March 1, 2019

The Honorable Daniel Simmons
Assistant Secretary of Energy
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Re: Request for Information DE-FOA-0002070: Efficient and Flexible Building Loads

Dear Mr. Simmons,

Thank you for the opportunity to submit comments in response to the U.S. Department of Energy's (DOE's) January 28, 2019, request for information (RFI) that seeks to better understand where efficient and flexible building loads research goals can be refined to reflect market needs and inform related research, development, demonstration, and deployment (RDD&D) activities (DE-FOA-0002070).

The Alliance to Save Energy is a nonprofit, bipartisan coalition of business, government, civil society and academic leaders who work together to drive greater U.S. energy productivity to achieve economic growth, a cleaner environment, and greater energy security, affordability and reliability. Since the Alliance was founded in the aftershocks of the energy crises of the 1970s, the U.S. has made huge strides in driving energy efficiency throughout our economy through RDD&D of new technologies, significant public- and private-sector investments, and sound policies. Thanks in part to federal energy efficiency policies, including energy conservation standards, building energy codes, and fuel economy standards, the U.S. today extracts twice as much gross domestic product from each unit of energy we consume when compared to 1980.

Load flexibility and energy efficiency are two related concepts that often reinforce each other. However, to maximize the benefits of each, it is important to recognize that they are important and separate goals. Load flexibility involves, in part, shifting the timing of building energy consumption to reduce demand on and stress to the electricity grid at daily, seasonal, or annual peak periods. But it does not necessarily address or alter how much energy the building consumes. Although traditional energy efficiency improvements can enhance the value of load flexibility, a building with a flexible load may or may not be energy efficient.[1] However, the RFI states in a footnote that the Building Technologies Office (BTO) "intends for energy efficiency to be subsumed within the flexible building loads term." The RFI continues: "…BTO seeks to build on existing energy efficiency efforts, and develop technical capabilities to optimize the interplay between energy efficiency, demand response, behind-the-meter generation and energy storage to increase the flexibility of demand-side management." The technologies and practices required to

[1] In addition, participants in demand response programs may capture cost savings benefits of shifting of non-efficient loads to non-peak times via rate arbitrage (i.e., buying electricity at a low price and accepting a utility reward that is higher than the rate paid to forego or delay consumption).

increase energy efficiency are different from those that enable load flexibility; the separate efforts required to support energy efficiency should not be minimized or overlooked in efforts aimed at enabling load flexibility. **The Alliance recommends that DOE not "subsume" energy efficiency within "flexible building loads", and instead use the terms load flexibility and energy efficiency separately to make this important distinction while also working to ensure that the two concepts and related strategies are aligned and reinforce each other.**

To maximize energy savings, it is critical to prioritize and not overlook energy efficiency, including systems efficiency,[2] at the building before enabling load flexibility. There is significant opportunity for federal leadership in supporting systems efficiency, building on DOE's current energy efficiency programs. DOE has policies and programs at its disposal to encourage systems efficiency, including the Building Energy Codes Program and (in cooperation with the Environmental Protection Agency (EPA)) the ENERGY STAR® program. **The Alliance encourages BTO to coordinate with organizations responsible for developing model building energy codes, as well as those responsible for test methods for appliance standards, metrics including building energy ratings, and voluntary labeling programs such as ENERGY STAR and WaterSense to consider how to evaluate the load controllability benefits of connected devices in ways that complement and ensure the cumulative benefits of continued energy efficiency.**

Category 1: Building Technologies R&D and Integration Needs for Increased Load Flexibility

The RFI seeks feedback on RDD&D integration needs to achieve building load flexibility at scale. BTO should recognize that maximum value of flexible building loads may only be captured if innovative, transformational technologies reach the market. To support this outcome, BTO can help overcome research "valleys of death" through efforts to shepherd high-risk, high-reward innovations to market in situations where private sector stakeholders are unwilling to undertake such risk.

Both technical and non-technical barriers affect opportunities for increased building load flexibility. There is a lack of data on the ability of load flexibility to improve grid reliability, which undermines the ability of building owners and utilities to use building-to-grid technologies in a way that optimizes energy efficiency both at the building and the grid. Data and analysis that clarify the various impacts of load flexibility would support the development of enabling technologies for load flexibility, promote the energy-efficient deployment of these technologies, and also inform the development of any standards or incentives promoting or addressing load flexibility. **BTO should use any relevant data collected from the RFI to help quantify and further explore the value of connected, automated, and flexible buildings, including in terms**

[2] The term "systems efficiency" refers to the co-optimization of multiple energy-consuming or -producing technologies and structures to maximize energy efficiency, conservation, and productivity at the building system, building subsystem, multi-building system, whole-building, neighborhood, microgrid, or electricity distribution grid level. The Alliance's Systems Efficiency Initiative (SEI) published the "Greater than the Sum of its Parts" report, which defined a systems-efficient building as a building in which multiple building systems (e.g., lighting, HVAC) are designed, installed, and operated to optimize performance collectively to provide a high level of service or functionality for a given level of energy use or input. Integrating systems and optimizing their operations through controls and smart technologies can help maximize the benefits of flexible building load management.

of improved energy efficiency, improved reliability, reduced energy bills, reduced grid congestion, improved occupant comfort levels, and environmental benefits. The Federal Energy Regulatory Commission (FERC) opened a docket (No. AD-18-7-000) in January 2018 to examine the resilience of the bulk power system.[3] **BTO should consider feedback supplied to the FERC proceeding on resilience that would help to integrate its RDD&D and further identify the value of load flexibility to grid operators.**

BTO should seek specific input from utilities on the degree of any building load reductions needed, especially during coincident peak periods. **BTO, in cooperation with states, utilities, and industry, should undertake RDD&D to determine how best to reduce building loads given a demand response signal.** Research also should incorporate any impacts on occupants of any building systems or equipment being shut off or curtailed, or operating in a reduced speed or manner. A better understanding of the implications for occupant comfort and convenience of these and other load control strategies should also account for the available incentive structure and how the load adjustments are communicated to building occupants. **BTO should consider the need for utilities to work closely with building operators, tenants, and other stakeholders in developing load reduction strategies to ensure equity and access to affordable power for occupants.**

As BTO, states, and utilities assess the value of building efficiency and load flexibility through demonstration and pilot programs, developing standardized methods to collect and share data on these efforts would support at-scale deployment of efficient building-to-grid ("B2G") interactions. **BTO should collaborate with states and utilities to develop a "B2G data repository" to share data and models that reflect: the technical potential to reduce (or increase) individual building electrical loads for various periods of time with different amounts of advance notice; and the demonstrated willingness of building owners and occupants to accept changes in service which may accompany load variations of different frequencies, intensity, and duration.** As the Alliance's Systems Efficiency Initiative (SEI) found, such a data repository, which could be an extension of DOE's existing Building Performance Database, should use standardized data categories and definitions, as well as an analytical framework that moves beyond occasional, planned peak load reductions to include continual, fine-tuning adjustments between building operations and grid conditions. States and utilities could use such a data repository as a resource for best practices and for informing decisions on whether and how to encourage or deploy B2G technologies.

Category 2: Controls and Communication to Enhance Building-to-Grid Interactions

In addition to developing a B2G data repository, another RDD&D opportunity for BTO to support load flexibility is to explore and better define the role of controls and communications in enhancing efficient B2G interactions. While home and business owners are primarily interested in advanced controls because of the additional comfort, convenience, and safety benefits, B2G connected features also have significant potential to improve energy efficiency of building systems in addition to enabling load flexibility. There is untapped potential for increased systems-level energy

[3] Federal Energy Regulatory Commission. *Grid Resilience in Regional Transmission Organizations and Independent System Operators.* 8 January 2018. Retrieved from https://www.ferc.gov/CalendarFiles/20180108161614-RM18-1-000.pdf?csrt=752677694346763086

efficiency and savings through the utilization of grid-enabled connected devices. Connectivity and load controllability, made possible through connected products, expands the quantifiable benefits of efficiency to include improved overall energy system reliability and efficient grid operation; reduced needs for costly new generation, transmission, and distribution assets; and potential for significant savings for consumers.[4] Controls and communications, enabled by connected products, also make it possible to optimize systems efficiency—i.e., by enabling the interactions among components that are necessary to maximize energy savings at the systems-level. Optimizing systems efficiency also generates significant non-energy benefits.[5] **The Alliance encourages BTO to evaluate the added savings and benefits of controls and connectivity through better documentation of reliable energy savings and the development of systems-level metrics, which would further encourage investment in controls and communications technology and increase their appeal.**

Connected devices that enable B2G interactions should be evaluated in terms of the benefits they bring to both load flexibility and systems efficiency. More rapid and automated B2G interactions are making it easier to support load flexibility via the convergence of "smart" sensing, metering, and control technologies with remote, wireless connectivity and "big data" analytics. Nevertheless, as the Alliance's SEI found, in some cases, there may be a trade-off between energy consumption reductions from energy efficiency and connectivity/controllability, due to the incremental energy requirements for controls and communications technologies.[6]

BTO's energy conservation standards program offers an important vehicle for addressing these potential tradeoffs. High-efficiency products, including those covered by energy conservation standards, are a critical building block for both systems efficiency and load flexibility. Currently, energy conservation standards are concerned mainly with minimum efficiency and annual kilowatt-hours (and, in some cases, peak kilowatt) savings. **The Alliance encourages BTO to explore how energy conservation standards might incorporate the added value of connected products that offer load-controllability or features that enhance energy system reliability without sacrificing energy efficiency.**

From a broader perspective beyond connected devices, building load flexibility relies on controls and communications that play a critical role in enabling integrated markets that include both the utility (i.e., supply) and customer (i.e., demand) sides of the meter. Beyond the regulatory challenges that come with addressing needs on both sides of the meter, integrated markets may be limited in their ability to attract widespread participation by smaller buildings and loads, which individually may appear to offer little dollar value from grid-responsive control, but which may nonetheless represent a significant demand-response resource in aggregate. Focused demand-response pilot projects could help determine the value of building load flexibility for smaller buildings. **To support these efforts, BTO, in cooperation with states, utilities, and industry,**

[4] Strother, Neil. (2016, May 9). Smart Home Products Resonate with Consumers, and Utilities Should Take Note. Retrieved from https://navigantresearch.com/news-and-views/smart-home-products-resonate-with-consumers-and-utilities-should-take-note

[5] In addition to reducing energy use, a systems approach has the potential to achieve significant non-energy benefits: reduced carbon emissions, improved grid reliability, water savings, extended equipment life and increased occupant comfort and productivity.

[6] Technology that enables controls and communications can be referred to as information communications technologies (ICT), including sensors and control circuitry, processors, and additional required data centers.

should undertake RDD&D to identify and evaluate opportunities for smaller commercial and multi-family buildings to participate fully in B2G transactions.

Load flexibility is a key feature of the emerging "transactive energy ecosystem" where consumers can buy and sell energy and related services in a dynamic and interactive manner. Load flexibility can be supported by improved utilization of distributed generation -- including renewable wind and solar power and combined heat and power -- and energy storage; these distributed energy resources can enhance the value of load flexibility by providing energy, capacity, and ancillary services to the grid. The growth in distributed generation such as combined heat and power, wind or solar photovoltaics, along with demand response, electric vehicle-to-grid deployment, and developments in battery storage, are offering a multi-directional flow of power between a utility and its customers, further enabling load flexibility.[7] Load flexibility achieved with distributed energy resources can not only offset peak demands, but also can reduce the amount of curtailed generation from intermittent wind and solar resources when integrated with energy storage. **The Alliance encourages BTO to conduct research on enabling more rapid, automated, and mutually-beneficial B2G interactions to broaden the opportunities for building energy management and controls, improve utilization of distributed generation and of intermittent renewable wind and solar power, accelerate the deployment of energy storage, and improve the overall system efficiency of electricity and natural gas delivery.**

As controls increasingly enable distributed energy resources to support load flexibility, it will be important to address the wear on energy storage devices. For instance, an electric vehicle battery that discharges energy to the grid, and charges up again for transportation needs, is experiencing more frequent cycles of charging and discharging than it may have been designed for. In this example, this increased cycling could decrease the lifetime of the battery and potentially the energy efficiency of the equipment it powers as well. **As new opportunities for energy storage emerge, BTO should support RDD&D on the equipment used for energy storage and collaborate with manufacturers to explore impacts on the equipment's lifetime and its energy efficiency.**

There is also an opportunity to create educational, training, and technical assistance resources to help building owners and managers understand the impacts and options for load management. At present, building load management literature reflects consumer experience with relatively "lumpy" (and rarely used) on-or-off control of a few larger end-use devices (e.g., air conditioners and ventilation fans, water heaters, office lighting). As the Alliance's SEI found, there is a need for a detailed map of potentially controllable loads by building type, with the attendant transmission and distribution constrictions or "pinch points", better representing a wider range of control scenarios ranging from very short-term "trimming" to longer interruptions varying by time of day, season, and frequency. This technical potential for fine-grained load control could then be tested against actual consumer response. **To the extent practical, the Alliance encourages BTO to pursue research on sub-metering and benchmarking at the systems level, which would be extremely valuable for measuring and comparing the efficiencies of various building systems, to help owners identify areas in need of improvement and understand the level of controllability in a total load of a building or campus.**

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[7] For instance, in areas powered by wind energy, electric vehicles could charge at night to coincide with periods of high output from wind farms and provide vehicle-to-grid power for peak periods during the day.

Further, connected products, which are addressable devices and often operate on expanded communications networks within and outside the building, call for a higher level of attention to issues of data privacy and cybersecurity. The large amount of data collection enabled by connected products has the potential to increase vulnerability to cyberattacks. **The Alliance encourages BTO to work with equipment manufacturers, technology providers, and the National Institute of Standards and Technology to determine best practices for incorporating connectivity into more devices, considering lessons learned from appliances and equipment that already function as connected products.**

Category 3: Building Energy Modeling for Load Flexibility

Most energy modeling is carried out after the building design is complete to document predicted performance for code compliance purposes, green building ratings, and utility incentives. However, energy modeling also offers a critical -- and underutilized -- opportunity during the early design stage of a building, when designers, architects, and engineers can optimize a building's parameters for efficiency. Several tools appropriate for early design stage modeling exist: For example, DOE's OpenStudio enables users to design "what-if" scenarios and quickly make changes to test building response, and Autodesk (a commercially available architectural, engineering and construction software) has incorporated DOE's EnergyPlus modeling software to enable annual energy simulations. **As the value of load flexibility is further explored and as accepted metrics emerge, DOE should calculate and report them through its modeling tools and encourage third-party tool developers to do the same.** The value of load flexibility should be evaluated at the early stage of the design process, in tandem with prioritizing the importance of energy-efficient design, to inform decisions on enabling load flexibility.

Category 4: The Value of Building Load Flexibility

The RFI requests feedback on whether it accurately recognizes the value of load flexibility. We appreciate BTO's forward-looking approach to explore how load flexibility can provide additional benefits to the grid's many users. We are hopeful BTO will explore not just the value to the building occupant or the grid operator, but the full scope of various benefits of load flexibility to the many users of the grid, including its operators (utilities, independent system operators (ISOs), regional transmission organizations (RTOs)), the direct consumers of delivered electricity, and the broader category of ratepayers within a service area. It is also extremely important to consider those benefits that accrue to society at large (i.e., public goods such as air quality improvements). Load flexibility can optimize integration of variable renewable energy generation resources and provide essential reliability services (also known as ancillary services) that improve the resilience and reliability of the transitioning grid—as well as providing cost savings across the energy sector. Energy efficiency lowers system costs for all customers by reducing the need for new capacity. Load flexibility can reduce generation, transmission, and distribution costs by reducing or shifting the electricity demand of buildings. It can avoid wasteful overbuild, overgeneration, and curtailment of generated electricity. Power utilities can benefit from significant cost savings by enabling building systems to act as distributed energy assets for the grid. The value of these benefits can be monetized and weighed more appropriately in cost-benefit analyses.

Further, the value of load flexibility is enhanced when combined with energy efficiency to provide additional cost and energy savings. Energy efficiency results in smaller energy loads, which are operationally easier to shift to a different time of day, and accelerate deployment of renewables. Combined with grid-interactive strategies, energy efficiency can provide additional relief from system stress, and provide further resiliency benefits. **Building energy efficiency should be a core foundational element of any BTO initiative that helps advance flexible building load management, including DOE's Grid Modernization Initiative and Grid-Interactive Efficient Buildings research.**

Buildings should be as efficient as possible to maximize benefits of flexible building loads. Therefore, it is of foremost importance to deploy and demonstrate all the energy saving strategies in the energy efficiency toolbox to remove information barriers to energy efficiency optimization and help realize the full potential value of load flexibility. Critical energy efficiency strategies include setting energy conservation standards and prioritizing and encouraging the construction of highly efficient buildings, particularly within model building energy codes. For example, strong envelope performance not only reduces peak power and natural gas demand, it also extends the timeframe during which mechanical cooling or heating systems can be cycled off, allowing indoor temperatures to passively remain within an acceptable performance range for longer periods. This capability could dramatically increase the flexibility to manage peak loads on critical days. Also, the building element with the longest lifetime is its shell. Therefore it is critical to invest in and scale up the use of high-performance building envelope technologies, including high R-value insulation to minimize energy wasted on thermal control and maximize long-term energy and cost savings. Another strategy involves moving beyond widgets by advancing systems efficiency, as described in the sections above. **BTO should collaborate with states, local governments, utilities, and equipment manufacturers to encourage greater energy efficiency and systems efficiency as a precondition to enabling load flexibility, including within the development of building energy codes.**

Values that energy services can provide include the ability to increase integration of variable renewable energy generation resources, enabling reduced cost of electricity through either reduced demand or increased dispatch of lower-cost generation; jurisdictional public policy priorities (such as meeting requirements for renewable energy or energy efficiency); the ability to reduce emissions; and improving the reliability and resilience of the grid. It is important that market signals do not erode the value of flexible building loads, particularly by incentivizing perverse results. The intent behind load flexibility is to shift loads to off-peak periods, and typically for those loads to decline. Although the amount of energy consumed by a building during an on-peak period versus off-peak period can be the same at the building level, the cost of that electricity consumption is reduced during off-peak periods. Therefore, there is a cost incentive for building occupants to adjust load—often due to improved (heat rate) efficiency at the source of generation.

When a building flexes its load, benefits can be captured by all electricity consumers within the region from the shift to off-peak periods. In fact, the larger the load, the greater the potential arbitrage opportunity if a building owner shifts its load to an off-peak period. Even though energy efficiency reliably and predictably cuts energy waste and financial costs, the value of energy efficiency could be overlooked in the market when compared to the potentially-large cost savings presented by load shifting alone. There is a need for the value of energy efficiency to be recognized more clearly in the market, particularly as it pertains to time and location of energy efficiency deployment. **The Alliance encourages BTO to ensure that RDD&D for incentives or standards encouraging load flexibility continually recognizes energy efficiency and systems efficiency to ensure the maximum benefits of building load flexibility.**

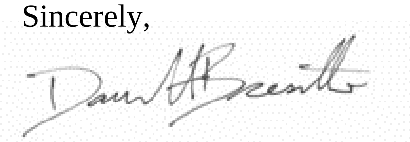
Finally, there is an important regional factor in determining the value of load flexibility. The local value of load management and services, including load flexibility and energy efficiency, varies based on location, time of the day, and season. The National Association of State Energy Officials (NASEO) adopted a Board resolution to encourage states "seeking to improve grid reliability and security, expand economic opportunity, reduce utility costs to consumers and businesses, and enhance resiliency in their buildings sector, to support the policies, programs, and practices that will improve systems energy efficiency and building-to-grid integration" including by supporting "integrated buildings to grid frameworks including communications protocols, transactions, and device and building connectivity" and incorporating "systems strategies throughout the building life cycle."[8] Through these efforts, NASEO, states, and utilities may identify specific local and regional RDD&D needs that would support load flexibility. **BTO should seek and use the expertise and experience of NASEO, states, and utilities to inform any RDD&D projects that would involve the development of load flexibility infrastructure or standards.**

<u>Conclusion</u>

Thank you for the opportunity to comment on DOE's Efficient and Flexible Building Loads RFI. Within the confines of current statute, there are several approaches available to the Department of Energy's Building Technologies Office to encourage innovation while ensuring that the maximum benefits from both energy efficiency and load flexibility are achieved. The energy conservation standards program is a pillar of federal energy policy and should remain a top priority. In addition, the evolution of load flexibility, enabled by the ongoing communications and technology revolution, if paired effectively with systems efficiency, presents a new opportunity for BTO to achieve many of the stated goals of the RFI.

The Alliance looks forward to the results of this work and stands ready to support BTO's efforts to continue to advance energy efficiency and improve U.S. energy productivity.

Sincerely,



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[8] National Association of State Energy Officials (NASEO). *Board of Directions Resolution Supporting Buildings-to-Grid Integration and Improved Systems Efficiency.* February 2017. Retrieved from [https://www.naseo.org/naseo-policy.](https://www.naseo.org/naseo-policy)