar+ storage projects.

- Insufficient energy data collection, policy research, and economic analysis to understand the development of solar+storage technology in low-income markets.

- Insufficient capacity of technical service providers, project developers, and nonprofit intermediaries to reach underserved communities.

- Inadequate market rules, incentives. and regulatory policies to advance new solar+storage technologies in low-income markets.

The report recommended a broad palette of options for investors interested in different market efforts:

- *Support New Tax Credit Aggregation Entity.* There is a need for the creation of new legal entities to aggregate solar and storage tax credits for multiple portfolio owners' LMI projects to create a scaled investment opportunity for investors.

- *Provide Credit Enhancement for Performance Risk.* There is a need for credit enhancement for investors and building owners to reduce technology and performance risk (e.g., "performance loss reserves" to reimburse monetary losses from unrealized economic benefits).

- *Provide Working Capital*. Fund predevelopment costs and bridge the payment of developers' fees that are often tied up in multiple projects.

- *Provide Long-term Capital.* Provide 15-year term capital to take out construction financing and as a capital source for on-bill payment programs.

- *Fund Leadership Awards to Owners.* Provide funding ("Leadership Awards") to portfolio owners through nonprofit intermediaries for offsetting the organizational costs and new predevelopment costs of first-time solar+storage projects (e.g., technical and legal review, doc prep, assembling additional development team members, compliance, etc.).

- *Invest for LMI Expansion.* Invest in existing companies active in solar+storage development in the commercial space to expand reach into low-income markets.

- *Fund LMI Advocates*. Support advocacy organizations to provide information and training to LMI residents on issues regarding resilient solar+storage benefits with the goal of increasing LMI participation in policy discussions.

CEG's report directly led to the creation of an important new investment vehicle to overcome these market barriers. From our analysis, we developed a financing tool with generous support from The Kresge Foundation and in collaboration with several community development financial institutions (CDFIs). That comprehensive finance model, *Financing Resilient Power,* could jumpstart solar plus battery storage (solar+storage) financing in LMI communities.

- *Supporting a foundation-funded payment guarantee model for battery storage financing.* "Financing Resilient Power" is a pioneering philanthropic effort—a $3.3 million initiative of The Kresge Foundation to accelerate the market development of solar+storage technologies in

historically underserved communities. The Foundation's investment—developed with CEG, which manages the effort—represents the first time a US foundation has committed to use both its grantmaking and endowment resources in a comprehensive strategy to bring these new clean energy technologies to affordable housing and critical community facilities. New York City Energy Efficiency Corporation (NYCEEC) is the first lender selected to participate in the financing initiative.

The new financing partnership consists of three elements:

1. A $3 million loan guarantee to reduce credit risk for solar+storage project investments.
2. $170,000 in capacity grants to NYCEEC to accelerate their ability to finance solar+storage projects, build project pipelines, and actively engage in information sharing; and
3. $120,000 in technical assistance grants to enable eligible project owners and developers to assess the technical and financial aspects of new solar+storage projects.

Financing Resilient Power is unprecedented in several ways that could be considered for adoption in a new federal financing program for battery storage in LMI markets:

1. It provides the participating lender with a 50 percent *payment guarantee* for loans made to solar+storage projects. If the project can't cover its portion of borrower's debt service, then the guarantor foundation pays up to 50 percent of the project debt service to keep borrower's loan payments current, substantially reducing the risk of a payment default to the lender's investor(s) who provided capital for the loan.
2. The cumulative payments made by the guarantor will not exceed 50 percent of the original amount of the solar+storage portion of the project loan. The guarantor foundation assumes the first-loss position for these loans.
3. The loan guarantee appears as a reserve liability against the guarantor foundation's endowment, but no funds are transferred until such time as a demand for payment is made under the loan guarantee, which then takes the form of a program-related investment (PRI).
4. The foundation endowment continues to earn market rate returns on the reserved funds until demand for payment is made under a specific guaranteed loan transaction.
5. The term of the loan guarantee is 14 years, which includes an initial two-year origination period. There is no minimum or maximum guaranteed loan amount.
6. *Financing Resilient Power* is available for construction and permanent financing when originated by an approved participating lender for low- and moderate income solar+storage projects for the following:
    - Multifamily affordable housing
    - Elderly and other supportive housing
    - Unsubsidized workforce rental housing
    - Commercial and mixed-use projects
    - Community facilities
7. *Financing Resilient Power* has been designed to be responsive to a range of loan types and ownership structures. Loan types include construction loans, bridge financing to other sources of funding and permanent financing. Permanent ownership types include:
    - Direct immediate ownership
    - Third-party ownership
    - Special purpose entities
    - For-profit and nonprofit ownership
    - Co-operative/community ownership

Financing Resilient Power is initially available to support solar+storage projects throughout the Northeast, with the intention of expanding efforts nationally over time.

The Kresge loan guarantee is unlike other loan guarantee programs. A traditional loan guarantee program provides repayment to a lender if the borrower can't make its debt service payments and the guaranteed loan falls into default and is liquidated. The guarantor then pays up to the agreed percentage of borrower's outstanding project loan balance per the terms of the loan guarantee agreement. The guarantor will make payment under the guarantee only once:

1. The borrower has failed to pay amounts due on the project loan either at the loan's stated maturity date or earlier upon acceleration of the loan resulting from an event of default that the borrower has been unable to cure per the terms of the loan agreement; and
2. There has been a foreclosure of the loan collateral.

Instead, the Kresge payment guarantee is structured *to help keep loan payments current*. To avoid an uncured default, the Foundation will provide up to 50 percent of the project debt service to keep borrower's loan payments current, regardless of the reason why debt service payments related the solar+storage portion of the loan are unable to be made.

The *Financing Resilient Power* initiative recognizes that credit enhancement alone is insufficient to change behavior in this nascent market. There are two important new grant elements to this program that should improve the ability of nonprofit lenders to develop this new underserved clean energy market.

First, participating lenders have access to new *capacity grants* to help those lenders build additional in-house capacity to finance solar+storage projects and strengthen project pipelines and loan demand. Second, the program offers new *technical assistance grants* to help community and nonprofit groups ascertain project feasibility and ensure that proposed projects will deliver on the expected energy, economic, and resiliency benefits. These pre-development awards also recognize a major obstacle to project development in low-income communities – there is a basic need to add to the expertise of local groups to understand project risks and opportunities so they can make informed decisions about ownership and other issues for projects in their communities.

DOE has recognized the importance of this project as it has provided funding (DOE Award #: DE-EE0008758), CEG and the Clean Energy States Alliance (CESA) are working to expand and adapt the Kresge loan guarantee model by exploring an alternate finance model that begins with aggregating a portfolio of projects that share similar credit characteristics and project profiles.

Scaling up Solar for Under-Resourced Communities is a multi-year, US DOE-supported project to build momentum behind LMI solar by advancing innovative financing solutions in three market segments: single-family homes, manufactured homes, and multifamily affordable housing.

***Recommendation*.** US DOE should expand the payment guarantee model for battery storage by supporting efforts to recruit additional foundations and government guarantors, as well as establish a dedicated "Clean Energy Financing" program that would support the development of new initiatives to overcome financial risk in LMI clean energy markets. US DOE also should provide funding to support a pilot demonstration of this portfolio finance model. That support

might take the form of additional loan guarantee funds (or other means of credit enhancement) as match for foundation PRIs, and to cover project predevelopment expenses.

Utility Incentive Programs for Battery Storage -- the ConnectedSolutions Utility Model

Another direct way the federal government could support financing for BTM battery storage is through support for new state-level utility energy efficiency programs that can provide various forms of new financial incentives for peak reducing battery storage installations. The template for these new innovative battery storage incentive programs was developed by CEG in conjunction with state agencies and utilities in New England, under a utility model called "ConnectedSolutions."

- *Support Replication of the ConnectedSolutions Model.* ConnectedSolutions is a utility demand response payment program that reduces the economic performance risk of battery storage use of contracts between the utility and customer. Under this model, the utility pays participating battery owners to allow the utility to call on the power stored in the customers' batteries to reduce regional grid demand peaks. These utility-contracted payments are assignable to a lender to finance the systems, significantly reducing credit risk and increasing the availability of financing.

  Last year, with technical support from CEG, Massachusetts became the first state to adopt this program, officially incorporating behind-the-meter battery storage into its energy efficiency plan, and utilities began enrolling customers across the state in this groundbreaking pay-for-performance program. Now 18 months later, the concept has spread across New England, with similar programs being offered in Rhode Island, Connecticut and New Hampshire.

  The essential difference between this new program and traditional utility demand response is that ConnectedSolutions incorporates battery storage into a state's Energy Efficiency Plan, which enables customers to access batteries through their utility efficiency program, as they would any other efficiency appliance. Payments from the utility for customer battery performance make it possible for the battery storage system to pay for itself – even for low-income utility customers, who may not be able to reduce demand-related utility charges or take advantage of other significant energy cost savings in the absence of such a program. In fact, new analysis by CEG shows that the ConnectedSolutions funding model results in a 30%-40% reduction in the simple payback period for battery systems, as compared to a demand charge management model.

  In addition to improving project economics, ConnectedSolutions lowers risk for investors. In the past, affordable housing developers and their financing partners have been concerned that battery owners will have to predict their property's demand peaks and then time the use of their battery's power to accurately cover the peak's entire duration to reduce the demand charge portion of their utility bills. This method, known as "demand charge management," has now been eclipsed by the ConnectedSolutions model, which both lowers risk and enhances returns on investment. Under ConnectedSolutions, customer "guesswork" has been eliminated through a utility-contracted payment stream that compensates battery owners for allowing the utility to use the battery. The credit profile of the property/battery owner is replaced by the rated credit of the utility.

Additionally, the program uses standardized legal documents between utilities, participating installers and demand response aggregators, and program eligibility requirements and utility interconnection rules work to standardize system designs.

In Massachusetts, state incentives and utility battery demand response contract payments can be paid either to end-user customers who own the battery systems or to third-party solar+storage developers. The ConnectedSolutions model presents an opportunity for housing developers/owners and solar developers to build pipelines of multifamily affordable housing solar+storage projects that can leverage state incentives and utility contract payments, at the same time accessing flexible financing through the recently launched *Financing Resilient Power* initiative and the Massachusetts HEAT loan program. Combining these funding initiatives creates a powerful integrated incentive and financing model that can be readily expanded to other states that adopt the ConnectedSolutions model. (For an example of what states can achieve, see the Connecticut Green Bank's *Solarize Storage* program proposal, which takes as its centerpiece the ConnectedSolutions aggregated pay-for-performance contracts model, and adds on many of the best practices CEG has advocated: an energy storage rebate, low-cost financing, on-bill finance, resilient power benefits for customers, and a significant adder for LMI participation.)

The ease with which ConnectedSolutions can be adopted by new states points to another advantage of the program: it allows storage to gain access to state energy efficiency budgets – among the largest and most stable clean energy incentive budgets in the nation. Currently, states commit more than $6 billion to electric energy efficiency programs annually, with another $2 billion for natural gas efficiency. Battery storage, which offers an entirely new kind of efficiency (peak demand shifting), should be the next major new type of clean energy technology adopted into these efficiency programs across the nation.

***Recommendation*.** US DOE should support the expansion of the ConnectedSolutions model through EERE and other programs that support innovative utility energy efficiency programs across the country. This support should also encourage better protections for low income provisions in these programs, including an LMI carve-out, to ensure that some portion of program funds are allocated in underserved communities, as well as an LMI adder to help developers in these communities overcome barriers. Such support also should demand greater resiliency provisions in these programs, such as a resiliency adder that acknowledges the added expense for the customer in making solar+storage systems "islandable" (able to support host facility loads during a grid outage).

Conclusion

The draft Roadmap is a good first step to an effective federal strategy to advance energy storage technologies. But the Roadmap can be substantially improved with a heightened focus on the strategies proposed in this response, with recommendations that the final Roadmap would address the following:

- It should articulate a clear path forward to specific, time-bound, targeted cost reductions and committed funding pathways for battery storage.
- It should pay greater attention to support the BTM market for battery storage, as that is where the greatest innovations can produce the most immediate benefits to energy consumers.
- It should adopt a host of new federal policy roles for DOE and other agencies, including the national laboratories, to promote a multi-agency federal effort to address the need for greater

market analysis, support for state partnerships and other policies to advance battery storage throughout the federal government.

- It should especially address a noteworthy omission in the current draft, as it does not materially focus on the need to get these new energy saving technologies into the hands of LMI customers, who in various sub-markets are in most in need of the many economic, public health and environmental benefits the pairing of solar and battery storage can provide now.
- It should develop new financing platforms that help reduce the financing risk of early stage battery storage technologies, again especially in hard to reach LMI markets.

Thank you for your consideration of these comments and recommendations. (A summary of these recommendations can be found here.) We welcome the opportunity to discuss them with DOE officials as policy recommendations are developed.

Respectfully submitted,

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