The Future of Energy Efficiency:
Opportunities, Challenges, and Considerations for Federal and State Energy Policy Makers

Executive Summary:

This briefing prepared by the National Association of State Energy Officials (NASEO) examines opportunities for federal and state coordination on energy efficiency policies and programs. In particular, it highlights the importance of the State Energy Office role in promoting end-use energy efficiency and other distributed energy resources in state, multi-state, and federal efforts to modernize the U.S. electric system. It summarizes the main discussion points and perspectives raised during a facilitated discussion co-hosted by NASEO and the U.S Department of Energy's Office of Energy Policy and Systems Analysis (EPSA) in February 2016, which was organized to collect State Energy Office feedback and input for EPSA's consideration as it researches, prepares analyses, drafts, and implements the second installment of the Quadrennial Energy Review.

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This white paper was authored by Sandy Fazeli of NASEO in October 2016.

INTRODUCTION

The U.S. electric system powers markets across the country. In most circumstances its operation is seamless, unnoticed except in times of disruption. Yet, technological advancements, increasingly diverse grid and customer facing energy supply and demand resources, and evolving consumer options and preferences are catalyzing significant changes in the electric system and the requirements of a more modern electric system. Policy, regulatory, academic, and market actors have coined numerous new terms and concepts in an effort to capture this dynamic, including "Utility 2.0," "Grid of the Future," "Energy Systems Integration," and "Smart Power," among others. Such changes are the focus of the U.S. Department of Energy's (DOE's) ongoing analysis informing the second installment of the Quadrennial Energy Review (QER 1.2), which "will develop a set of findings and policy recommendations to help guide the modernization of the nation's electric system and ensure its continued reliability, safety, security, affordability, and environmental performance through 2040."[1]

For the National Association of State Energy Officials' (NASEO) State Energy Director members– many of whom inform and advise their governors and legislatures on energy issues–electric system modernization presents a complex policy imperative and poses challenging analytical and planning questions: how can policy effectively modernize the electric system's aging infrastructure and equipment, as well as the legacy regulatory frameworks that govern it? What will be the costs of this transformation, who will bear them, and how will they be financed? What is the role of energy efficiency in facilitating the transition to a better-integrated, "smarter," and more resilient grid, while maintaining reliability, security, and affordability?

In February 2016, NASEO members convened for a roundtable to discuss these issues. Co-hosted by NASEO's Fuels and Grid Integration Committee and DOE's Office of Energy Policy and Systems Analysis (EPSA), the "Future of Energy Efficiency Roundtable" in Washington, D.C. highlighted how state energy policy makers are assessing their energy markets and engaging stakeholders in state and local electric system modernization efforts and energy efficiency programs.[†] It showcased the significant opportunities for scale-up and deployment of energy efficiency to support electric system integration and modernization, but also highlighted the challenges associated with realizing these opportunities. Three key themes and considerations emerged from the discussion:

- **Opportunity:** End-use energy efficiency helps realize benefits both on the grid and economy-wide, and is a key characteristic and enabler of the "electric system of the future." U.S. deployment of energy efficiency and distributed energy resources is growing, and driven by greater progress and investment not only by utilities but also by governments, the private sector, and consumers.
- **Challenges:** To be truly modern, the U.S. electric system still needs to experience a rise in current levels of investment and better-coordinated deployment of distributed energy resources (which include supply-side and end-use efficiency and other solutions such as renewables, demand response, and energy storage). However, market and institutional barriers pose a challenge to deeper penetration of these technologies, highlighting the need for innovative policy and regulatory pairings that drive holistic market progress and innovation.
- **Recommendations to consider:** End-use energy efficiency in the electric system of the future will require data-driven policy, long-term planning, and expansive stakeholder involvement and

[†] More information about the expert discussants who contributed to this roundtable, as well as the conversation prompts that NASEO used to facilitate discussion with roundtable participants, is available at energyoutlook2016.naseo.org.

coordination – which State Energy Offices, using flexible funds such as those provided through the U.S. State Energy Program (SEP), are well-positioned to deliver alongside federal partners such as DOE. Leveraging and expanding State Energy Offices' policy development, program administration, and planning roles offers an opportunity to catalyze investment for deeper integration of energy efficiency in the U.S. electric system.

The focus of the February 2016 roundtable and of this white paper is end-use efficiency, which represents a significant priority that aligns with the State Energy Offices' functions promoting economic development and competitiveness, and resiliency. An equally important area of focus for many states (though not covered in this paper directly) is supply-side energy efficiency, which when complemented with demand-side efficiency can help the grid experience substantial gains in reliability and affordability. Obviously, integrating these resources with existing and planned generation can help advance a cost-effective electric system.

The sections below offer further detail and nuance to the high-level considerations presented above.

OPPORTUNITY

For state energy policy makers, energy efficiency not only presents multiple opportunities to facilitate infrastructure modernization but is also a necessary characteristic of the electric system of the future. As end-use efficiency continues to grow, it helps avoid the construction of costly new energy infrastructure, injects flexibility into the electric system, balances supply with demand, and supports the integration of new technologies and generation sources that offer additional opportunities for system optimization. For these reasons, many State Energy Offices have found energy efficiency to be a compelling policy option not only for its positive impacts on the grid but also for its ability to promote economic development, environmental quality, energy security, and community resiliency.

The Electric Power Research Institute defines the smart grid as "one that incorporates information and communications technology into every aspect of electricity generation, delivery, and consumption in order to minimize environmental impact, enhance markets, improve reliability and service, and reduce costs and improve efficiency." [2] This characterization suggests that the updates needed to transform our current electric grid into a 21st century, "smart" electrical system are wide-ranging, involving not only physical components of the grid itself but also the devices, facilities, and users that interact with the grid, and the technologies that enable this interaction to occur. These updates have been the focus of billons of dollars of federal, state, local, and private investment and research, and they include such features as two-way flow of information and communications; the ability to integrate distributed energy resources, energy storage, and other emerging products and services; increased resiliency, durability, and speed of repair; and greater consumer involvement in grid operations and choice of supply.[3]

Benefits of End-Use Efficiency

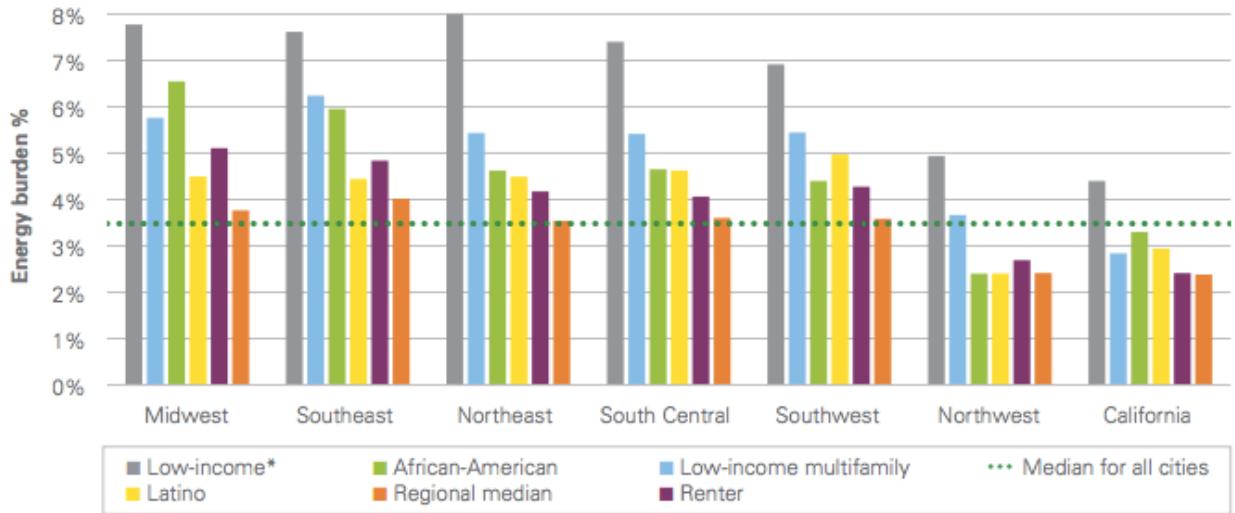
Well-targeted and properly-deployed end-use efficiency measures can enable many of the above distribution resource grid integration updates to occur without compromising the electric system's core ability and obligation to ensure reliable and affordable electric service to homes, businesses, and industries. Efficiency investments can help electricity providers deal with grid constraints and may help defer or avoid supply-side investments in transmission and distribution infrastructure. When integrated with demand response and other forms of distributed energy resources (such as energy storage and advanced renewable technologies), energy efficiency supports the grid's operational flexibility, diversifies its energy sources, can increase the share of renewable resources available, and enables newer technologies (such as electric vehicles and energy management systems) to interact with and participate in the electric system.

Conversely, grid modernization represents a growing opportunity for deeper and broader end-use efficiency. Grid technologies enabling two-way power technologies and information exchange create greater synchronicity between end-users and the grid. In buildings, these advancements allow facilities to become self-configuring, self-commissioning, self-learning, self-diagnosing, and self-transacting, capable of optimizing energy use and operations to maximize energy savings in relation to other facilities and devices using grid services.[4] Beyond building walls, the grid is now able to connect with an increasingly electrified transportation and transit system. In a business-as-usual setting, charging of technologies such as electric cars and electric buses may just add load to the grid; yet, with proper grid planning and technology deployment, electric vehicles can offer energy storage resources, support peak shaving, and introduce major end-use efficiencies and emissions reductions to U.S. transportation systems.

The technical success of buildings-to-grid, vehicles-to-grid, and buildings-to-vehicles integration has already begun to take root in innovative projects and policy initiatives. The State Energy Offices in Massachusetts[5] and New York[6] have both launched pilot programs and studies to investigate grid interactive vehicles. In 2013, California passed AB 266, requiring the California Building Standards Commission to adopt "building standards for the installation of future electric vehicle charging infrastructure for parking spaces in multifamily dwellings and nonresidential development"; this directive, though focused on the built environment, has nevertheless been incorporated into the California Energy Commission's plug-in electric vehicle charging infrastructure deployment strategy[7] as well as the California ISO's vehicle-grid integration roadmap.[8]

The opportunity and benefits of energy efficiency do not stop at the electric system, but extend to the economy and national security. Energy-efficient technologies and policies save 52 quads of energy per year. Energy efficiency is estimated to save U.S. citizens, businesses, and agencies more than $500 billion annually, improving bottom lines and supporting state and local economies. It also reduces U.S. dependence on fossil fuels and foreign suppliers, promoting national security and resilience.[9]

Well-targeted end-use efficiency programs can also play a key role in advancing energy affordability, equity, and community resiliency factors such as public and economic health. Particularly for those with low or fixed incomes, the elderly, and the disabled, energy costs represent a significant portion of household expenditures and increase the likelihood of respiratory illness, stress, and economic hardship.[10] According to an analysis on energy burden conducted by the American Council for an Energy-Efficient Economy (ACEEE), energy efficiency programs tailored to affordable housing are crucial to mitigate these stresses: "low-income households and for multifamily low-income households, bringing housing stock up to the efficiency of the median household would eliminate 35% of excess energy burden, reducing energy burden from 7.2% to 5.9%. For African-American, Latino, and renting households, 42%, 68%, and 97% of their excess energy burdens, respectively, could be eliminated by raising household efficiency to the median."[11]



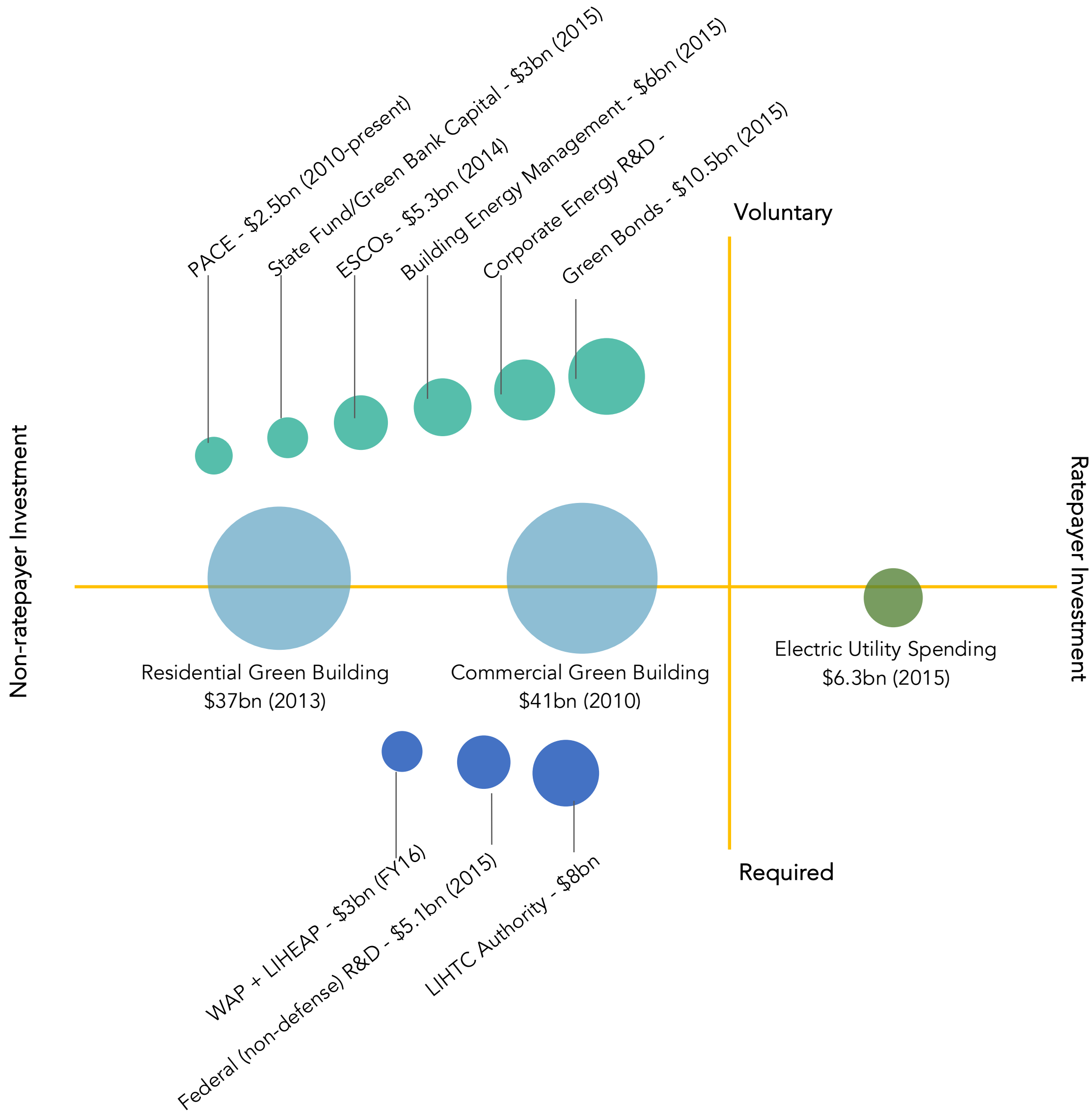
Energy Burden of Select Groups by Region.
Source: ACEEE 2015.

End-use efficiency is a key tool in preserving affordable housing because it promotes home comfort for tenants, decreases operations and maintenance costs for owners, and reduces turnover.[12] It also offers a significant, largely-untapped opportunity for investment (in the multifamily rental market alone, several studies estimate cost-effective end-use efficiency gains of up to 30 percent are available[13]), and in these ways it offers a particularly important policy opportunity for states and communities experiencing housing shortages and community development challenges alongside electric system modernization needs.

Multiple Drivers of and Paths to End-Use Efficiency Investment

Initiatives across the country offer a spotlight on how investment in end-use energy efficiency occurs. While programs offered by ratepayer-funded electric utilities – both investor- and consumer-owned – are typically perceived to be the dominant source of this investment, increasingly robust action from the private sector, bolstered and steered in part by policy initiatives such as building energy codes and voluntary public-private partnerships, paint a more robust picture of the variety of channels through which end-use efficiency investments can and do occur.

Motivation for end-use efficiency investment can be plotted along two key dimensions: source of funding and level of mandate. First, major funding sources may include ratepayer funds (whose use is typically overseen by public utility commissions, electric cooperative boards, municipal governments, or federal regulators) as well as public government funds, private sector capital, or individuals' own reserves (which may be overseen by regulatory bodies but which do not necessarily need to conform to the rules and cost-effectiveness standards that drive utility energy efficiency programs). Second, energy efficiency investments may also be mandated or required (for instance, in the form of energy efficiency targets, codes and standards, or program requirements) but may also occur voluntarily (for instance, through incentive programs or through procurement and purchasing).



Major Streams and Sources of Energy Efficiency, Renewable Energy, and "Green" Investment.
Data Sources: Various (see bullet points below).

When drivers for end-use efficiency are considered along these dimensions, it highlights the many ways energy efficiency investments occur:

- *Through utility programs:* Electric utility spending on energy efficiency has steadily increased, from $5.9 billion to $6.3 billion between 2011 and 2015.[14] This spending can be driven by an array of factors, including system benefit charges; energy efficiency performance targets (which are often mandated by law or by regulation but may also be voluntary); regulatory requirements that utilities obtain cost-effective energy efficiency resources; and integrated resource planning and demand-side management planning requirements.[15]

- *Through building energy codes:* Building energy codes govern the minimum energy efficiency levels of new building construction and existing building alteration, in both the residential and commercial sectors. In this regard, energy code development, adoption, and enforcement represent a key factor in the energy efficiency levels of new construction in the United States. The energy-efficient construction market equaled $37 billion for residential single-family and multifamily homes in 2013[16] and $41 billion for commercial buildings in 2010 in the United States[17], according to industry analyses. (A more recent estimate prepared for the U.S. Green Building Council places the size of these markets at $55 billion and $95.6 billion respectively in 2015.[18])
- *Through income-based assistance and incentive programs:* End-use energy efficiency has been integrated as a requirement of many federal and state affordable housing and energy assistance programs. The federal Weatherization Assistance Program (WAP) and Low Income Home Energy Assistance Program (LIHEAP) are funded at $215 million and $3.3 billion for Fiscal Year (FY) 2016 respectively, and the Low Income Housing Tax Credit (LIHTC) program provides state and local allocating agencies with nearly $8 billion in annual budget authority. While funding for the latter two programs is not necessarily entirely dedicated to energy efficiency, end-use efficiency is still pervasive in these efforts. Approximately $300 million of LIHEAP dedicated to energy efficiency. Additionally, every property development using the LIHTC program is required meet a federally-established minimum for energy efficiency, and, in at least 35 states, additional energy efficiency levels beyond the federal minimum are either required or awarded additional points by the agency scoring and considering development applications[19].
- *Through incentive and innovative financing mechanisms:* In nearly every state, financial incentives for energy-efficient equipment, appliances, measures, and practices, such rebates, grants, or low-interest loans, are available to end-users through state agencies, manufacturers, utilities, or third-party program administrators. State Energy Offices and state green banks (some of which, like the New York Green Bank in NYSERDA, are housed within the State Energy Office) have invested over $3 billion in public funds to support clean energy projects and leverage private capital.[20] Investments also occur through Energy Service Companies (ESCOs), comprising a $5.3 billion a year industry as of 2014; many ESCOs rely heavily on Energy Savings Performance Contracting (ESPC) or design-build contracts to complete energy efficiency and other energy upgrades in the federal, state, and municipal markets as well as in universities, schools, and hospitals.[21] And, since the inception of Property Assessed Clean Energy (PACE) programs in 2010, PACE financing has attracted over $2.5 billion of capital to energy efficiency and renewable energy (and is predicted to grow exponentially as projects mature).[22] In the secondary, institutional investor market, labeled green bonds represented a $10.5 billion industry in the United States last year, with a majority of proceeds used for energy efficiency, renewable energy, and low-carbon transport projects.[23]
- *Through corporate and individual procurement:* Market-driven procurement and purchasing of energy efficiency technologies represents another source of investment and decision-making. The U.S. market for building energy management (BEM) systems and enterprise energy management surpassed $6 billion in 2012[24], and home energy management systems (boosted by trendy products like the Nest thermostat and integration with smart phone technology) is poised to become a multi-billion dollar industry nationally over the next decade.[25] Corporate and individual consumer procurement of energy efficiency and renewable energy is growing, enabled by innovative purchasing mechanisms such as equipment financing, leasing, and power purchase agreements. As of 2016, more than half (60%) of Fortune 500 companies have instituted a greenhouse gas emissions reduction or energy efficiency goal, signaling strong private sector commitment.[26]

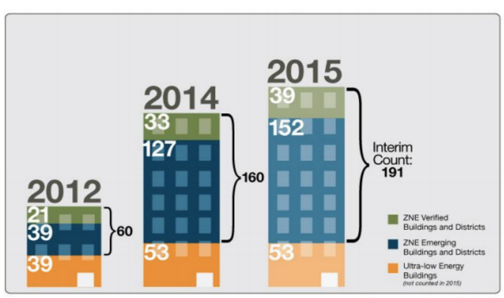
- *Through early-stage support of energy technology:* Corporate and federally-funded research and demonstration (R&D) of clean energy technology together exceeds $11 billion annually,[27] driving continued innovation in end-use energy efficiency technologies and practices.

Enabling State and Local Policy Progress through the U.S. State Energy Program

The potential benefits that energy efficiency can unlock for the electric system, local economies, the environment, and national resiliency and security present a compelling case for why state energy policymakers should cultivate multi-faceted opportunities and seek to catalyze multiple types of investment (utility, public, and private) for end-use energy efficiency.

Many State Energy Offices use a combination of policy, planning, and incentive levers to realize these investment opportunities. Much of this activity is enabled by the U.S. State Energy Program (SEP), a cost-shared program administered by DOE that provides resources directly to states for allocation by the State Energy Offices for use in efficiency, renewables, and alternative energy demonstration activities. Using this important program, the State Energy Offices manage strategic programs to support the private sector in increasing efficiency, developing domestic and renewable sources, promoting economic development, delivering emergency planning and response, and reducing imported oil reliance. Through SEP and other sources of support from the federal and state level, the State Energy Offices have become crucial voices to advance energy efficiency in partnership with private businesses and local governments in their states. They ensure the needs and issues of industry, business, and residential energy consumers are considered during the energy policy and program development process, and have helped usher groundbreaking energy projects to the marketplace.

Notable SEP successes include Kentucky's facilitation of the country's first zero-energy-ready schools and its use of SEP funds to engage and train public school energy managers; the District of Columbia's extensive public energy building benchmarking program; and Massachusetts' first-of-its-kind wireless energy monitoring and demand response energy efficiency program for state buildings.[28] Importantly, these activities have helped pave the path for strong state-local cooperation on energy efficiency through ESPCs, PACE, building code support and enforcement, and energy technology innovation and incubation, and they have also helped demonstrate and grow emerging markets (for instance, in zero-net-energy and zero-energy-ready buildings). By NASEO's estimate, each dollar of federal funds invested in SEP is associated with annual savings of 1.03 million source BTUs and energy cost savings of $7.22, and leverages $10.71 of non-federal (state and private investment).[29]



Growth in Zero Net Energy (ZNE) Buildings Since 2012.
Source: New Buildings Institute

Grid Modernization and Energy Efficiency Linkages

Importantly, several key states have begun to use energy infrastructure modernization initiatives as an opportunity to link to and deepen the use of energy efficiency to create a smarter and more integrated electric system. In New York, various agencies are playing a critical role in the "Reforming the Energy Vision" (REV) strategy. The groundbreaking REV regulatory innovation process, including features that increase customer knowledge and management of energy bills; animate the market and leverage ratepayer contributions with private investment; and increase system-wide efficiency, fuel and resource diversity, and system reliability and resiliency. As part of this effort, the New York State Energy Research and Development Authority (NYSERDA, which serves as the State Energy Office), is charged with advancing the Clean Energy Fund (CEF), a 10-year, $5 billion program. CEF's market-oriented approach uses innovation, research, and financing (through the New York Green Bank) to encourage private investment in energy efficiency and other clean energy technologies.[30]

In January 2016, Nevada Governor Brian Sandoval issued an executive order to re-establish the New Energy Industry Task Force. Under the direction of the Governor's Office of Energy (the State Energy Office), the Taskforce was convened to address policies that encourage development of diverse energy sources and integrate renewable energy technologies into Nevada's energy sector, foster the creation of a modern, resilient, and cost-effective electric system, and support distributed generation and storage with a specific focus on rooftop solar and net metering. This Taskforce concluded in September 2016 with an extensive list of recommendations, most notably a policy that allows existing customer-generators to be grandfathered in to prior net metering rates for a term of 20 years following the Public Utilities Commission's decision to alter reimbursement rates for net energy metering customers. Other Taskforce recommendations that are currently being pursued by the Governor include: improvements to the Integrated Resource Planning process; a bill to support energy efficiency by giving the PUC legislative authority to examine decoupling as a ratemaking mechanism; and, unanimous support for enabling Property Assessed Clean Energy (PACE) to leverage private sector financing for renewable energy and energy efficiency improvement on private property. Nevada will continue to examine the recommendations of the New Energy Industry Taskforce through its participation in the NASEO Energy Markets and Planning Program (E-MAP), a multi-state initiative aimed at helping states develop comprehensive approaches to addressing electric system modernization issues to ensure affordability, reliability, and resiliency.

In April 2016, Michigan Governor Rick Snyder issued an executive order creating the 21st Century Infrastructure Commission. Over an eight-month period, this Commission has convened residents, state agencies, the private sector, and other industry stakeholders to identify strategic best practices to modernize Michigan's energy, transportation, water and sewer, and communications infrastructure. Final recommendations from the Commission will be presented in the Infrastructure Commission Report by the end 2016 and will inform Michigan's efforts as another partner in NASEO's EMAP project.

Utilities in Michigan are also incorporating electric system modernization strategies into ongoing planning processes. In February, a Detroit-based utility filed a request with the Michigan Public Utility Commission to continue a multi-year modernization of its distribution infrastructure to improve efficiency, reliability, and affordability. In addition, all electric and natural gas service providers in the state have submitted energy optimization plans designed to provide program evaluation support and develop any needed re-design and improvements to energy efficiency programs. These plans are submitted in accordance with Public Act 295 to promote the development of clean and renewable energy and energy optimization through the implementation of standards that will cost-effectively provide greater energy security and diversify the energy resources used to meet consumers' needs, encourage private investment in renewable energy and energy efficiency, and improve air quality.

In Minnesota, the Public Utility Commission, the State Energy Office, and private and utility stakeholders organized by the Great Plains Institute through its e21 Initiative have been significant proponents of grid modernization. Among e21's guiding principles are: creating an economically viable utility model that aligns with public policy goals; providing universal access to electricity services; and encouraging and enabling electricity users to take advantage of all cost-effective energy efficiency and other demand-side management opportunities, among others.[31]

In Massachusetts, the Green Communities Act (GCA) of 2008, which is the statute mandating the Department of Public Utilities to oversee a smart grid pilot program, links energy efficiency directly with grid modernization: "a specific objective of the pilot shall be to reduce, for those customers who actively participate in the pilot, peak and average loads by a minimum of 5 percent."[32] Correspondingly, the working group recommendations informing this grid modernization program, released in 2013, included a heavy emphasis on both operational and end-use efficiency.[33] In addition to grid modernization policy, the GCA also charged the Massachusetts Department of Energy Resources with engaging communities on building energy efficiency, codes, and planning, which has served as a model for other State Energy Offices to work with their local counterparts (for instance, in West Virginia).

CHALLENGES

The vast benefits and opportunity of end-use efficiency notwithstanding, there is still significant room for scale-up from an electric system modernization and public policy perspective. Research indicates that current levels of energy efficiency investment and deployment need to continue to increase, along with investment in other distributed energy resources as well as infrastructure upgrades, in order to cost-effectively realize the future grid. A study from the "More Than Smart" initiative posits that customer adoption of distributed energy resources would need to surpass a threshold level of approximately 5 percent of peak load in order to require significant changes to grid capabilities and to realize material system benefits. Current levels of distributed energy resource adoption are low enough to be accommodated within most of the existing U.S. distribution system without significant changes to planning, infrastructure, or operations.[34] Even in California, a state which is consistently ranked as a leader on energy efficiency, The state has set a goal "to double the efficiency of existing buildings and make heating fuels cleaner," highlighting the need for continued aggressive investment in this resource.[35]

For this reason, to optimize and mobilize energy efficiency for the grid of the future, state and federal electricity policy efforts must continue to address barriers that hinder energy efficiency market growth and adoption. These challenges fall in three broad, sometimes-overlapping categories: regulatory, financial, and analytical.

Jurisdictional Complexities

Investor-owned utilities, regulated at the state level, account for the vast majority of electricity customers in the country (approximately 73 percent). However, other bodies, including electric cooperatives, municipal utilities, and federal power marketing administrations (many of which are structured in different and unique ways) also play a role in grid systems. According to the first installment of the QER, "the variety of ownership and scope of the entities that comprise the grid leads to a complex set of motivations and decision drivers…precluding 'one-size-fits-all' policies."[36]

Additionally, as energy use and generation become increasingly decentralized and mobile, grid modernization will require holistic consideration of not only critically important utility, state, federal, local, and consumer-owned grid issues, but also a range of non-utility electricity market elements such as appliances and devices, distributed generation, storage, advanced sensors, smart meters, advanced manufacturing, provision of ancillary services, and electric vehicle deployment. For policy makers, the result is that broad stakeholder coordination becomes a crucial need for electric system modernization efforts, since there is no one entity that is fully charged with making decisions about investments in end-use energy efficiency or other energy resources.

Utility Revenue Decline

Many electric utilities are experiencing declines in sales due to such factors as changing demographics, flattening demand, and low returns on invested capital. This creates a challenging financial environment, as well as a potential revenue disincentive, for utilities to invest proactively in end-use efficiency or other measures that reduce sales volume. Continued proliferation of distributed generation technologies may exacerbate this trend: as locally-generated electricity replaces load typically served by centralized power plants, "grid operators [are forced] to raise prices on the remaining units to recover their fixed [transmission and distribution] costs."[37]

Some utilities have sought to combat revenue decline by adopting fixed-charge tariffs as a revenue recovery tool. However, such measures may have adverse effects on end-use efficiency, as they eliminate or skew the price signals needed to encourage energy efficiency and energy resource deployment.[38] They likely also pose adverse impacts for the remaining ratepayers relying on utility grid systems, who may be burdened with sometimes-untenable bill increases.

Lengthening Returns on Investment

The upfront costs of energy infrastructure modernization and technology advancement are typically higher than business-as-usual grid operation. While energy efficiency has often played a cost mitigation role because of its ability to lower ratepayer bills and reduce overall system costs, higher levels of energy efficiency may require deeper funding and lessen the sizeable return on investment that less expensive efficiency measures have thus far been able to attain.[39] This dynamic may make energy efficiency investments appear less attractive in the conventional cost-benefit tests that drive utility investment in programs and projects.

Uncoordinated Investment

Though growing, investment and funding for energy efficiency deployment can be fragmented or difficult to access or navigate for end-users. While state and local financing structures such as credit enhancements, interest rate buy-downs, loan participation programs, and PACE have helped draw greater attention from lenders and consumers to the energy sector, many financial institutions have not yet adopted underwriting and lending practices that are specific to energy efficiency, nor has there been significant action from institutional investors to rate and value clean energy assets differently than other consumer assets in the secondary market. These factors can make it difficult for energy users to access the capital that may be needed to take full advantage of utility programs and incentives, undergo deeper retrofits, or comply with building energy codes and standards set by state and local governments.

Disjointed Paths to Market

The speed of technology innovation outpaces the ability of many utilities and their regulators to effectively integrate new technologies, devices, and practices into their planning and programming. This lag time may impede the ability of new energy-efficient technologies to utilize traditional utility deployment channels to reach the marketplace, and creates a disconnect between R&D initiatives and many of the pilot, demonstration, and deployment programs that can help innovators and their investors grow the economy and realize timely returns on investment.

Valuation Uncertainty:

A major challenge to realizing the full potential of end-use energy efficiency lay in addressing how energy efficiency savings in generation, capacity, and distributed generation can be adequately valued at a particular place or time on the electric system. Studies indicate that energy efficiency has been consistently undervalued by regulatory cost-effectiveness frameworks, resulting in under-investment.[40] Increasingly sophisticated and more widely-accepted analysis is needed to dissect and investigate end-use efficiency not only for its system value (in terms of avoided transmission and distribution losses and deferred infrastructure investments) but also for its time and locational value (in terms of enhanced system optimization, load congestion alleviation, and deferred distribution equipment costs)[41] and its broader economic benefits. With more interconnected buildings using distributed energy sources entering the market, the question of appropriate valuation is among the most challenging barriers to modernization of the electric system.

Data Gaps

Lack of data and information about customer energy usage and patterns may slow the pace of deployment of energy technologies. Smart meters and other smart grid-related technology has enabled utilities to provide customers with detailed information on their own energy use; but, to understand and act on this data, many customers rely on third parties (such as smartphone software companies) to analyze, monitor, and adjust their electricity use accordingly. However, third-party data access to support customer decision-making has faced roadblocks due to concerns over utility customer privacy and data security.[42] Data access, and the energy analytics and grid-connected services that data access can unlock, could result in not only in the appropriate sizing, operation, and maintenance of innovative grid updates but also in improved customer behavior, creating large dividends in end-use energy efficiency.

Data gaps pose a challenge not only for customer education and adoption of innovative energy technologies, but also for policy makers, utilities, property appraisers, and capital providers for energy projects, all of whom require sound data to justify larger investments and greater market valuation of end-use efficiency and other distributed resources. Streamlined access to data, combined with better valuation of energy efficiency grid services, can help facilitate implementation of beneficial energy efficiency policies and regulations. For the buildings sector, such policies may include benchmarking and disclosure programs that drive building owners to reduce their properties' energy use, as well as building energy labeling programs that may ultimately drive real estate appraisers, mortgage underwriters, and prospective buyers to value energy-efficient properties at a higher price than inefficient buildings.

RECOMMENDATIONS

The following recommendations focus on the shape state and federal partnerships and innovative policies can take to further advance end-use energy efficiency in support of the grid of the future and QER 1.2 implementation. They highlight impactful opportunities for cooperation that bring resources and coordination to energy efficiency challenges across the country, while continuing to showcase the role of states as testbeds of action, innovation, and impact. This focus advances what NASEO members largely believe to be high-need activities: elevating and improving the quality of electricity policy as a means to advance innovative regulation and prioritize the role of energy efficiency in electric system modernization, as well as leveraging the convening power of State Energy Offices as a means to advance stakeholder participation and buy-in.[§]

Recommendation 1 – Use public policy to innovate electric utility investment and regulation.

The state energy policy role is distinct from the state regulatory role, yet both are critical to advancing a more modern and resilient transmission, distribution, and end-use electricity system. The State Energy Offices' position within the executive branch, combined with their ability to access flexible and innovation-oriented SEP resources, affords them a lead role in convening and consensus building, as well as access to governors and legislators who can propose and enact innovative reform based on their recommendations, stakeholder engagement, and analysis. By contrast, the regulatory role of public utility commissions is to use existing state policy to guide their regulation of and ratemaking for investor-owned utilities, highlighting the important implementation and compliance role that these bodies play in support of established public policy goals.

These complementary roles underscore the need for strong public policy leadership and alignment with electric utility regulation. Such a pairing improves the prospects for integrating deeper levels of energy efficiency and other energy resources onto the grid by using policy processes and stakeholder engagement to overcome the complexities and barriers blocking greater utility investment. Evolution and transformation of the electric system will require a shift in regulatory oversight "from being administered primarily through periodic rate cases to a forward-looking focus on planning, accountability, and financial incentives for results achieved."[43]

Many states have used policy levers and planning discussions to examine regulatory and cost recovery mechanisms and overcome barriers limiting ratepayer investment of end-use efficiency. Such activities have helped introduce stakeholders, regulators, and lawmakers to innovative solutions such as revenue decoupling, lost revenue adjustment mechanisms, and performance-based regulation of investor-owned utilities based on operational efficiency, environmental performance, and customer satisfaction (options which are being explored in Colorado[44] and Missouri,[45] [46] among others). Some states, such as Iowa and Oregon, have instituted "benefit adders" (typically ranging between 5% and 15%) to account for the non-energy benefits that energy efficiency programs realize. Other states have quantified these benefits as a separate benefit stream in their tests; for instance, the 2013-2015 Massachusetts Energy Efficiency Plan includes a benefit stream for savings from reduced operations and maintenance as a result of end-use efficiency measures. Yet other states have made corrections in their tests to account for the ability of

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[§] *Note:* these recommendations do not include specific insights on how to design and execute energy efficiency and electric system modernization programs. However, several entities, including NASEO, have published "how to" guides on energy efficiency for state policy makers and regulators; see "Eight Approaches to Enable Greater Energy Efficiency: A Guide for State Government Officials" by the National Council on Electricity Policy, a joint venture between NASEO, the National Association of Regulatory Utility Commissioners, the National Association of Clean Air Agencies, the National Governors Association, and the National Conference of State Legislatures.

energy efficiency to reduce vulnerability to future energy price volatility and for avoided emissions, among other variables.[**]

These types of policy innovations, when buttressed by utility and regulator engagement, can result in more productive and less punitive cost recovery frameworks that better enable ratepayer investment in deeper levels of energy efficiency and other distributed resource deployment. They also offer an important springboard for grid modernization efforts because of the value they place on maintaining utility and ratepayer investment in end-use energy efficiency. Through the national laboratories, DOE's Grid Services and Technologies Valuation Framework is working with regulatory and planning partners to develop a methodology for evaluating the collection of value streams provided by grid-related technologies and services. As more attention is paid to the nuances of energy efficiency's value from a grid and economic perspective, this framework may offer a promising option for policy makers, regulators, and utility program administrators to consider as they advance grid innovations at the state level, and may eventually support more consistent, less varied, and wider-scale adoption of end-use efficiency and other distributed energy resources.[47]

Recommendation 2 –Animate non-ratepayer investment in energy efficiency.

In addition to engaging the electric utility sector, policy makers can also help coordinate and expand non-ratepayer investment. Several successful initiatives and programs have provided platforms for productive state and federal collaboration, and warrant continued focus and growth because of their ability to move private actors in the market. These include adoption of building energy codes and improvements in code compliance and enforcement; cultivation of "lead by example" and "challenge" programs demonstrating the viability of high-performance, grid-connected, and zero-net-energy buildings; continued support of whole-building energy data and benchmarking programs; participation in voluntary, market-driven partnerships such as ENERGY STAR; and workforce training to support quality installation of energy efficiency projects by contractors and technical professionals. Importantly, SEP provides important resources enabling states to participate in these signature policy innovation programs and to improve coordination with their federal agency leads such as DOE and the U.S. Department of Housing and Urban Development.

Innovative financing offers another area of opportunity for greater and better-coordinated investment. Even with limited public dollars, local, state, and federal governments can leverage private funds, match investment-worthy energy projects to available sources of capital and lending, and synthesize financial performance data to increase private lenders' familiarity and comfort with energy efficiency underwriting and financing over time. For instance, the Nebraska Energy Office has attracted approximately $200 million of private investment from local banks and credit unions for energy efficiency projects through the Dollar and Energy Savings Loan program. Similarly, the Texas State Energy Conservation Office has used innovative financing through the LoanSTAR program to fund much-needed maintenance and energy upgrade projects for public buildings in the state, and has used its energy financing expertise to support the growth of commercial PACE financing across the state.

Due in part to joint NASEO-DOE efforts[48] to help states establish and enable innovative energy financing programs (using funds such as SEP, locally-oriented, Energy Efficiency and Conservation Block Grants,

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[**] ACEEE has done a helpful analysis on the various adjustments states have used: www,aceee.org/files/proceedings/2014/data/papers/8-1084.pdf.

and other sources of state, local, and private capital), the resources and skills needed for effective financing partnerships can be found in many State Energy Offices as well as in state and local green banks, through expert personnel who can act as trusted connectors between energy project developers, capital providers, and other backers such as bond authorities and institutional investors. This opportunity highlights the need for increased coordination among federal agencies, State Energy Offices, and private and public financial institutions in order to create higher leverage ratios and support wider-scale deployment.

Recommendation 3 – Connect innovation with deployment.

Realizing the grid of the future will require greater penetration of energy efficiency and distributed energy resources, as well as continued technological innovation. While the national laboratories have been the centerpiece of federal energy technology innovation efforts, there is a greater need to connect the broader U.S. energy innovation system, which incorporates not only the labs, but also large corporations, small and start-up business, research institutions, incubators, and innovative market deployment programs and channels.

State Energy Offices, and other state-level agencies and innovation centers, can help meet this need. Because energy innovation and commercialization do not end at demonstration, many State Energy Offices work to assess the energy savings potential and market feasibility of emerging technologies using deployment-oriented programs such as SEP. To do so, they identify strategies to integrate them into state and local "lead by example" energy programs and initiatives, work to create policy environments to enable new technologies to thrive, and participate in strategic partnerships to help businesses expand.[††]

Diverse examples help demonstrate the important connective role that State Energy Offices can play in energy technology commercialization and technology-based economy development. The Texas State Energy Conservation Office runs a Clean Energy Incubator Emerging Technology Program, which supports incubators and incubator corridors in the state. Since the inception of this program, the energy office has helped raised nearly $3 million in capital for innovative energy technology in the state, with nearly $6.5 million in direct and indirect economic impact.[49] In California over the past few decades, some of the states' innovative and most widely-recognized energy policies, standards, and programs have their roots in the California Energy Commission's Emerging Technologies Program, which has fostered innovative demand response, advancing lighting, zero-energy building, and other types of technologies.[50]

CONCLUSION

In the U.S. electric system of the future, end-use efficiency is appropriately valued, integrated with diverse and distributed energy resources, and a key factor in ensuring electric system reliability, resilience, and affordability in a cost-effective manner. Well-designed electricity policy can help advance this vision of the future for energy efficiency because of its ability to promote innovative regulatory practices, attract private sector buy-in and investment, and increase levels of consumer education, involvement, participation, and equity in energy efficiency programs. Accomplishing this vision will require a holistic consideration of the costs and value of energy efficiency as well as deeper and wider stakeholder involvement than conventional regulatory decision processes have achieved.

[††] NASEO tracks State Energy Office programs in clean tech commercialization at http://naseo.org/technology-transitions, and has produced a white paper on states' roles in technology transitions, also available on that page.

As DOE and its federal partners implement QER 1.2 and continue to support a modernized grid, partnerships with State Energy Offices offer a powerful mechanism by which to convene stakeholders and understand energy issues from complex policy, regulatory, and market-based perspectives.

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