National Association of State Energy Officials Comments on
Request for Information (RFI) DE-FOA-0002070:
Efficient and Flexible Building Loads

National Association of State Energy Officials (NASEO)
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The National Association of State Energy Officials (NASEO) represents the 56 governor-designated state and territory energy directors and their offices across the nation. We appreciate the opportunity to provide input on the U.S. Department of Energy's (U.S. DOE) Building Technology Office (BTO) RFI on Efficient and Flexible Building Loads.

NASEO's mission is to support the states' efforts to promote energy-related economic development, deliver affordable energy from all energy sources including cost-effective energy efficiency and demand management, meet state environmental objectives, and ensure energy system security, reliability, and resilience.

We recognize that improving technologies offer opportunities to advance grid-interactive efficient buildings (GEB) and facilities that can enhance performance of the electricity and broader energy systems. Benefits that may accrue include:

- Enhanced energy efficiency, energy productivity, and energy affordability,
- More impactful and flexible load management to
    - Reduce peak power demand,
    - Make buildings more flexible, or even dispatchable, to act as demand-side resources and virtual energy storage assets,
    - Improve integration of variable energy resources (both distributed and grid-side), and distributed energy resources (including storage), and
    - Allow transactive energy business opportunities,
- Improved economic and environmental performance,
- Strengthened energy resilience of buildings and facilities, the electric grid, and the broader energy system, including expansion of micro-grids and the use of energy storage, and
- Resource optimization (building/facility, distribution, grid) and cost savings to businesses and households.

NASEO passed a resolution in 2017 "Supporting Buildings-to-Grid Integration and Improved Systems Efficiency" encouraging states "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…"[1]

NASEO greatly appreciates the U.S. DOE's research and development (R&D) and related analytical activities supporting this area. The State Energy Directors have stressed the value they see in U.S. DOE's leadership and leverage of public and private efforts to address building integration with the grid.

NASEO has seen robust state engagement in and support for our partnership work with the U.S. DOE, the National Association of Regulatory Utility Commissioners (NARUC), National Laboratories, and others to strengthen state exchange in this area, including opportunities to provide state feedback on U.S. DOE's R&D as well as on the related market opportunities and barriers that are affected by the states.

NASEO is also pleased to have the opportunity under this RFI to offer comments and hopes that the U.S. DOE will share with the states the results to help inform state research and demonstration investments and policies aimed at reducing market barriers to GEB while meeting state energy objectives and serving state consumers and businesses. Certainly NASEO is expanding our efforts to educate the states in this important area.

The following provides NASEO's response to selected RFI questions.

NASEO Response to Category 1 Questions – Building Technologies R&D and Integration Needs for Increased Load Flexibility

Regarding Category 1, in addition to the distinction between technological and non-technological barriers one should consider technical aspects that affect the non-technological barriers, such as data availability and confidence (or lack of confidence) in such data for decision making by public policymakers, state energy officials, regulators, and private sector businesses and households.

Data and confidence in technology performance may be insufficient to support state policy decisions (distinct from regulatory decisions) that direct the adoption of utility (investor-owned, public power, and cooperative) market structures and rules conducive to GEB or to drive markets for more flexible and agile energy management beyond those incentivized through existing time-of-use (TOU) rates, peak charges, and demand response (DR) programs. Current TOU and peak charge rate structures and DR programs are relatively gross level incentives for load management compared to more temporally and locationally agile load management opportunities that GEB can provide. Data and analytical needs of decision makers overseeing or operating consumer-owned as well as investor-owned utilities must also be considered.

NASEO Board of Directors Resolution: Supporting Buildings-to-Grid Integration and Improved Systems Efficiency, https://www.naseo.org/Data/Sites/1/naseo-building-grid-resolution-feb-2017-.pdf

Building owners (including households) need to perceive benefits to installing GEB capabilities and participating in associated markets or programs: What incentives, compensation, or other benefits would they get from implementing GEB? Will they be sure that GEB implementation will not sacrifice occupant comfort and service or make operations and maintenance (O&M) more complex or costly? Can some GEB technologies support onsite energy resilience and/or power quality benefits to enable better operation during times of grid stress or outage? Can GEB and flexible load management help meet owners' non-financial objectives, such as corporate or public sector emissions commitments.

From the (consumer-owned and investor-owned) utilities' points of view: What benefits and incentives are there to use non-utility-owned resources that GEBs can provide? Will GEBs be reliable and cost-effective providers of grid services? Are there technical or operational challenges that must be addressed? Can GEB help meet environmental and social objectives, including regulatory compliance and corporate or organizational emission goals? One barrier could be constraining rules by regional transmission organizations (RTOs) and independent system operators (ISOs).

These questions impinge on the ability of third party energy firms to perceive a business case for providing GEB-related products and services, whether to individual large customers or to aggregations of smaller residential and business customers.

These and other pertinent questions relate not only to the need to perceive benefits from adopting GEB technologies but also the need to define and reduce risks. The adoption and diffusion of technology literature applies here, particularly factors identified in Everett Rogers' Diffusion of Innovations, including *perceived advantage*, *compatibility*, *complexity*, *trialability*, and *observability*.[2,3] Potential adopters of new technologies are often skeptical of performance claims made by vendors and assistance providers, and they are also concerned about compatibility with existing processes, products, skill sets, and business relationships and practices.

Trialability and observability are important for resolving questions of relative advantage and compatibility of a proposed technology or practice with existing systems. Being able to try a new approach or technology on a portion of a facility allows the potential user to mitigate risks of disrupting large parts of its operations for something that may not deliver the expected

[2] Rogers, Everett M., Diffusion of Innovations. 4th ed. New York: The Free Press, 1995.
[3] This and the next paragraph draw from Alliance Commission on National Energy Efficiency Policy, "Advancing Energy Productivity in American Manufacturing," Alliance to Save Energy, Washington, DC, January 2013.
http://www.ase.org/sites/ase.org/files/resources/Media%20browser/commission_manufacturing_2-7-13.pdf

benefits. Observability, meaning the ability for others to discern the results, is also important for diffusing techniques. Seeing a technology or practice work at one facility can give confidence that it will work at the observer's own facility.

The U.S. DOE should heed these diffusion of technology factors in developing its R&D, demonstration and validation, and technical assistance activities.

Many of the issues concerning motivations and incentives for GEB relate to utility policies, business models and organization, and regulatory structures, including impediments (or lack of incentives) posed by traditional utility structures and rate design. We will not recount here the growing body of literature and expertise on this topic nor list various pilot approaches (e.g., "non-wires solutions" as alternatives to conventional substation upgrades) and state explorations of alternative business models and regulatory approaches, but we recommend that U.S. DOE track this topic. We reiterate that these issues apply to consumer-owned utilities as well as to investor-owned utilities, although the particulars may vary. Thus, they pertain to policy-making for consumer-owned utility governance, public utility commission jurisdiction, and state policy levers. Of course, larger building owners, technology companies, and others are increasingly dealing with these issues on the customer-side of the equation. This is a potentially significant economic development opportunity for state and local governments.

Disaster response and pre-disaster mitigation can be greatly improved with the use of GEB. Recent changes in the Stafford Act allow states to focus in this area, which should help address future needs. U.S. DOE could work with states on expanding "Smart Cities" initiatives to facilitate GEB.

The U.S. DOE can have an important role in developing data and performance metrics that will support the implementation and diffusion of GEB and flexible load management technologies. Data on load shapes of building and facilities by type, region, and even individually would provide a baseline against which potential load management impacts could be assessed. This would enable utilities, building owners, and product and service providers (and their investors) to identify potential benefits and, thus, economic opportunities on which to build business cases. Metrics to characterize building "grid friendliness" or "grid citizenship" (term used by the New Buildings Institute) will be important to target GEB markets among existing buildings and further GEB incorporation in new and renovated buildings.

Another role U.S. DOE could play is to support the demonstration and validation or verification of GEB pilots and GEB-pertinent technology applications. Trying new technologies and business approaches entails risk. Government cannot (and usually should not) bring the risk to zero but objective independent technology verification can assuage skepticism of technologies offered by vendors and others with vested interests. The U.S. government has demonstrated and validated building and facility energy technologies at federal facilities through the Department of Defense's (DoD) Environmental Security Technology Certification Program (ESTCP) and the General Service Administration's (GSA) Proving Grounds program. The U.S. government also has experience developing with the private sector verification protocols that states, the private sector, and others can use to validate technology performance.[4] ESTCP or Proving Grounds type test bed activities extended to state, local, and institutional facilities (including critical infrastructure facilities) would be useful as would development of metrics and performance verification protocols that both private and public sector stakeholders could use.

Beyond test bed demonstrations, federal as well as state, local, and institutional “lead-by-example” implementation of GEB and flexible load management in building renovations and reconstruction could yield simultaneous taxpayer, building-owner, and electric (and broader energy) system benefits while helping strengthen workforce skills and business competitiveness for building trades, O&M contractors, and energy product and service providers.

The Category 1 questions ask about challenges and issues that may be pertinent to some kinds of distributed energy resources (DERs) or building/facility types. We would presume that aggregation of GEB and flexible load management functions and services across multiple types of DERs and among numerous small utility customers (e.g., households, small businesses) would be a greater technical and business challenge than dealing with individual large facilities or multi-building facilities and complexes under a single ownership (e.g., college campus, military post, medical center). We are pleased to note the U.S. DOE award to the Colorado Energy Office (CEO) for the Colorado Residential Retrofit Energy District (Colorado RRED) under the U.S. State Energy Program (SEP). CEO has partnered with the National Renewable Energy Laboratory, Rocky Mountain Institute, and Xcel Energy to scope, construct, study, and evaluate a residential energy district through building retrofits. An energy district is a system of interconnected buildings that incorporates DERs, including energy-efficient technologies, energy storage, and advanced building controls to optimize energy load and performance. We look forward to the progress of this project.

The Category 1 questions also ask about R&D opportunities among four categories of building technologies (flexible materials, flexible power draw, flexible energy source, flexible timing). We understand the presentation of four categories as conveniences but hope U.S. DOE will approach the categories in a flexible manner. There are overlaps and synergies among the categories (e.g., phase-change materials [including water-ice] are flexible materials that can serve flexible timing; storage [flexible timing] can support flexible power draw) and they may be best used in combination. In addition to supporting R&D and demonstration/validation of technologies in these categories, we hope U.S. DOE will encourage and support system design approaches that consider buildings and building interactions with other buildings, surroundings and the grid (and electrified transportation) in a holistic manner.

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[4] For example, the Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) program verified many environmental technologies for use by public and private sector parties, including homeland security and first responder communities for certain monitoring and treatment technologies, and developed protocols employed by state authorities for water treatment. https://archive.epa.gov/nrmrl/archive-etv/web/pdf/p1002ccd.pdf

We do not have comments on R&D priorities for particular technologies at this time, though one area that comes to mind that is not among the illustrative examples in Table 1, is metamaterials applications for passive cooling.

NASEO response to Category 2 Questions – Controls and Communications to Enhance Building–to-Grid Interactions

One question concerns the locus and level of two-way grid communication—whole building, zone, subsystem, component. This appears to be a critical question as "smart" appliances and equipment come to market. Ideally, different building subsystems and equipment should be coordinated via a building energy management system (or building management system that manages energy along with other building operations). However, for smaller residential and small business applications, the grid interactivity may lie primarily with individual appliances and equipment. Some attention should be paid to the ability to integrate individual grid-interactive capable equipment into home or building energy management systems.

Consideration should also be given to consumer choice in designing control and communications technical functionality as well as in designing services. Communications infrastructure improvements are a necessary precondition of this effort, including common interoperability standards. O&M, whether by building professionals or homeowners, greatly affects the energy performance of systems even with highly capable building energy management systems and smart home thermostats. Potential benefits will not be realized if poor installation or poor O&M occur (e.g., over-ridden control to respond to a proximate comfort complaint without addressing root causes). At the same time, there are good reasons to allow user/operator/customer over-ride when there are unusual circumstances (e.g., urgent need to charge electric vehicles during a peak period). GEB controls should also allow for other contingencies, such as Internet connectivity disruptions, equipment failure, or software "glitches," by having provisions for default settings, "safe" modes, and manual operation. Training and education of building operators and user-friendliness to building operators and household users are important.

NASEO is concerned about cybersecurity risks that may accompany GEB. Opportunities for mischief and damage exist at several levels. Cyberthreats can be aimed at harming the electricity and broader energy system ("anti-DR" to cause problems perhaps) but also the Internet of Things can be a conduit for distributed denial of service (DDOS) attacks, malware propagation, and fraud or theft (recall Target stores' loss of payment card data reportedly via hacking of a building energy management system). Users also need assurance that GEB will not threaten privacy and data security.

NASEO response to Category 3 Questions – Building Energy Modeling for Load Flexibility

Currently NASEO does not have comment on Category 3 Building Energy Modeling for Load Flexibility beyond the comments offered in response to Category 1 on the importance of load shape information (modeled, estimated, and actual) and on metrics of "grid friendliness" or "grid citizenship."

NASEO Response to Category 4 Questions – The Value of Building Load Flexibility

NASEO is pleased to see a range of building-grid services in the RFI discussion and Table 2. However, we note that resilience is not directly mentioned there though it appears within the Category 4 questions.

We believe GEB can enhance electricity system resilience through at least two levels: (1) the grid; and (2) at individual buildings/facilities or campuses and communities. For the grid, GEB and flexible load management can reduce stresses to the electricity system by reducing peak demand, tempering ramp rates, and providing ancillary services (like voltage and frequency support). These stress reduction features can be especially useful if supply constraints arise from damage to generation, transmission, and perhaps some distribution assets by natural calamity, accident, attack, or other disruption.

In addition to helping reduce chances of outages or compromised power quality, GEB perhaps can be useful in recovery from an outage by supporting more orderly reconnection of load and smoother coordination with distributed generation assets (e.g., CHP, microgrids, backup generation, onsite solar).

At the level of individual facilities or campuses, GEB capabilities as part of an onsite building or facility energy management system may offer resilience support during a grid outage by helping optimize onsite loads with onsite supply (e.g., backup generation, CHP, microgrid) and storage. As noted above, GEB support of grid reconnection can be beneficial both to the facility and the utility. (This raises a question of U.S. DOE's scope for GEB: Does it cover only the interaction of buildings/facilities (and their equipment) directly with the electric utility or does it also cover interaction of buildings and their equipment with a mini- or microgrid serving a campus, military post, or community?)

NASEO looks forward to learning more from others' RFI responses and from U.S. DOE, National Laboratory, and other work on valuation of resilience. This is a topic of great interest to the states, particularly regarding facilities critical to cost, public safety, health, security, and the environment. The question of resilience valuation is also important to state, local, and institutional financing of energy performance upgrades, including how energy savings performance contracts (ESPC), energy-as-a-service, and other private-public partnership mechanisms can be applied.

While not focused on GEB and grid-interaction and flexibility, we note a study focused on military facility energy security that explores some perspectives on energy resilience, assurance, and security.[5] The authors note that for facilities equipped with backup diesel generators there already is a price/cost (and implied value) to energy resilience and security, namely the cost of installing and maintaining the backup system (although the authors note reliability and fuel availability vulnerabilities of conventional backup generation). The question becomes what the relative cost and services provided of microgrids or other options are as compared to conventional backup generation rather than the value of resilience per se.

We note that the just-noted study considers the question of valuing resilience at individual facilities or campuses/bases where backup generation is or would be installed. That is a different question from resilience services to the broader grid that GEB can support.

Regarding the Category 4 question on how flexible building load grid challenges may differ by region, it appears likely that penetration rates of variable renewable resources (both utility scale and distributed) would be a significant factor. These challenges will vary by region and time depending on the level and type of variable generation resources present.

Category 4 also asks about other costs and other value streams not discussed in the RFI text and Table 2. Table 2 notes reduced capital costs for distribution system upgrades as well as avoided costs for distribution voltage control equipment. We believe that GEB can facilitate "non-wires solutions" as alternatives to conventional distribution system upgrades and can sometimes allow deferral or avoidance of the need to "upgrade" some distribution systems (whether conventional or "non-wires"). We also ask if a potential value and avoided cost that might not be captured in Table 2 is avoided wear-and-tear to distribution (and, for that matter, generation and transmission) equipment by reducing the level and duration of peak loads and associated heat and physical stress. (Table 2 refers to avoided capital costs of *upgrades* but not of replacing like-for-like worn out or failed equipment.) GEB and flexible load management may also reduce operational costs (in contrast to capital costs in Table 2) of distribution by reducing cooling needs at substations.

Another value stream to consider is avoided emissions from power generation (and perhaps onsite combustion by boilers, furnaces, and CHP if integrated in facility energy management). Some states have or are exploring carbon dioxide limitations or fees (e.g., Regional Greenhouse Gas Initiative, California AB32). Also, various parts of the country have market trading of nitrogen oxides (NOx) emission allowances. To the extent that GEB approaches allow higher utilization of non- or low-emission generation resources, avoided emissions could be estimated and, perhaps, monetized.

[5] Marqusee, J., C. Schultz, and D. Robyn. 2017. *Power Begins at Home: Assured Energy for U.S. Military Bases*. Reston, VA: Noblis. www.pewtrusts.org/~/media/assets/2017/01/ce_power_begins_at_home_assured_energy_for_us_military_bases.pdf.

Another question in Category 4 concerns the demonstration and verification of energy and demand savings and performance. As discussed in earlier responses, metrics and verification of performance is very important to demonstrate the value and benefits of GEB, and to creating a market that offers compensation and incentives for load flexibility and GEB. However, we have concerns about evaluation, measurement and verification (EM&V) in this context. We also have concerns about voltage level support and DER integration at the circuit level.

Conventionally, EM&V is used to document energy savings and sometimes peak demand reductions so that a utility or energy efficiency program administrator (PA) can get "credit" for regulatory compliance or compensation purposes. The "E" in EM&V centers on savings attribution; the question of whether a utility's incentives actually incited the energy savings or if the customer would have achieved the savings anyway (i.e., that the customer "free rode" on the utility incentives). The topic can get arcane and contentious.

What matters for flexible load management and GEB is a building's performance, not whether the building owner was motivated by a utility "program" rebate or subsidy. As noted in earlier responses, there is a need to measure building performance with reasonably useful metrics to document benefits and to base market compensation for grid services. The conventional M&V options under the International Performance Measurement and Verification Protocol (IPMVP)[6]—on which most M&V and EM&V is based—are currently poorly suited to measure dynamic, flexible, time-differentiated building or facility energy performance.

There is discussion in the energy efficiency evaluation community of "M&V 2.0" where building energy management systems and analytics would be used to determine energy (and peak) savings in lieu of or in complement to more established IPMVP option-based M&V. In such cases, the building energy management systems primarily serves to optimize building performance (and, with GEB technologies, building-grid interactions) with the M&V as a byproduct rather than a discrete activity. There is also considerable discussion of so-called beneficial electrification which must incorporate technological solutions in order to optimize the use of electricity.

NASEO does not believe that the typical EM&V or M&V approaches now used for utility energy efficiency programs and energy savings performance contracts (ESPC) are well suited to the context of GEB and flexible building load services and benefits.

Another pertinent consideration is cost-effectiveness testing for DERs and GEB technologies. Whether application of GEB is cost-effective (and to whom) depends on costs, benefits, and valuation, and on metrics of building and grid performance previously discussed. We note development of the National Standard Practice Manual (NSPM) developed by a National

[6] Efficiency Valuation Organization, "International Performance Measurement and Verification Protocol," https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

Efficiency Screening Project coordinated by E4TheFuture.[7] The NSPM was developed to improve the quality, balance, and consistency of cost-effectiveness testing of energy efficiency resources. There is an effort by E4TheFuture and its partners to expand the NSPM to include other DERs. Such an effort deserves consideration and may be useful for advancing cost-effective GEBs and efficient and flexible load applications.

Conclusion

NASEO, on behalf of the Nation's State and Territory Energy Offices, appreciates this opportunity to respond to this important RFI. We hope this is useful to the U.S. DOE and we are grateful for our partnership with the Department to support state energy priorities.

[7] National Efficiency Screening Project, "National Standard Practice Manual," https://nationalefficiencyscreening.org/national-standard-practice-manual/