WATER UTILITY PUMP EFFICIENCY ENERGY SAVINGS SUCCESS STORY

American Water

Much of American Water's energy efficiency work concentrates on improving pump efficiencies through refurbishment and/or replacement. A total of 52 pump refurbishments/replacements were completed from 2011-2013, at a cost of approximately $6 million, and provided an estimated energy reduction of 8 million kWh/year.

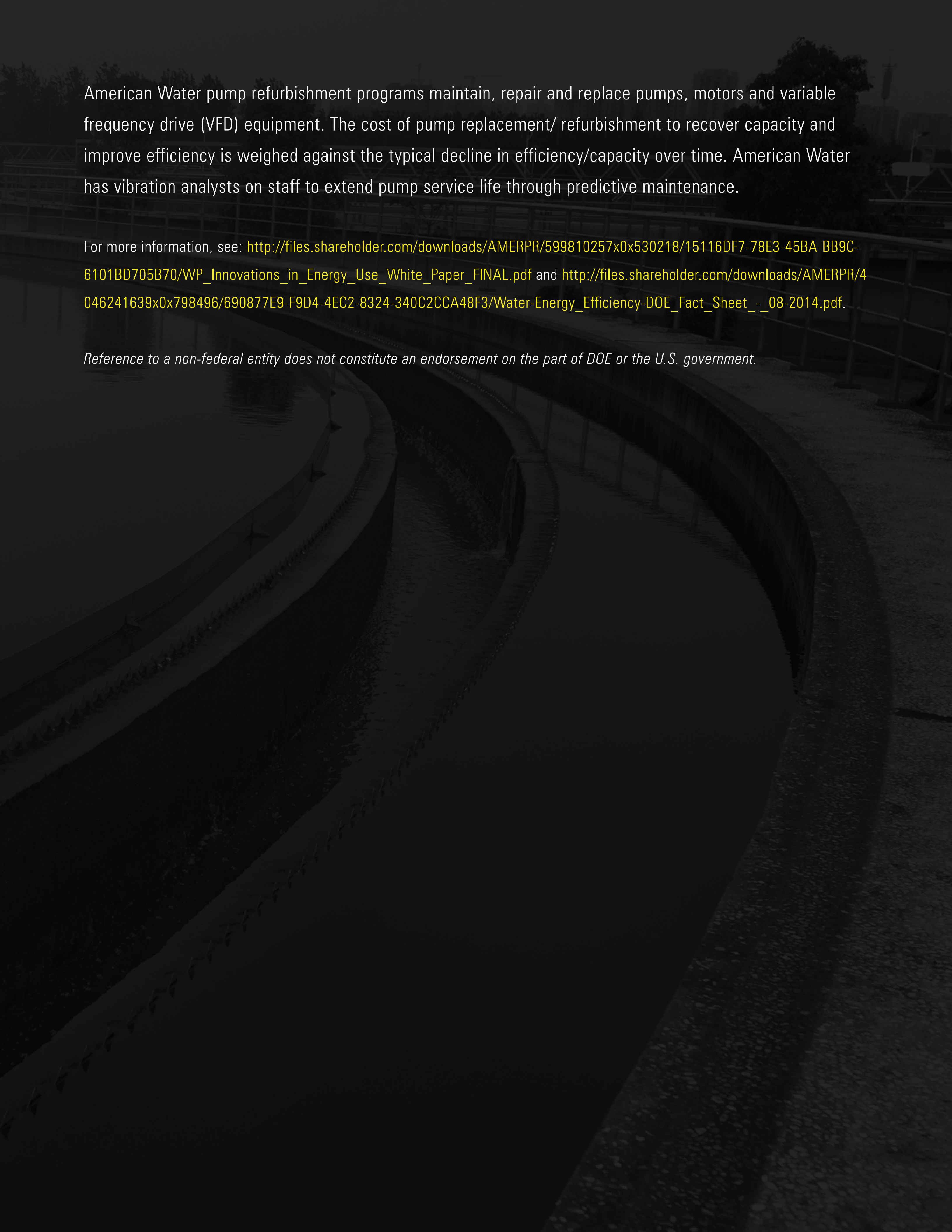
American Water manages its energy program using an Energy Usage Index (EUI) metric derived by dividing total power usage in megawatt-hours (MWh) by the volume of water sold in million gallons (MG) during a discrete period of time. The current baseline for this metric is 2.89 based on 2011-2013 operating data. The EUI data is collected and monitored to serve as a barometer for the condition of the pump fleet. Specifically, as pumps age, they wear and become less hydraulically efficient, which translates to more power required to deliver the same volume of water. American Water's pumping inventory is comprised of about 7,500 centrifugal pumping units. Of this, it is estimated that about 20 percent of the largest pumps consume 80 percent of American Water's total power usage.

American Water also conducts wire-to-water efficiency testing to monitor the efficiency of pumps and motors. We deliver over a billion gallons of water each day, so even a small increase in efficiency can yield energy savings. Research has shown that the average "wire-to-water" efficiency of existing "in-field" water utility pumps is about 60 percent. New installations are designed to achieve efficiencies of between 76 percent and 82 percent. American Water sees this as a major opportunity to decrease its carbon footprint. By replacing or refurbishing older pumps, studies have shown that pump efficiencies can be restored to their original efficiencies of 76-82 percent. This efficiency gain may yield energy savings of 10-20 percent at facilities that have completed pump improvements.

American Water pump refurbishment programs maintain, repair and replace pumps, motors and variable frequency drive (VFD) equipment. The cost of pump replacement/ refurbishment to recover capacity and improve efficiency is weighed against the typical decline in efficiency/capacity over time. American Water has vibration analysts on staff to extend pump service life through predictive maintenance.

For more information, see: http://files.shareholder.com/downloads/AMERPR/599810257x0x530218/15116DF7-78E3-45BA-BB9C-6101BD705B70/WP_Innovations_in_Energy_Use_White_Paper_FINAL.pdf and http://files.shareholder.com/downloads/AMERPR/4046241639x0x798496/690877E9-F9D4-4EC2-8324-340C2CCA48F3/Water-Energy_Efficiency-DOE_Fact_Sheet_-_08-2014.pdf.

Reference to a non-federal entity does not constitute an endorsement on the part of DOE or the U.S. government.



2.5 Higher Education Institutions

Increasing energy productivity across all sectors requires a suitably prepared workforce. And, cross-disciplinary coursework is needed to support the needs of emerging areas of energy productivity, such as the Smart Grid, advanced manufacturing, and building energy systems. Strategies in this section were developed using feedback from the regional dialogues, the roundtable discussions, and goal endorsers.Actions taken by higher education institutions contribute to four energy productivity wedges:

Smart Energy Systems
Technologies for Buildings Energy Productivity
Smart Manufacturing
Transportation

2.5.1 WORKFORCE TRAINING

Additional energy productivity gains can come from efficiently operating and maintaining buildings. Building operators can realize annual energy bill savings of 5-20 percent by implementing operations and maintenance (O&M) best practices, including operating equipment only when needed, performing preventative O&M, and tracking performance.[143]

The Building Operator Certification (BOC®) is a training and certification program that provides building operators with the skills and knowledge to implement the types of O&M best practices that can help maximize the efficiency of existing and future buildings. BOC certification is offered by several Regional Energy Efficiency Organizations as well as community and technical colleges in the Northeast, Mid-Atlantic, Southeast, and the West.[144] Annual energy and utility bill savings specific to companies with BOC-certified operators are estimated to be 170,000 kWh per year and $12,000 per year, respectively, which is enough electricity to power nearly 100 refrigerators for a year.[145]

143 "Operations and maintenance reports," Energy Star, accessed July 2015, https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/comprehensive-approach/operations-and; Portland Energy Conservation, Inc., *Fifteen O&M Best Practices for Energy Efficient Buildings* (Washington, D.C.: U.S. Department of Energy and U.S. Environmental Protection Agency, 1999), accessed July 2015, https://www.energystar.gov/sites/default/files/buildings/tools/Fifteen%20O%26M%20Best%20Practices.pdf.

144 "Training Locations & Schedules," Building Operator Certification, last updated August 11, 2015, http://www.theboc.info/h-training-locations.html.

145 "Value & Benefits of BOC," Building Operator Certification, last updated August 24, 2010, http://www.theboc.info/w-value-benefits.html.

While higher education can lead to certain careers that will help accelerate energy productivity, many job opportunities exist in the energy and advanced manufacturing fields that do not require four-year degrees. Technical and community colleges can provide the skills and knowledge for the next generation of energy and manufacturing industry employees. Mississippi's Get on the Grid[146] and Ohio's Advanced Manufacturing Industry Partnership[147] are examples of the types of workforce training programs that can be leveraged to increase energy productivity.

The workforce of an advanced energy economy needs to not only have the skills to operate today's technologies but needs to have the skills and support to make further innovations. Partnerships with industry and businesses, such as the DOE's Building University Innovators and Leadership Development (BUILD) program, can further help support educating and training future innovators in energy productivity.

2.5.2 ACCELERATING ENERGY PRODUCTIVITY FROM THE LAB TO THE REAL WORLD

Colleges and universities are instrumental partners for carrying out federally funded R&D. While the growth of federal R&D funding has largely stagnated since 2004, universities are contributing a larger share of funding and they were responsible for over $12 billion (FY 2014 dollars) of the $64 billion (FY 2014 dollars) total university science and engineering R&D funding in 2012.[148]

Universities can play an important role in transferring innovative technologies to businesses. Universities offer unique opportunities to act as real world testbeds for technologies and practices that increase energy productivity. For instance, the Future Renewable Electric Energy Delivery and Management (FREEDM) System Center, directed by North Carolina State University, supports fundamental research for breakthrough energy storage and power semiconductor technologies as well as partnerships with businesses to facilitate the transition of research into commercially viable products.[149] Several technologies developed by FREEDM have received commercial licenses.[150]

146 "Get on the Grid," Mississippi Energy Institute, accessed July 2015, http://www.getonthegridms.com/.

147 "Advanced Manufacturing Industry Partnership," Partners for a Competitive Workforce, accessed July 2015, http://www.competitiveworkforce.com/Advanced-Manufacturing.html.

148 "R&D at Colleges and Universities,"American Association for the Advancement of Science, last updated August 14, 2015, http://www.aaas.org/page/rd-colleges-and-universities.

149 "About: Center Goals," NSF FREEDM Systems Center, North Carolina State University, accessed July 2015, http://www.freedm.ncsu.edu/index.php?s=1&p=7.

150 NSF FREEDM Systems Center, "FREEDM Marks Progress in Innovation, Economic Impact," news release, undated, http://www.freedm.ncsu.edu/index.php?s=2&t=news&p=184.

HIGHER EDUCATION INSTITUTIONS SUCCESS STORY

North Carolina State University Creates Electricity at Renovated Utility Plant

When North Carolina State University (NC State) faced the challenge of deferred maintenance on equipment in its central utility plants with no available capital funding, university leadership used a $61 million energy performance contract to finance the addition of modern CHP technology. The new CHP facility enables NC State to generate some of its own electricity, and the money the university saves in avoided utility-provided energy costs pays back the loan that financed the CHP technology and boiler replacements.

Founded in 1887, NC State University has a campus community of more than 40,000 students, faculty, and staff in Raleigh. With an annual utility budget of approximately $32 million, the university provides electricity, steam, chilled water, and domestic water to more than 15 million square feet of campus building space.

As do many higher education institutions, NC State faces the challenge of funding vital maintenance on aging buildings and infrastructure, such as utility systems. As several crucial campus boilers exceeded the end of useful life, the university had no capital funding available for the replacement of this equipment. The university also faced challenges related to air quality compliance, as the old boilers relied on #6 fuel oil. NC State needed funding for new, cleaner-burning natural gas boilers and related equipment.

The university turned to an energy performance contract-funding model to finance replacement of critical boilers. A performance contract allows an owner to pay for a renovation through the energy savings generated by efficiency improvements. Using a performance contract, NC State was able to incorporate CHP technology on campus. The $61 million performance contract, financed over 17 years, also allowed the addition of two natural gas fired 5.5-MW combustion gas turbine generators and two 50,000-pound-per-hour heat recovery steam generators to the existing Cates Utility Plant in 2012. The contract also financed replacement of aging boilers, utility interconnects, and auxiliary equipment at the nearby Yarbrough Steam Plant. CHP allows NC State to create its own electricity and converts “waste heat,” which would be unused in traditional power plants, into energy. By using this campus-generated energy, NC State buys less energy from local utility companies.

In addition to more reliable steam production and better air quality compliance, the CHP facility reduced energy use and carbon emissions while expanding the university's resiliency and capacity for future growth. In the CHP plant's first two years, more than $10 million of energy costs were avoided and emissions associated with utility production on the university's central and north campuses dropped 24 percent. Educational benefits also resulted. Many NC State engineering students tour the facility to see CHP technology in action. The savings associated with the project have prompted the university to consider adding more CHP capacity at its nearby Centennial Campus utility plant.

An animation of CHP technology on campus is available at sustainability.ncsu.edu/chp/NCSU Case Study.

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2.6 Households

Households account for a large portion of U.S. energy use, and household purchases of goods and services drive much of the U.S. economy. Residential buildings and personal transportation together represented roughly 40 percent of primary energy use in 2014.[151] Household energy use is even more significant when the energy required to produce consumer goods and services, so called "embodied energy," is considered. Also, household expenditures constitute a large portion of overall economic activity.

The concept of household energy productivity may not be as intuitive as it is for a business, but the fundamental aspects are the same. Households can choose to purchase goods and services that allow more productive use of energy in providing services such as transportation, indoor comfort and illumination, and entertainment. However, these purchasing decisions can be clouded by market failures such as incomplete information and split incentives whose remedies may require government policies. Strategies in this section were developed using feedback from the regional dialogues, the roundtable discussions, and goal endorsers. Actions taken by households contribute to two energy productivity wedges:

Technologies for Buildings Energy Productivity
Transportation

2.6.1 ENERGY PRODUCTIVITY AT HOME

Households can reap energy productivity benefits by participating in the *Roadmap* strategies identified for government and businesses. The goal of many of these strategies is to enable households to choose the most energy-efficient products, which translates into savings on energy bills. Purchasing more energy-efficient appliances, in addition to taking other energy efficiency measures such as installing insulation, could reduce household electricity and natural gas use by 34 percent and 35 percent respectively and could result in utility bill savings of $83 billion (in 2007 dollars) by 2030.[152]

151 The sum of residential buildings, light-duty vehicles, bus transportation, passenger rail, and air primary energy use is from U.S. Energy Information Administration, *Annual Energy Outlook 2015 with Projections to 2040* (Washington, D.C.: U.S. Energy Information Administration, 2015), accessed July 2015, http://www.eia.gov/forecasts/aeo/.

152 America's Energy Future Energy Efficiency Technologies Subcommittee, National Academy of Sciences, National Academy of Engineering, and National Research Council, *Real Prospects for Energy Efficiency in the United States* (Washington, D.C.: National Academies Press, 2010).

Many strategies aim to improve the amount and quality of energy information available to households in order to allow consumers to make better-informed decisions on the use of energy in their home and to encourage early adoption of more energy-efficient products. Information-based strategies have been found to reduce electricity use by 7 percent.[153] The federal government provides a suite of websites that address the many facets of household energy efficiency, including homes (http://www.energysaver/.gov) and transportation (www.fueleconomy.gov). Utilities and companies are offering households greater visibility into home energy use. For example, they are providing homeowners and others the option to compare energy use with that of that their neighbors and similar houses.[154] A collaboration of the University of Florida and the International Carbon Bank and Exchange took energy data visibility a step further and created an online platform where anyone can view electricity use and building characteristics of homes in Gainesville, Florida.[155] Initiatives like DOE's Green Button initiative allow households to access their electricity meter data in a standardized format.[156] Green Button also allows users to automatically connect their data to services that will evaluate opportunities to reduce their electric bills.

As many as 37 states and the District of Columbia incentivize the use of EVs.[157] The Federal government and certain states, including California, Colorado, Connecticut, Louisiana, and Maryland, offer rebates or tax credits for purchases of EVs.

153 Magali A. Delmas, Miriam Fischlein, and Omar I. Asensio, "Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012," *Energy Policy* 61 (2013): 729–739, accessed July 2015, http://dx.doi.org/10.1016/j.enpol.2013.05.109.

154 Research points to the need at some minimal frequency to provide households with reports on their energy use in order for energy savings to persist. See Hunt Allcott and Todd Rogers, "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation," *American Economic Review* 104:10 (2014): 3003–3037, accessed July 2015, http://dx.doi.org/10.1257/aer.104.10.3003.

155 "Gainesville Green: Your Home Energy Tracking System," Gainesville Green, accessed July 2015, http://www.gainesville-green.com.

156 "Helping You Find and Use Your Energy Data," Green Button Data, accessed July 2015, http://www.greenbuttondata.org/.

157 Kristy Hartman, "State Efforts Promote Hybrid and Electric Vehicles," National Conference of State Legislators, June 29, 2015, http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx.

HOUSEHOLDS SUCCESS STORY

Opower Partners with the Nation's Utilities to Drive Energy Savings through Customer Engagement and Applied Behavioral Science

For utilities around the world, keeping the lights on is no longer enough. The utility industry is now in a time of significant change, and utilities are placing technology at the center of their strategies to navigate the path to a successful future. Today's utility customer only spends about 9 minutes thinking about their energy consumption each year, so utilities are challenged to make every moment of customer contact matter.

By combining data management, analytics, and behavioral science, Opower's customer engagement platform positions utilities as energy advisors to the customers they serve. Opower's technology platform analyzes more than 300 billion meter reads to deliver its services, and created enough energy savings to power all the homes in a city of 1 million people for a year. Opower has facilitated savings over 8 terawatt-hours of electricity to date, which equates to over $1 billion saved by customers on their monthly energy bills, affecting more than 50 million households today.

EXAMPLE: OPOWER'S CUSTOMER ENGAGEMENT PLATFORM

The utility National Grid Massachusetts (National Grid MA) needed to meet a strict state energy efficiency mandate, and traditional solutions like retrofitting and appliance rebates incurred high costs with limited return on investment. Furthermore, National Grid MA wanted to elevate its levels of customer engagement and satisfaction.

Opower's software gave National Grid MA the applications it needed to transform their customer experience. Built specifically for the energy industry, Opower's customer engagement platform met National Grid MA's need by combining the efficiency of the cloud with insightful analytics, applied behavioral science, and great design.

EXAMPLE: OPOWER’S HOME ENERGY REPORT

National Grid MA deployed Opower’s Home Energy Report (HER) program, a tailored energy usage evaluation that offers personalized energy-saving tips, anonymously compares customers’ energy usage with that of neighbors with similar home size and demographics, and suggests lifestyle changes to reduce their energy consumption. HERs are proven to reduce residential consumption by 1.5-3 percent across a utility’s territory, and furthermore have shown to increase positive customer sentiment towards utilities.

Several years after deploying Opower’s energy efficiency program in Massachusetts, National Grid MA announced that customers saved over $70 million on their energy bills. Working with Opower, National Grid MA helped customers reduce their electricity usage by 300 million kilowatt hours (kWh) and gas usage by 18 million therms – the equivalent of eliminating more than 300,000 metric tons of carbon dioxide from the environment.

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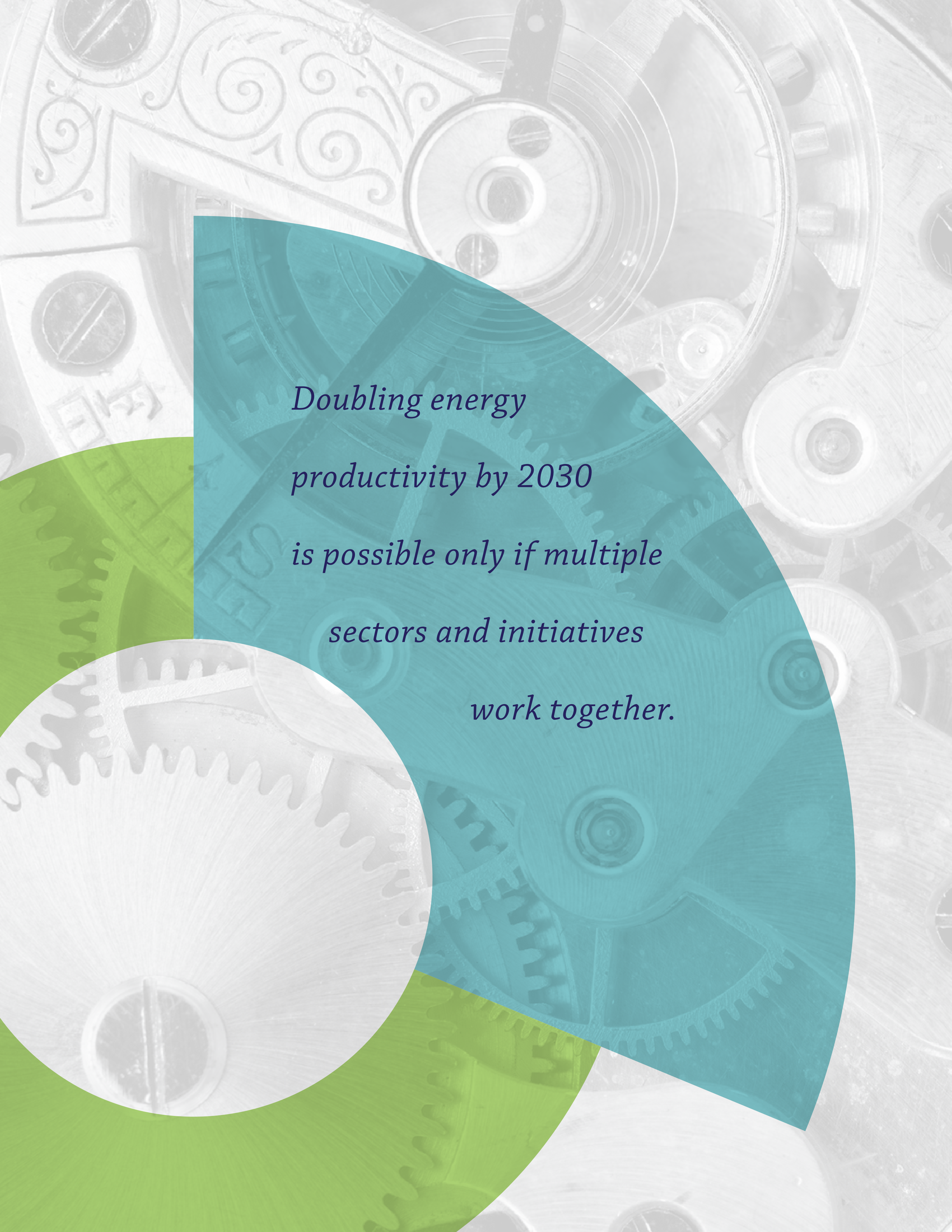


Doubling energy productivity by 2030 is possible only if multiple sectors and initiatives work together.

ANALYSIS & RESULTS

The previous section of the *Roadmap* describes a number of strategies to achieve significant improvements to U.S. energy productivity. In this section of the *Roadmap*, DOE models the impacts of six combinations of productivity improvement strategies, referred to as wedges, to identify the most effective pathway forward. Fully analyzing the effect of those wedges on energy productivity requires a model of interaction between the U.S. economy's use of energy and its GDP. Based on a review of the existing literature on energy productivity and GDP, DOE developed a modeling framework that dynamically relates changes in energy use and investment to changes in GDP.

The model improves upon previous analyses conducted by DOE because it combines robust estimates of the relationships between various sectors of the economy using historical data and because it dynamically estimates the future effects of changes to the economy using those historical relationships. More broadly, the model estimates the net effects of changes to energy use and investments on GDP, capturing any GDP feedback effects caused by energy efficiency investments. Consequently, the model is capable of directly estimating how future changes in both energy use and investments may affect energy productivity. For instance, the model can predict what level of national effort, in terms of investment and energy reduction, is required to meet the energy productivity goal.

3.1 Synthesis of Strategies into Energy Productivity Wedges

The energy productivity strategies presented in the *Roadmap* often involve multiple economic sectors and levels of government. To capture the collective potential impacts of those strategies, DOE has developed six productivity wedges. A summary description of each wedge, including associated investment and energy savings used in the analysis, is provided below. Model inputs for each wedge were developed using assumptions and results from published studies, as summarized in Table 2. The results of these studies were generated using models and assumptions that are separate from the model and analysis developed for the *Roadmap*, and do not represent impacts of specific strategies and actions identified in the *Roadmap*. The results from these studies, however, are assumed to be illustrative of the types of energy and economic changes that would be expected to result from following the *Roadmap* and are appropriate to use as inputs to the energy productivity model. The published studies are best described as prospective analyses that estimate potential energy savings (in Btu and dollars) for a particular economic sector, given a certain level of investment. However, not all sources included estimates of associated investment levels or energy savings in dollars. Where sources did not include dollar energy savings, estimates of these savings were generated using AEO 2014 fuel price projections and estimated energy savings. Note that successful implementation of energy productivity wedges are likely to affect future energy commodity prices. Where a source report did not include energy savings estimates, such as for the Smart Manufacturing wedge, assumptions from the report were used to develop energy savings estimates from AEO 2014 data.

Table 2 presents the productivity wedges and summarizes their connections to the strategies discussed earlier in the *Roadmap*. Note that there are overlaps and interactions between wedges and individual strategies that may be part of several wedges. Energy productivity wedges are entered into the model as changes in overall investment and total energy use. The model does not differentiate between the types of investments and energy savings by sector. More specifically, the model assumes that an increase in investment of $1.00 has the same effect regardless of what sector of the economy the investment occurs. Likewise, the model assumes that a 1 Btu change in energy use has the same effect regardless of the economic sector and the energy carrier. The model does report GDP impacts by three separate sectors: goods, services, and natural resources and utilities. The model does account for energy used to produce the additional goods and services that result from increased investments. This results in a net energy impact that is less than the sum of energy savings of each individual wedge.

Table 2. Summary of Model Analysis Sources and Inputs by Energy Productivity Wedge[158]

Wedge	Summary of Representative Energy Productivity Actions	Sources of Inputs	Inputs
Smart Energy Systems	Implementation of smart grid technologies in transmission and distribution systems and for consumers.	EPRI (Electric Power Research Institute). 2011. *Estimating the Costs and Benefits of the Smart Grid.* Palo Alto, CA: Electric Power Research Institute. EPRI. 2009. *The Potential to Reduce CO2 Emissions by Expanding End-Use Applications of Electricity.* Palo Alto, CA: Electric Power Research Institute.	$738 billion cumulative net cost savings to utilities and consumers; 70 Quadrillion Btu cumulative energy savings by 2030.
Technologies for Buildings Energy Productivity	High achievable potential for adoption of energy-efficient equipment.	EPRI. 2014. *U.S. Energy Efficiency Potential Through 2035*. Palo Alto, CA: Electric Power Research Institute.	5.4 Quadrillion Btu/year energy reduction by 2030; $331 billion cumulative investment costs by 2030; $409 billion cumulative cost savings by 2030.
Buildings Energy Productivity Financing	Building energy efficiency retrofits enabled by energy service agreements, property assessed clean energy, on-bill financing.	Rockefeller Foundation and DB Climate Change Advisors (2012). *United States Building Energy Efficiency Retrofits: Market Sizing and Financing Models.* Frankfurt: Deutsche Bank AG.	Cumulative investment of $279 billion with cumulative cost savings of $717 billion by 2030. 39 Quadrillion Btu cumulative energy savings by 2030.
Smart Manufacturing	ICT that enables energy efficiency in electrical equipment used in manufacturing processes and buildings. Recommendations for government (lead by example, R&D), public utilities, and ICT suppliers.	Rogers, Ethan A., R. Neal Elliott, Sameer Kwatra, Dan Trombley, and Vasanth Nadadur. 2013. *Intelligent Efficiency: Opportunities, Barriers, and Solutions.* Washington, DC: American Council for an Energy-Efficient Economy.	15 Quadrillion Btu cumulative reduction in energy use and $15 billion cost savings by 2030.
Transportation	Technical potential of energy efficiency improvements for light-duty vehicles; adoption of alternative fuel vehicles; reduction of vehicle miles traveled through trip reduction, land use change (e.g., higher densities, walkable neighborhoods), efficient driving, mode switching; and efficient technologies for freight modes.	DOE Office of Energy Efficiency and Renewable Energy, National Renewable Energy Laboratory, and Argonne National Laboratory. 2013. *Transportation Energy Futures* series. http://www.nrel.gov/analysis/transportation_futures/.	Cumulative energy reduction of 152 Quadrillion Btu and cost savings of $4,051 billion by 2030.
Water Infrastructure	Efficiency potential for pumps and other equipment in water supply and wastewater treatment utilities.	WRF (Water Research Foundation) and EPRI. 2013. *Electricity Use and Management in the Municipal Water Supply and Wastewater Utilities.* Denver, CO: Water Research Foundation, Palo Alto, CA: Electric Power Research Institute.	Cumulative energy reduction of 1 Quadrillion Btu and cost savings of $6 billion through 2030.

158 Care was taken to select a set of model inputs that would avoid double-counting investments and energy savings for each energy productivity wedge. However, it was not possible to quantify potential double-counting given the varying level of detail contained in the source reports. The buildings energy productivity technology and buildings finance wedges are the most likely to have some overlap, although this likely does not affect the conclusions drawn from results of the energy productivity analysis. The inputs for the buildings energy productivity-technology wedge were identified in the source report as part of a "high achievable" scenario, which includes barriers that limit adoption of energy efficiency measures. It is assumed that novel funding mechanisms represented by the buildings energy productivity-financing scenario overcome these barriers. As a result, the investments and energy savings are additional and not double-counted.

The published studies can be described as prospective analyses that estimate potential energy savings (in Btu and dollars) for a particular economic sector, given a certain level of investment. However, not all sources included estimates of associated investment levels or energy savings in dollars. Where sources did not include dollar energy savings, estimates of these savings were generated using AEO 2014 fuel price projections and estimated energy savings. Note that successful implementation of energy productivity wedges is likely to affect future prices of energy commodities. Where a source report did not include energy savings estimates, such as for the Smart Manufacturing wedge, assumptions from the report were used to develop energy savings estimates from AEO 2014 data.

Energy productivity wedges are entered into the model as changes in overall investment and total energy use. The model does not differentiate between the types of investments and energy savings by sector. In other words, the model assumes that an increase in investment of $1.00 has the same effect regardless of the economic sector in which the investment occurs. Likewise, the model assumes that a one-Btu change in energy use has the same effect regardless of the economic sector or the energy carrier. The model does report GDP impacts by three separate sectors: goods, services, and natural resources and utilities. The model does account for energy used to produce the additional goods and services that result from increased investments. This results in a net energy impact that is less than the sum of energy savings of each individual wedge.

- **Smart Energy Systems:** Energy systems, including those that participate in the generation and delivery of electricity, are sources and enables the backbone of improvements to U.S. energy productivity. Broad and deep transformations involving the effective integration of information and communications technologies are required to enable transitions to distributed energy resources, real-time energy pricing, smart appliances, and increased energy efficiency. The Smart Grid is estimated to produce cumulative benefits of $23.7 billion–$46.8 billion and 42 billion kWh–134 billion kWh of electricity savings by 2030.[159]
- **Technologies for Building Energy Productivity:** Improving R&D and increased focus on deployment is required to bring the next generation of energy productivity. Enabling technology and equipment for commercial and residential buildings requires both the widespread use of currently available energy-efficient technologies and practices, and the development of next generation technologies. Annual investment in the residential, commercial, and industrial sectors of $7 billion, $12 billion, and $74 million respectively are estimated to yield combined energy savings of 5.4 quads.[160]
- **Financing for Building Energy Productivity:** Significant changes to financing mechanisms are required to ensure that energy productivity-enabling technology is purchased by businesses and households. Strategies include

159 C. Gellings, *Estimating the Costs and Benefits of the Smart Grid: A Preliminary Estimate of the Investment Requirements and the Resultant Benefits of a Fully Functioning Smart Grid* (Palo Alto, CA: Electric Power Research Institute, 2011), accessed July 2015, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001022519.

160 S. Mullen-Trento, *U.S. Energy Efficiency Potential Through 2035* (Palo Alto, CA: Electric Power Research Institute, 2014), accessed July 2015, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001025477.

on-bill financing, creating secondary markets for energy efficiency loans, and tailoring financing for the unique needs of small and medium enterprises. Building retrofits enabled by new financing mechanisms are assumed to result in a 10-year cumulative investment of $279 billion and 3.0 quads of annual energy savings in 10 years.

- **Smart Manufacturing:** Sensors and other ICT will allow industries better control over their processes, as well as improved energy management of their buildings. Based on analysis by the American Council for an Energy-Efficient Economy, annual energy savings are estimated to reach 2.1 quadrillion Btu by 2030.[161]
- **Transportation:** Increasing the energy productivity of moving goods and people relies on developing and deploying new technologies that increase vehicle efficiency; increasing options for mass transit; and better integrating transportation needs with the built environment. Model inputs for this wedge are net annual energy reduction of 16 quads/year by 2030 and investments of $531B/year by 2030.
- **Water Infrastructure:** The linkages between energy and water systems provide opportunities to increase energy productivity. Specifically, water and waste water treatment plants can improve energy efficiency and demand response, implement emerging technologies and processes, and deploy energy recovery and generation technologies. Improvements made in this wedge are assumed to result in an energy reduction of 0.14 quads/year by 2030 and investments of $800M/year by 2030.

Table 3. Energy Productivity Strategies Organized by Productivity Wedge

	Smart Energy Systems	Technologies for Buildings Energy Productivity	Buildings Energy Productivity Financing	Smart Manufacturing	Transportation	Water Infrastructure
FEDERAL GOVERNMENT						
Research and Development	X	X		X	X	X
Performance Information and Product Standards	X	X			X	X
Tax Policy	X	X	X		X	X
Workforce Training	X	X			X	
Demonstration and Leading by Example	X	X	X		X	X

161 Ethan A. Rogers, R. Neal Elliott, Sameer Kwatra, Daniel Trombley, and Vasanth Nadadur, *Intelligent Efficiency: Opportunities, Barriers, and Solutions, Research Report E13J* (Washington, D.C.: American Council for an Energy-Efficient Economy, 2013), accessed July 2015, http://aceee.org/research-report/e13j.

	Smart Energy Systems	Technologies for Buildings Energy Productivity	Buildings Energy Productivity Financing	Smart Manufacturing	Transportation	Water Infrastructure
STATE GOVERNMENT						
Energy Efficiency Portfolio Standards		X	X			
Energy Productivity Financing		X	X			
Combined Heat and Power		X	X			
Smart Regional Transportation Solutions						X
Building Codes		X				
LOCAL GOVERNMENT						
Local Ordinances to Facilitate Distributed Resources, where appropriate	X	X				X
Building Energy Dis-closure Ordinances	X	X	X			
Creating Advanced Manufacturing Ecosystems		X	X		X	X
Built Environ-ment-Transportation Nexus	X	X				X
COMMERCIAL BUSINESSES						
New Financing Models		X	X	X		
Workforce Training	X	X		X	X	
INDUSTRIAL BUSINESSES						
Public-Private Partnerships	X				X	X
Energy Management Certification		X			X	
Advanced Manufac-turing					X	X
Innovative Products to Enable Energy Savings	X	X		X	X	X

	Smart Energy Systems	Technologies for Buildings Energy Productivity	Buildings Energy Productivity Financing	Smart Manufacturing	Transportation	Water Infrastructure
ELECTRIC UTILITIES						
Grid Infrastructure Productivity	X					
New Business Models	X		X		X	X
Rate Design	X	X			X	X
WATER UTILITIES						
	X			X		
HIGHER EDUCATION INSTITUTIONS						
Workforce Training	X	X			X	X
Accelerating Energy Productivity from the Lab to the Real World	X	X			X	X
HOUSEHOLDS						
Energy Productivity at Home		X				X

3.2 Overview of Energy Productivity Analysis Framework

As described in the previous section, the strategies identified in the *Roadmap* are aggregated into six illustrative energy productivity wedges. These wedges are representative of the *Roadmap* strategies and illustrate the types of economic and energy changes that could be expected following implementation of the *Roadmap*. The investments and corresponding reductions in energy use for each wedge are described in Table 2 and serve as inputs to the modeling efforts.

In the abstract, diverting spending from one use (such as consumption) to another use (such as investments in energy-efficient technology) has ambiguous effects on GDP that depends on the relative GDP multipliers of the specific type of consumption and investment. (The GDP multiplier captures the direct and indirect effects of a change in direct spending patterns on GDP.) Thus DOE built a model to better understand how changes in direct spending, such as increases in energy efficiency investment as described by the wedges, would produce indirect effects on GDP. The combination of those direct and indirect effects represent the net effects of changes to energy use and investments on GDP, capturing any GDP feedback effects caused by energy efficiency investments.

Specifically, DOE employed a vector error correction model (VECM) to estimate the effect of the wedges on U.S. GDP. This approach is commonly used by economists as a forecasting tool because of its ability to robustly estimate historical relationships between various sectors of the economy and then use those historical relationships to dynamically predict economic growth in a way that incorporates interactions and feedback effects between economic sectors. The model improves upon previous analyses conducted by DOE. The model has three component parts, each with two periods: the estimation period when historical relationships between sectors are statistically estimated (1970 to 2013), and the forecast period (2014 to 2030).

The objective of the first set of VECM equations is to dynamically estimate GDP and energy use with feedback effects. The equations capture how energy expenditures interact with consumption and investment, two major components of GDP. The primary actors in all wedges are investors, privately held businesses, and households; this set of equations models the economic relationships between those actors and energy expenditures.

The objective of the second set of VECM equations is to estimate energy prices such that energy expenditures can be converted to the quantity of energy used. Energy expenditures were estimated in the first set of equations, which consist of prices for various energy commodities multiplied by the quantities of those energy commodities consumed. The second set of VECM equations captures feedback effects between prices, quantities and other macroeconomic variables including consumption, investment, and total energy expenditures.

The objective of the third set of VECM equations is to estimate the changes in activity for each modeled sector of the economy. The model decomposes GDP into three component sectors: goods, services, and natural resources combined with utilities. These sectors were chosen because they correspond well with the structure of the model, which focuses on GDP and energy. The goods sector contains agriculture, manufacturing, and construction. The natural resources and utilities sector contains mining and other extractive industries as well as utilities. The services sector contains all other industries, including sales, warehousing, transportation, information business services, leisure services, and other services. These equations rely on the variables estimated in the first two sets of equations, as well as other variables such as the size of the labor force, net exports, and industrial production.

Data for the model is drawn primarily from the Energy Information Administration (EIA) with sector-specific data pulled from the Bureau of Economic Analysis (BEA) and the World KLEMS Initiative.[162] Specifically, the VECM model relies on historical data between 1970 and 2013 and forecasts from 2014 to 2030, which is developed in EIA's AEO 2014. The model's baseline does not precisely match that of AEO 2014 because of different model structure and assumptions, although the two baselines are similar. Data that relate economic growth to the use of economic inputs are provided by the Bureau of Economic Analysis (BEA) and the World KLEMS Initiative. These data are widely used in productivity analysis to estimate how changes in the use of economic inputs affect changes in economic output.

Energy productivity wedges are entered into the model as increases in overall investment and reductions in total energy use. The model does not differentiate by sector between the types of investments and energy savings by sector. More specifically, an increase in investment of $1.00 is the same regardless of what sector of the economy the investment occurs. Likewise, the model assumes that a 1 Btu change in energy use is the same regardless of the economic sector and the energy consumer.

This modeling technique is not without limitations. Perhaps the most significant hurdle to successful implementation of the model is the large amount of historical detail required for each sector modeled. As the number of sectors increases, longer time series are necessary to find statistically significant relationships between industries. Other techniques that are often used for similar forecasting exercises, such as input-output (I-O) and computable general equilibrium (CGE) models, often have even more sector-level detail, yet rely on theoretical interactions between sectors rather than observed historical relationships. In addition, I-O models are described as static because they assume that prices, technology, and productivity remain unchanged over time. And although relative prices can change in a CGE model, CGE model results are dependent on what the modeler specifies, instead of historical relationships, with respect to the sensitivity of changes in energy consumption by each industry or households are to prices. Thus, the VECM model was attractive because it is a dynamic model that relies on historical data to identify relationships between sectors.

3.3 Energy Productivity Potential

Given the scenario outlined above for all six productivity wedges, the model shows that doubling energy productivity by 2030 is possible but only if multiple sectors and initiatives concurrently work together. By 2030, model results show that

162 KLEMS is an acronym for the five components of intermediate inputs used by industries: capital (K), labor (L), energy (E), materials (M), and services (S). These data are widely used in productivity analysis to estimate how changes in the use of economic inputs affect changes in economic output. See, for example: Douglas Koszerek, Karel Havik, Kieran McMorrow, Werner Röger, and FrankSchönborn, *An Overview of the EU KLEMS Growth and Productivity Accounts* (Brussels: European Commission Economic and Financial Affairs, 2007), accessed July 2015, http://ec.europa.eu/economy_finance/publications/publication9467_en.pdf and Era Dabla-Norris, Si Guo, Vikram Haksar, Minsuk Kim, Kalpana Kochhar, Kevin Wiseman, and Aleksandra Zdzienicka, *The New Normal: A Sector-Level Perspective on Productivity Trends in Advanced Economies* (Washington, D.C.: International Monetary Fund, 2015), accessed July 2015, http://www.imf.org/external/pubs/ft/sdn/2015/sdn1503.pdf.

GDP (2005$) increases to $22.5 trillion and primary energy use falls to 78 quads. In comparison, the Energy Information Administration's (EIA) *Annual Energy Outlook* (AEO) 2015 projections are $21.7 trillion and 103 quads Btu in 2030. Thus, in 2030, the Roadmap scenario achieves 3.6 percent higher GDP and 24 percent lower primary energy use than AEO 2015 projections. These results are equivalent to increasing energy productivity in 2030 to $287/MMBtu, which is more than double the modeled 2010 baseline of $134/MMBtu, as shown in Figure 7. From 2014 to 2030, energy productivity increases at an annual average rate of approximately 4.2 percent. This rate of improvement is slightly greater than the rate experienced from 1981 to 1983, the period of the largest multi-year energy productivity growth experienced between 1970 and 2010. The buildings- and transportation-related productivity wedges offer the greatest potential to drive energy productivity improvements. Although these wedges alone may result in significant progress, achieving the doubling goal requires many actors working together across all sectors of the economy.

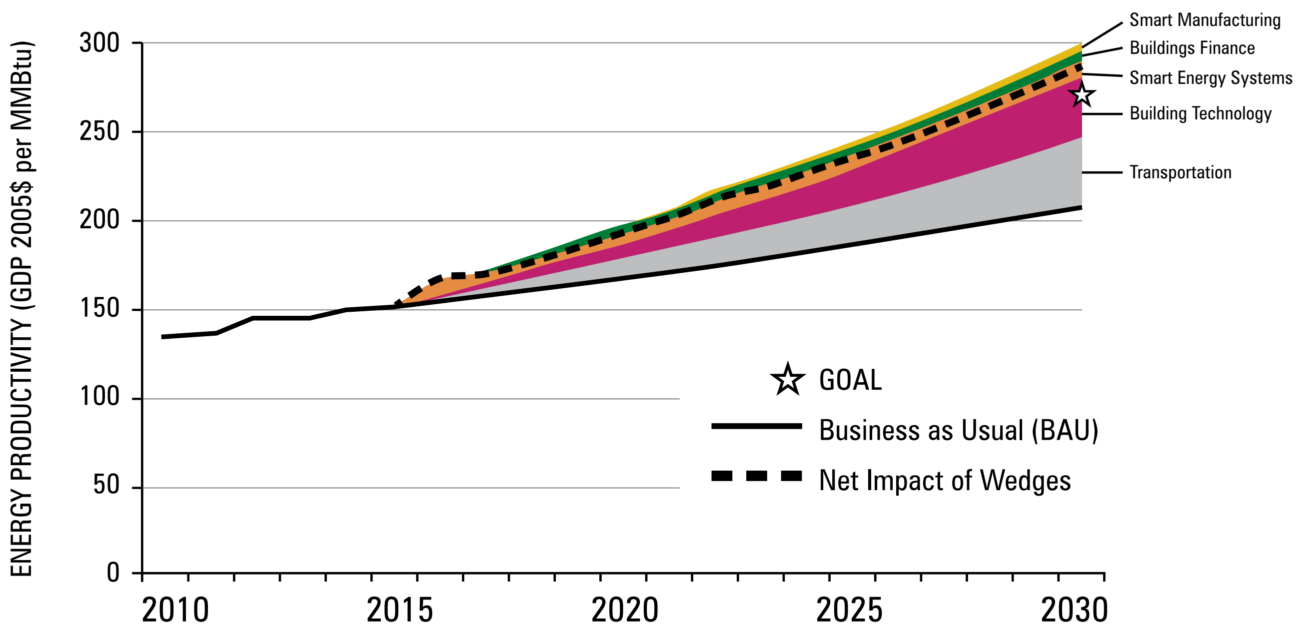


Figure 7. Projected Energy Productivity Benefits to 2030

The wedges in aggregate contribute to a net increase of $922 billion in U.S. GDP by 2030. This is primarily supported by an increase of $753 billion in household expenditures, although it is also driven by a $169 billion increase in investment.

Consumption and investment represent allocations of expenditures in an economy. These are not modeled as two different groups of consumers. One household, for example, could invest while also making personal consumption expenditures. The wedges analyzed involve changing these allocations and subsequently receiving returns on these investments in the form of savings from reduced energy expenditures. Investors are also the owners of businesses, so business investments also directly affect households. These capital expenditures must come from the population,

and subsequent returns then accrue back to these investors. Put more simply, households are able to increase their purchases of other goods and services by making energy productivity investments that reduce their energy bills.
By 2030, there is a 26-quad gross reduction in energy consumption compared to the baseline. Over the period of the analysis, the net total reduction is 23.7 quads. The model does account for energy used to produce the additional goods and services purchased by households. This results in net energy savings values that are approximately 14 percent smaller than the 26-quad gross reduction specified in the model inputs for each productivity wedge. The effect is shown in Figure 7 as the dashed line.

Producers of goods and services are also shown to benefit from increased economic activity spurred by energy productivity investments. As shown in Figure 8, the service industry exhibits the most significant growth, with a nearly $1.08 trillion increase in baseline by 2030. By 2030, goods-providing industries increase by approximately $51 billion over the model baseline. Declines in economic activity in the natural resources and utilities are due to decreases in energy expenditures and demand for production from utilities and their supply chain. By 2030, this decrease is $248 billion, or -1.6 percent of GDP, below baseline. Because the analysis focuses on investment and energy spending, these results do not capture other benefits that are likely to accrue to the natural resources and utilities sector, such as reduced economic losses from power outages (discussed in Section 2.3.1.)

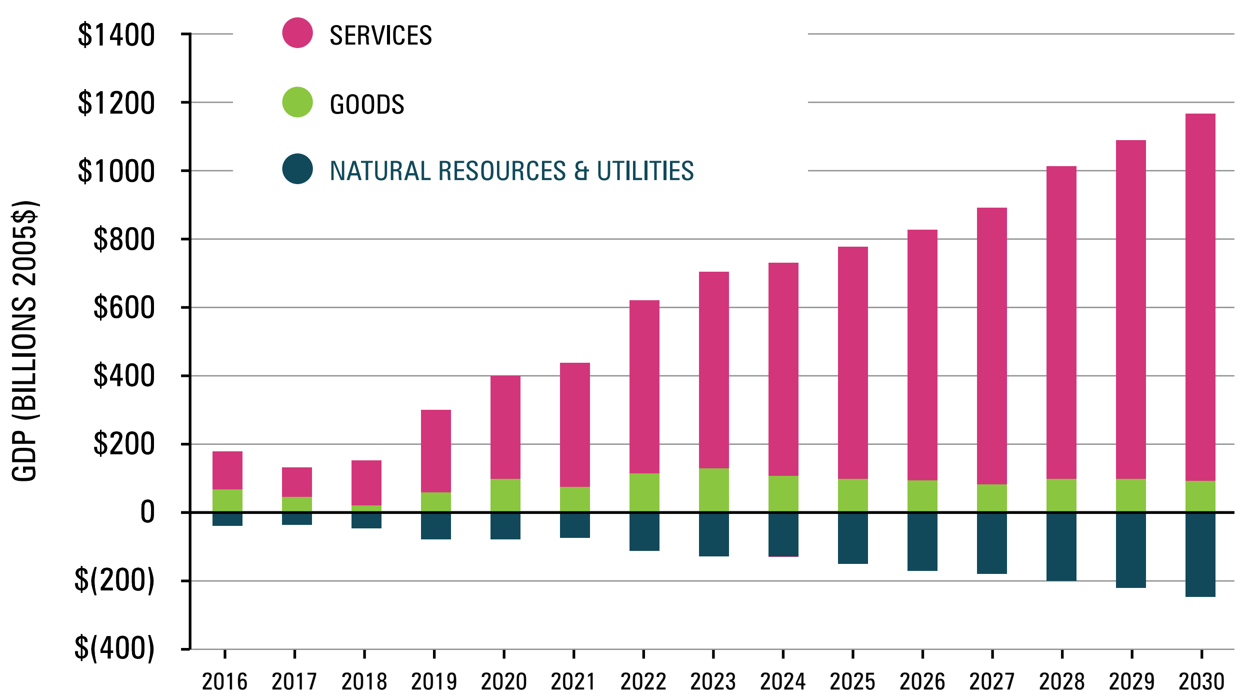


Figure 8. Projected Changes to GDP by Sector (Billions 2005$)

Implementation will require changes in behavior, investment, and deployment of technologies.

NEXT STEPS & CONCLUSION

The federal government has taken significant actions that will improve energy productivity, but these steps require private-sector participation and they will only get the United States roughly halfway to the goal. To achieve the other half of the national goal, decision makers across the United States also need to take action. Participants at the regional dialogues discussed a wide range of opportunities for diverse stakeholders to improve their own energy productivity and contribute to meeting the national goal. The *Roadmap* provides an overview of the types of strategies and actions that need to be taken by businesses, the government, and other actors in the U.S. economy to increase energy productivity and fully meet the goal.

GOVERNMENT

- **Federal Government:** Invest in long-term energy productivity through research, development, and demonstration in transportation, buildings, and manufacturing technologies; secure energy productivity through setting and updating vehicle and product codes and standards, and providing energy performance information to consumers; support policy action by state and local governments and the private sector through the provision of tools and other resources to reap the benefits of energy efficiency; set the financial foundation for energy productivity through tax policies; help train a workforce geared for energy productivity; and lead by example in adopting new technologies and strategies in its own operations.
- **State Government:** Pursue policies to encourage greater energy efficiency; promote new and innovative financing for investments that support energy productivity; support and incentivize increased deployment of combined heat and power (CHP); implement smart regional transportation solutions; and adopt and enforce increasingly efficient building codes.
- **State Regulators:** Adopt rates and implement related policies affecting utility sector efficiency programs that more effectively align efficiency efforts with utility business models; and support energy productivity investments in buildings and infrastructure.

- **Local Government:** Facilitate distributed generation; establish good practices for building energy information; support the development of advanced manufacturing ecosystems; and reduce personal vehicle miles traveled through the built environment-transportation nexus.
- **National Laboratories:** Serve as incubators for new energy productivity technologies—and where appropriate, enable new, energy-efficient technologies to move rapidly from the lab to the marketplace.

BUSINESSES

- **Commercial Businesses:** Reduce energy consumption in their own buildings and facilities through energy efficiency; reinvest the resulting avoided energy costs into growing their businesses; adopt new financing models that promote energy productivity investments; encourage their suppliers and vendors to take measures to improve energy productivity; and assist in training a workforce geared for energy productivity.
- **Industrial Businesses:** In addition to taking similar steps as commercial entities, leverage public-private partnerships; adopt energy management systems; transition to advanced manufacturing technologies; and explore new, innovative products that enable energy productivity for customers and suppliers.

UTILITIES AND LARGE CONSUMERS

- **Electric Utilities:** Modernize the grid infrastructure through smart grid investments and improving the efficiency and interoperability of generation, transmission, storage, and distribution; adopt new utility business models to empower the improvement of energy productivity; design rates and support related policies for utility energy efficiency programs that more effectively align energy efficiency with utility business models; and support energy productivity investments in buildings.
- **Water Utilities:** Adopt more energy-efficient and energy-extracting technologies at water and wastewater treatment facilities and more water-efficient technologies in distribution and end use water systems (e.g., wastewater treatment plants can implement more efficient pumps and deploy onsite waste to energy conversion, such as digesters and combined heat and power; end use hot water conservation measures also have a direct impact on energy consumption).

HIGHER EDUCATION INSTITUTIONS, AND INDIVIDUALS AND HOUSEHOLDS

- **Higher Education Institutions:** Create new curricula and expand workforce training opportunities across multiple disciplines (e.g., building trades, engineering, governmental policy, economics, and legal) for careers in the clean energy, energy efficiency, and advanced manufacturing fields; and act as demonstration and commercialization "accelerators," enabling new energy-productive technologies to move rapidly from the lab to the marketplace. In addition, higher education institutions can invest in making their facilities and fleets more efficient.
- **Individuals and Households:** Support the markets associated with energy-efficient products in the home and for transportation, and use available resources to make informed choices.

According to both the regional dialogues and the technical analyses conducted as part of the Accelerate Energy Productivity 2030 initiative, a wide range of activities can be taken that will yield significant productivity benefits. Implementing these activities will require changes in behavior, investment, and deployment of technologies. Collectively, they can improve U.S. economic output, reduce U.S. energy consumption, and reduce the impact of energy on the environment. The fact that the government and private sector, including endorsers of the goal, are undertaking many of these activities suggests the significant challenge of doubling energy productivity can be—and is on the way to being—met. The *Roadmap* provides a foundation for scaling up these efforts nationwide while allowing for flexible and tailored solutions. Through the roundtables, three regional dialogues, innovative analysis, and this *Roadmap*, the Accelerate Energy Productivity 2030 Initiative catalyzed action to meet this important national goal.

APPENDIX 1

International Energy Productivity Efforts

Overview and Background

Note: This summary is derived from a forthcoming roundtable report from the sixth Clean Energy Ministerial.

The United States is not alone in its interest in increasing energy productivity. Energy productivity, the ratio of economic output per unit of energy use, focuses attention on how scarce energy resources can be put to their best use and how energy efficiency can lift economic growth. The last decade displayed growth in the energy productivity of both Organization for Economic Co-operation and Development (OECD) member country groups and non-member economies. According to the International Energy Agency's Energy Efficiency Market Report, 2014, energy productivity in OECD Americas grew by 22 percent between 2003 and 2013 (see Figure 9).

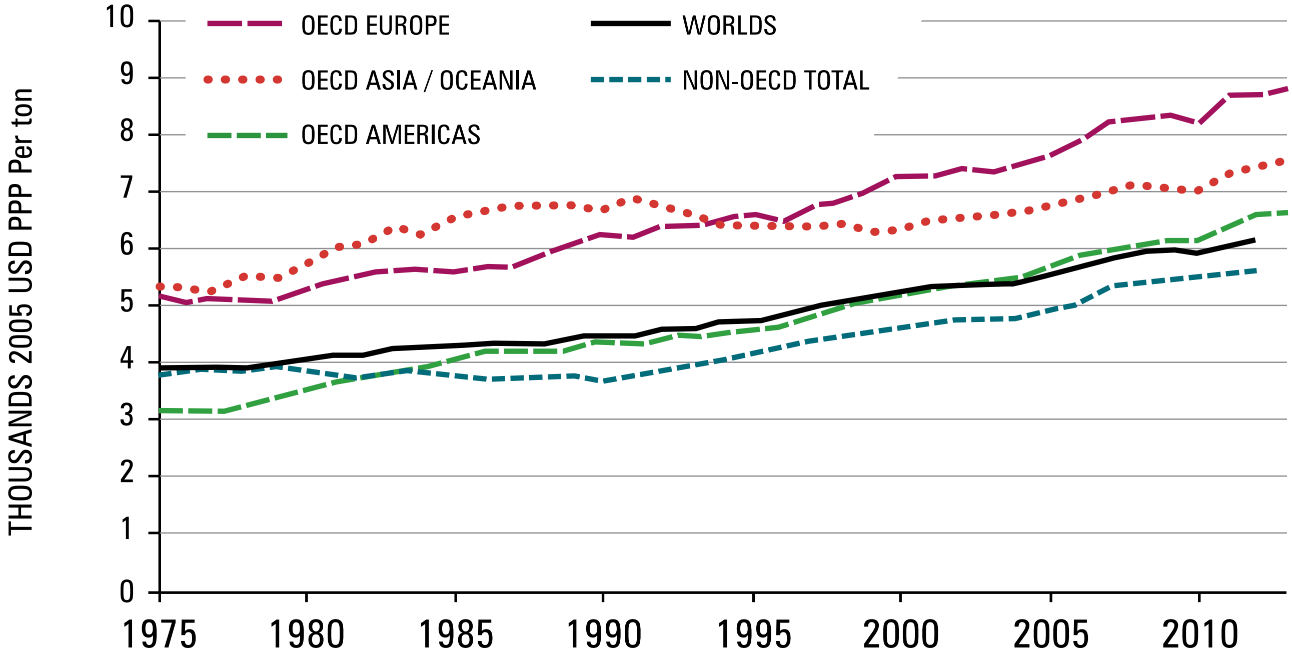


Figure 9. Increase in Energy Productivity by Region

While energy productivity is a relatively new concept compared to its inverse, energy intensity, a number of governments and international actors are embracing this framework to set or support the achievement of national and regional goals.

Australia is notable for a call in its 2015 Energy White Paper to focus on boosting the productive use of energy, which includes the development of a national energy productivity plan.[163] The Energy White Paper identifies that an achievable target for national energy productivity could be an increase of 40 percent by 2030, but even this level of improvement will require regulatory and voluntary actions across the economy. Analysis from ClimateWorks Australia supports the possibility of nearly doubling energy productivity by 2030 through a combination of improved energy supply, energy efficiency, electrification, and structural change.[164]

In addition to individual actions, countries have begun sharing best practices and discussing common barriers. The sixth meeting of the Clean Energy Ministerial (CEM), a global forum for advancing clean energy policy and technology, included a roundtable discussion on accelerating energy productivity where topics included opportunities for partnerships and the challenges of retrofitting existing energy generation and end use infrastructure.[165] According to the *2015 Energy Productivity and Economic Prosperity Index* study commissioned by Royal Philips, Europe's efforts to double energy productivity by 2030 could cut energy expenditures by one-third, improve energy security, and create 1.2 million jobs by 2020.

Achieving these benefits requires identifying and implementing policies and measures that lower energy use while growing the economy, as well as making available financing instruments to translate future savings into liquidity for investments today.

Articulating the Case for Energy Productivity

Businesses that have already adopted energy productivity practices find the business case is overwhelmingly compelling. Nonetheless, a barrier to scale is lack of awareness, necessitating the engagement and education of all stakeholders on the benefits of energy productivity.

CEM Roundtable participants highlighted examples of government and private-sector approaches that have delivered energy savings and economic benefits. In Denmark, the Central Bank concluded that a focus on energy efficiency and savings resulted in approximately 9 percent gains in wage competitiveness over the last decade. This success

163 Commonwealth of Australia, 2015 Energy White Paper (Canberra: Commonwealth of Australia, 2015), accessed July 2015, http://ewp.industry.gov.au/files/EnergyWhitePaper.pdf.

164 ClimateWorks Australia, *Australia's Energy Productivity Potential: Energy's Growing Role in Australia's Productivity and Competitiveness* (Melbourne: ClimateWorks Australia, 2015), accessed July 2015, http://climateworks.com.au/sites/default/files/documents/publications/climateworks_energy_productivity_report_20150310.pdf.

165 Clean Energy Ministerial, "A Summary of the Clean Energy Ministerial 6 (CEM6)" *CEM Bulletin* 181:12 (2015), accessed July 2015, http://www.iisd.ca/download/pdf/sd/crsvol181num12e.pdf.

is attributed to establishing predictable, long-term efficiency policies such as the National Energy Efficiency Action Plan; targeting both residential and commercial sectors simultaneously; setting standards; and sharing information on best practices. India's energy productivity is increasing by 1.6 percent annually and is being boosted through policies to align energy pricing, promote new business models and new markets, and enhance regulations for efficiency.

> *"Economic productivity is a major priority for governments across the world, especially as labor productivity slows. Energy productivity offers one of the most promising productivity solutions, with resultant benefits for competitiveness, wages, living standards and profit margins."*
>
> Dan Hamza-Goodacre
> Program Director
> ClimateWorks Foundation

Benchmarking, setting goals, and monitoring progress toward those goals were identified as best practices by businesses that have achieved significant productivity gains and energy savings. The practice of continuous improvement was also highlighted, as was working with supply chains to encourage efficiency along the value chain. The international standard for energy management, ISO 50001, provides a flexible and robust framework for businesses to "Plan–Do–Check–Act" their way to continual improvement in energy savings. In Germany, incentives such as tax rebates or exemptions from surcharges have been effective in fostering the uptake of energy management systems (more than 3,000 ISO 50001 certified systems).

Finally, the discussion highlighted the importance of setting and publicizing goals. According to a study conducted by the Johnson Controls Institute for Building Efficiency,[166] organizations that made their goals public were almost twice as likely to have made investments in energy efficiency and renewable energy in the previous year, implemented 50 percent more measures, and were roughly three times more likely to increase investments the following year.

Scaling Up Energy Productivity

A common theme that emerged around energy productivity from the CEM roundtable was the importance of partnerships between the public and private sectors—most importantly, the need to agree on common goals and a vision to motivate actions. Coordinated platforms and forums, such as the CEM, International Partnership for Energy Efficiency Cooperation,

166 Institute for Building Efficiency, *2013 Energy Efficiency Indicator Survey* (Washington, D.C.: Johnson Controls, Inc., 2013), accessed July 2015, http://www.institutebe.com/InstituteBE/media/Library/Resources/Energy%20Efficiency%20Indicator/061213-IBE-Global-Forum-Booklet_I-FINAL.pdf.

United Nations Sustainable Energy for All Energy Efficiency Accelerator Platform, and the International Energy Agency's Low-Carbon Energy Technology Platform, offer mechanisms for governments and the private sector to work together and avoid duplicating efforts.

Several specific policy areas were discussed, including regional alignment of energy efficiency test procedures, standards, and codes, as well as providing support for the development of regional testing laboratories. Participants agreed that key ingredients for effective codes and standards are awareness-raising and investment in implementation and compliance support. Participants further identified the challenge of extending successful policies to system-level solutions, recognizing the desire to avoid unintended consequences that can arise, for example, from focusing solely on component-level standards.

Participants also distinguished between policies for new versus existing facilities and products. While developing policies and standards for new facilities and products is often easier than retrofitting existing facilities, policies focused on the efficiency of industrial processes, especially new processes must be carefully designed and tested before implementation. This is especially true in the power sector, where robustness and resilience are critical. Significant opportunities exist to improve power system efficiency and resilience through system optimization and controls that enable situational awareness and integration of distributed generation and microgrids, but realizing this potential requires developing robust interoperability standards.

Unlocking finance for efficiency investments is also essential to overcoming first cost barriers. KfW, the government-owned development bank, served as a "neutral contractor," successfully accelerating energy-efficient renovations. In France, the use of fee-and-rebate programs, or "feebates," is encouraging the purchase of clean energy products, helping make France's vehicle fleet among the most efficient in the world. In the power sector, there is a need to bridge traditional finance mechanisms for conventional generation that have long-term contracts with newer technologies and business models that attract risk investors.

One outcome of the Clean Energy Ministerial roundtable discussion on accelerating energy productivity is recognition of all participants' importance in the dialogue to promulgate the "Energy Productivity Imperative" across many different policy and business platforms—regionally, in the participants' respective nations, and in partnership with other global and non-governmental organization (NGO) initiatives. The roundtable included a formal commitment to include the "Energy Productivity Imperative" as one of the 2015 "Principles of Competitiveness Strategy" that the Global Federation of Competitiveness Councils (GFCC) will present at its 6th Annual Meeting in Saudi Arabia, November 1–3, 2015. The pivotal role of CEM6 in elevating energy productivity as a core driver of economic growth and industrial competitiveness was also be highlighted at the GFCC's Innovation Summit on 21st Century Infrastructure in 2015.

Industrial energy use accounts for roughly one-third of global energy demand. While there is significant potential to decrease energy consumption in this sector, opportunities to improve energy efficiency are still underexploited.[167]

Although energy efficiency measures have frequently been demonstrated to contribute to the competitiveness of companies and to raise their productivity, energy efficiency actions and improvements are still not typically or widely viewed as a strategic investment in future profitability. A number of barriers to industrial energy efficiency exist including limited access to technical know-how and to capital, risk aversion and transaction costs.[168]

Improving energy efficiency in industrial companies provides benefits for the companies themselves as well as for the economy as a whole. Company-level benefits include improved productivity, optimized processes, and new business opportunities. In addition, energy efficiency in industry contributes to improved energy security and emission reductions.[169]

167 Institute for Industrial Productivity, Energy Management Programmes for Industry: Gaining through Saving (Paris and Washington, D.C.: International Energy Agency and Institute for Industrial Productivity, 2012), accessed July 2015, http://www.iipnetwork.org/PolicyPathway_IEAIIP.pdf.

168 Ibid

169 Ibid.

APPENDIX 2

Accelerate Energy Productivity 2030 Launch

EVENT SCHEDULE

DATE	November 6th, 2014
LOCATION	DEPARTMENT OF ENERGY 1000 Independence Ave. SW Rm. 7E - 069 Washington DC 20585

9:00 AM **SECURITY CHECK-IN AND REGISTRATION**

9:30 AM **OPENING REMARKS**

The Honorable Ernest J. Moniz, Secretary of Energy, U.S. Department of Energy
Ms. Carla Frisch, Director of End-Use Analysis, U.S. Department of Energy
The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness
Ms. Kateri Callahan, President, Alliance to Save Energy

9:45 AM **IMPACT: Driving Energy Productivity in the Private Sector**

MODERATOR **The Honorable Ernest J. Moniz,** Secretary of Energy, U.S. Department of Energy

Productivity—and the prosperity that comes from innovation—is the engine for national competitiveness. This opening conversation aims to identify, from the perspective of the private sector, real success stories in improving energy productivity—output produced (measured in $ real GDP) relative to energy used (measured in million British thermal units (MMBtu) primary energy). This roundtable discussion will explore concrete competitive opportunities the United States can gain, leverage and scale by meeting President Obama's goal to double U.S. energy productivity through an examination of best practices, including specific technologies, processes, and organizational structures "ripe" for increasing energy productivity.

- Can you point to a significant success story your organization has had in improving energy productivity, either in your own operations or for clients?

- How is your organization more competitive because of a focus on energy productivity? How do you quantify this competitive advantage?
- What roles do supply chain efficiencies play in achieving greater productivity gains, and how are you working with supply chain partners to meet your energy productivity goals?
- Looking across your organization's global business base, which nations are focused on the energy productivity challenge—and opportunity? What energy productivity strengthening lessons are you learning abroad that could be emulated in the United States?

10:30 AM **BREAK**

10:35 AM **PATHS FORWARD: Routes to Doubling U.S. Energy Productivity**

MODERATOR **The Honorable Ernest J. Moniz,** Secretary of Energy, U.S. Department of Energy

Deploying energy-efficient technologies and practices, streamlining business processes, and innovating technologies for optimized output all increase energy productivity. Building on the lessons learned in the previous session, this discussion will focus on specific strategies to meet President Obama's goal and to scale for national competitive advantage—identifying how best to propagate industry best practices across the broader economy and examining opportunities for public-private engagement.

- What would a set of industry best practices around energy productivity look like? What would be the most effective ways to share and scale these practices across the broader economy? Which stakeholders need to be involved in these efforts and what would be their roles?
- From the perspective of your organization and your own experiences, how can we articulate the best business case for the investments necessary to drive greater energy productivity?
- Does the United States need new initiatives or specific policies (federal, state, or local) to reach—and surpass—the president's energy productivity goals? If so, what would be some examples?
- Can you define, from the perspective of your organization and industry, the most promising opportunities for the private sector to partner with the Department of Energy to meet the goal to double energy productivity by 2030?

11:25 AM **REFLECTIONS AND CLOSING REMARKS**

The Honorable Ernest J. Moniz, Secretary of Energy, U.S. Department of Energy

11:30 AM

ACCELERATE ENERGY PRODUCTIVITY 2030: Where Do We Go from Here?

Ms. Kateri Callahan, President, Alliance to Save Energy

The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

PARTICIPANTS

Dr. Tilak Agerwala
Vice President, Systems, IBM

Mr. Marty Bates
President, Global Primary Products (GPP) Strategy and Transformation, Alcoa

Ms. Kateri Callahan
President, Alliance to Save Energy

Mr. Paul Camuti
SVP, Innovation and CTO, Ingersoll Rand

Mr. Richard Caperton
Director, National Policy and Partnerships, Opower

Mr. Jorge Carrasco
General Manager and CEO , Seattle City Light

Mr. Jeff Eckel
President, CEO and Chairman of the Board, Hannon Armstrong

Ms. Amy Ericson
U.S. Country President, Alstom

Mr. John Galyen
President, Danfoss North America

Mr. Christian Gianni
SVP, Product Development, Whirlpool

Ms. Judi Greenwald
Deputy Director for Climate, Environment and Energy Efficiency
Office of Energy Policy and Systems Analysis,
U.S. Department of Energy

Mr. Al Halvorsen
Senior Director, Environmental Sustainability, PepsiCo

Dr. Kathleen Hogan
Deputy Assistant Secretary for Energy Efficiency, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Ms. Melanie Kenderdine
Director, Office of Energy Policy and Systems Analysis,
U.S. Department of Energy

Mr. Jim Madej
SVP, Customer Energy Solutions, National Grid

Dr. Ernest Moniz
Secretary, U.S. Department of Energy

Mr. Blake Moret
SVP, Control Products and Solutions, Rockwell Automation

Ms. Jane Palmieri
Business President, Dow Building & Construction,
The Dow Chemical Company

Dr. John Palmour
CTO, Power & RF, Cree Inc.

Mr. Gil Quiniones
President and CEO, New York Power Authority

Mr. Ram Ramakrishnan
EVP and CTO, Eaton

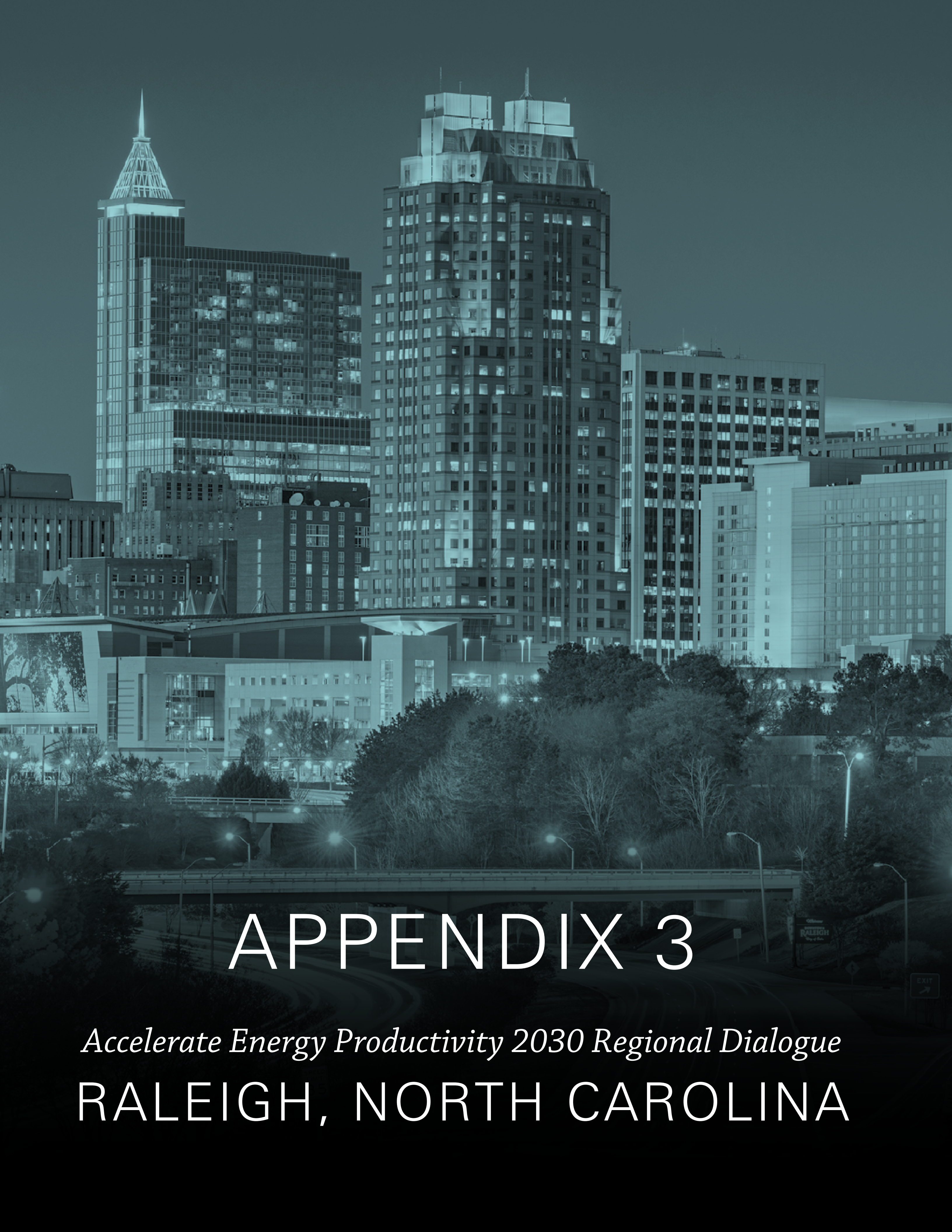
Ms. Aurelie Richard
SVP, Strategy and Business Development, Schneider Electric

Dr. Gayle Schueller
SVP, Sustainability, 3M

Mr. Kevin Self
Vice President, Strategy & Corporate Development, Johnson Controls Inc.

Dr. William Sisson
Director, Sustainability, United Technologies Corporation

The Honorable Deborah L. Wince-Smith
President and CEO, Council on Competitiveness



APPENDIX 3

Accelerate Energy Productivity 2030 Regional Dialogue

RALEIGH, NORTH CAROLINA

EVENT SCHEDULE

Day 1 - Executive Roundtable Dialogue Overview

On the first day, 30 key private and public sector leaders convened for a private roundtable discussion aimed at gleaning information regarding approaches and challenges associated with advancing energy productivity in the transportation and buildings sectors, and the nexus between the two.

NC State Chancellor and Council on Competitiveness Executive Committee Member Randy Woodson hosted the Day 1 leadership dialogue. Council on Competitiveness President & CEO Deborah L. Wince-Smith, Alliance to Save Energy President Kateri Callahan, and Jonathan Pershing, Principal Deputy Director for EPSA at DOE, led the discussion.

ACCELERATE ENERGY PRODUCTIVITY 2030:
Emerging Opportunities in the Transportation Sector and Built Environment

DATE	February 4th, 2015
LOCATION	NORTH CAROLINA STATE UNIVERSITY James B. Hunt Jr. Library 1070 Partners Way Raleigh, NC 27606
12:00 PM	**CHECK-IN AND REGISTRATION**
12:30 PM	**OPENING REMARKS** **Dr. Randy Woodson**, Chancellor, NC State **The Honorable Deborah L. Wince-Smith,** President and CEO, Council on Competitiveness **Ms. Kateri Callahan,** President, Alliance to Save Energy

12:45 PM **ROUNDTABLE INTRODUCTIONS (two-three minutes per participant)**

1:30 PM **ACCELERATE ENERGY PRODUCTIVITY 2030: Overview**

Dr. Jonathan Pershing, Principal Deputy Director, Office of Energy Policy and Systems Analysis, Deputy Assistant Secretary for Climate Change Policy and Technology, Office of International Affairs, U.S. Department of Energy

The dialogues in Raleigh focused Accelerate Energy Productivity 2030 initiative—a partnership between the U.S. Department of Energy, the Council on Competitiveness and the Alliance to Save Energy. It supports the president's goal of doubling energy productivity from 2010 levels by 2030. This dialogue will focus on the intersection of transportation and the built environment, and its relationship to energy productivity and U.S. competitiveness. Examples of forward-thinking strategies include the future of urban planning and commerce, electric vehicle infrastructure and the emergence of IT and sensors.

1:45 PM **SESSION I – TODAY'S OPPORTUNITIES: Driving energy productivity at the intersection of transportation and buildings**

MODERATOR **Dr. Randy Woodson**, Chancellor, NC State

Transportation and the built environment—our ability to transport goods, provide services and conduct our daily business in a safe and efficient manner—play a critical role in U.S. commerce and competitiveness. The roles of these two economic pillars—buildings and transportation use roughly 70 percent of the nation's energy—represent both a challenge and an opportunity in achieving exponential gains in energy productivity.

This opening conversation explored current investments that can be made across and connecting the transportation and building sectors to capture near-term energy productivity gains, including what strategies and investments have or have not worked and how various public and private-sector players can support a broader effort around energy productivity. Framing topics included:

- How energy productivity functions as a core driver of growth, an enabler of new innovation and technologies, and market opportunities for new products and processes
- How organizations manage and measure energy use similar to other aspects of their business operations, including adopting energy management systems that integrate buildings and transportation considerations
- Barriers to investments that can improve energy productivity in both sectors, and how to communicate best practices and success stories to peer firms and institutions
- Current RD&D strategies underway to develop the next generation of energy-efficient

technologies, from new modes of transportation and building materials to a "systems" approach to transportation and the built environment

- Technologies, innovations, and strategies that leaders in the transportation and building sectors can offer the broader economy.

2:45 PM **NETWORKING AND COFFEE BREAK**

3:00 PM **SESSION II – THE FUTURE: Emerging opportunities and key challenges at the intersection of transportation and buildings**

MODERATOR **The Honorable Deborah L. Wince-Smith,** President and CEO, Council on Competitiveness

This session focused on the future of the intersection between the transportation sector and the built environment—in particular the technologies and the investments that will enable game-changing opportunities around energy productivity. Each participant gave their perspective on anticipated barriers and opportunities both within their organization and facing their organization in supporting productivity across economic sectors. In particular, emerging issues at the intersection of transportation and the built environment were explored. Framing topics included:

- RD&D investments and strategies that will enable the game-changing opportunities around energy productivity on a 5-, 10-, and 15-year horizon.
- Sunk costs and current capital investments that are barriers to the adoption of more energy productivity technologies and processes, and how to address them
- Workforce, education and training issues related to emerging technologies, systems and processes that drive energy productivity in both sectors
- The role of the public and private sectors in shaping the future of the transportation-building nexus.

4:00 PM **SESSION III – The role of public policy in facilitating energy productivity at the transportation-building nexus**

MODERATOR **Dr. Jonathan Pershing,** Principal Deputy Director, Office of Energy Policy and Systems Analysis, Deputy Assistant Secretary for Climate Change Policy and Technology, Office of International Affairs, U.S. Department of Energy

Smart public policy can act as an enabler and driver of productivity, innovation, and growth. Sending clear market signals, facilitating effective public-private relationships, and creating competitiveness opportunities are all possible through robust, forward-thinking policy. This session explored the various policy approaches—from building codes and fuel economy standards to urban development and IT-enabled smart buildings—to facilitate energy productivity across the broader economy. Framing topics included:

- Local, state, and federal policies that either enable or present challenges to meeting each participant's vision of energy productivity in the future
- Structuring policies around incentives and regulations in ways that facilitate and compliment private-sector strategies and investment
- How public organizations can help communicate industry best practices and the energy productivity roadmap to peer organizations and institutions, and across the broader economy
- Success stories from participating organizations that would be transferable to government agencies—as owners of vehicle fleets and building portfolios—to drive energy productivity in the public sector.

5:00 PM

CLOSING REMARKS

Ms. Kateri Callahan, President, Alliance to Save Energy

The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

Dr. Randy Woodson, Chancellor, NC State

PARTICIPANTS

Ms. Kateri Callahan
President, Alliance to Save Energy

Ms. Judith Cone
Interim Vice Chancellor for Commercialization and Economic, Development, University of North Carolina, Chapel Hill

Mr. Chad Evans
EVP, Council on Competitiveness

Ms. Carla Frisch
Director of End-Use Analysis, U.S. Department of Energy

Mr. Justin Gore
North America Energy Manager, Saint-Gobain

Dr. John Hardin
Executive Director, Board of Science, Technology and Innovation, North Carolina Department of Commerce

Mr. Chris Hess
Director of Public Affairs, Eaton Corporation

Ms. Julie Hughes
Director of Policy, Institute for Market Transformation,
Deputy Director for Strategy and Development, City Energy Project

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Mr. Mark Lantrip
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Dr. Louis Martin-Vega
Dean, College of Engineering, NC State University

Dr. John Palmour
CTO, Power and RF, Cree Inc.

Dr. Jonathan Pershing
Principal Deputy Director, Office of Energy Policy and Systems Analysis,
Deputy Assistant Secretary for Climate Change Policy,
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Dr. Andreas A. Polycarpou
Department Head & Meinhard H. Kotzebue '14 Professor,
Texas A&M University

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Mr. Tom Wenning
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The Honorable Deborah L. Wince-Smith
President and CEO, Council on Competitiveness

Dr. Randy Woodson
Chancellor, NC State University

Mr. Paul Woolverton
Vice President, Government and Institutional Business Development,
Mohawk Industrie

Day 2 - A State and Local Dialogue Overview

ACCELERATE ENERGY PRODUCTIVITY 2030:
Emerging Opportunities in the Transportation Sector and Built Environment

DATE	February 5th, 2015
LOCATION	NORTH CAROLINA STATE UNIVERSITY James B. Hunt Jr. Library 1070 Partners Way Raleigh, NC 27606
8:30 AM	**REGISTRATION & BREAKFAST**
9:00 AM	**WELCOME & OPENING REMARKS** **Kateri Callahan**, President, Alliance to Save Energy **Deborah L. Wince-Smith**, President and CEO, Council on Competitiveness **Kathleen Hogan**, Deputy Assistant Secretary for Energy Efficiency, U.S. Department of Energy
9:20 AM	**KEYNOTE REMARKS** **Keith Trent**, EVP, Grid Solutions and President, Midwest and Florida Regions, Duke Energy
9:35 AM	**KEYNOTE REMARKS** **Dr. John Hardin**, Executive Director, Board of Science, Technology and Innovation, North Carolina Department of Commerce
9:50 AM	**DRIVING ENERGY PRODUCTIVITY: An Integrated Approach to Buildings and Transportation**
MODERATOR	**Brian Coble**, SVP, Advanced Energy Corp.
PANELISTS	**Matt Cox,** Buildings Energy Efficiency Project Manager, Office of Sustainability, City of Atlanta **Sean Flaherty**, Program Director, Envision Charlotte **Paul Camuti**, SVP of Innovation and CTO, Ingersoll Rand **Steve Kalland**, Executive Director, North Carolina Clean Energy Technology Center at North Carolina State University

10:50 AM **NETWORKING AND REFRESHMENT BREAK**

11:20 AM **DRIVING ENERGY PRODUCTIVITY: In Buildings across Communities and on Campus**

MODERATOR **Kathleen Hogan**, Deputy Assistant Secretary for Energy Efficiency, U.S. Department of Energy

PANELISTS **Billy Jackson**, Facility Manager, City of Raleigh

Claudia Powell, PEM, Energy Program Coordinator, North Carolina State University

Adam Procell, President and CEO, Lime Energy

Ed White, Chairman, Research Triangle Cleantech Cluster

12:20 PM **DRIVING ENERGY PRODUCTIVITY: Best Practices and Policies in the Public and Private Sectors**

MODERATOR **Julian Prosser**, Assistant City Manager, City of Raleigh (Retired)

PANELISTS **John Palmour**, CTO, Power and RF, Cree Inc.

ToNola D. Brown-Bland, Commissioner, North Carolina Utilities Commission

David Doctor, President and CEO, E4 Carolinas

Bryan Cordell, Executive Director, The Sustainability Institute

1:20 PM **KEYNOTE REMARKS**

Chancellor Randy Woodson, North Carolina State University

1:40 PM **WRAP UP & NEXT STEPS**

Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

Kateri Callahan, President, Alliance to Save Energy

Summary

On February 5, 2015, the Department of Energy (DOE), and Council on Competitiveness (Council) joined the Alliance to Save Energy (Alliance) in co-hosting the first of three State and Local Dialogues in Raleigh, North Carolina as part of the Accelerate Energy Productivity 2030 initiative. The initiative, officially launched by Secretary of Energy Ernest Moniz in September, seeks to build momentum and support for energy productivity by catalyzing action in the public and private sectors through a series of dialogues aimed at co-creating a road map for doubling U.S. energy productivity by 2030. The half-day event—sponsored by Alliance Associate Members Ingersoll Rand, Lime Energy, and Cree—convened leading public and private-sector energy experts, and approximately 90 attendees in the impressive James B. Hunt Library at North Carolina State University for a discussion on emerging challenges and opportunities associated with improving energy productivity in the buildings and transportation sectors, as well as the intersection between the two. The event enjoyed robust discussion and provocative dialogue thanks in large part to an active and engaged group of participants.

The agenda for the dialogue was populated with regional and local stakeholders well positioned to discuss energy productivity in the buildings and transportation sectors from the various vantage points of the diverse group of organizations they represent. Speakers included representatives from the Department of Energy, North Carolina Utilities Commission, Duke Energy, North Carolina Department of Commerce, City of Atlanta, City of Raleigh, North Carolina State University, Lime Energy, Advanced Energy, Envision Charlotte, Ingersoll Rand, North Carolina Clean Energy Technology Center, Research Triangle Cleantech Cluster, Cree, E4 Carolinas, Council on Competitiveness, and The Sustainability Institute.

Ahead of the day's panel discussions, participants took in keynote remarks from Dr. John Hardin, Executive Director of the North Carolina Board of Science, Technology and Innovation and Keith Trent, EVP of Grid Solutions and President for the Midwest and Florida Regions for Duke Energy, learning more about how the state of North Carolina and the region's largest utility are working to make North Carolina a leader in the Southeast region on energy productivity.

The panelists' discussions honed in on the important themes of driving energy productivity in the built environment and transportation sectors, with a focus on the work speakers representing state and local government, academic institutions, businesses, utilities, advocacy organizations, and manufacturers are doing to drive energy productivity within their respective organizations, and the areas they serve.

Of note, participants heard stakeholders from the cities of Raleigh, Charlotte, Charleston, and Atlanta discuss various programs they have undertaken to influence consumer behavior and energy consumption; increase electric vehicle penetration, help finance energy efficiency retrofits for residential homeowners, and enhance efficiency in large buildings across the region. Additionally, the location of the discussion at NC State University, one of the top research universities in the region and an integral component of the Research Triangle, afforded the opportunity to hear from various stakeholders about the cutting-edge research taking place in the triangle to bolster energy productivity in the United States. In particular, a representative from Cree Inc., a LED lighting manufacturer that grew out of the NC State materials science and engineering lab, was able to highlight their groundbreaking work with the city of Raleigh to deploy LEDs across the city, as well as their recent triumph lighting this year's Super Bowl in Phoenix, AZ, making it the most efficient Super Bowl to date.

The Accelerate Energy Productivity 2030 goal of doubling U.S. energy productivity by 2030 resonated with the panelists and audience alike as both engaged in a dialogue regarding the specific approaches taken and challenges encountered in advancing energy productivity at the local, state, and regional levels. While in Raleigh, the productivity initiative was able to secure endorsements from several key companies and institutions, most notably Duke Energy, the largest utility in the United States and NC State University. The initiative partners look forward to fostering lasting relationships with these and many of the participants who joined us in Raleigh to ensure they remain engaged and proactive in their efforts to drive energy productivity within their spheres of influence.

ATTENDEE BREAKDOWN

There was a strong showing from all target stakeholder groups in the Raleigh, North Carolina region. One hundred five people were registered for the event with 88 in attendance at the Hunt Library. Registrants included 17 representatives from academic institutions; 32 advocacy group representatives; 20 business representatives; 23 government officials or staff members; and 13 energy utility representatives. In addition to the partners listed above, organizations represented include: The City of Raleigh, NC Clean Energy Tech Center, Eastman Chemical Company, Research Triangle Cleantech Cluster, Duke Energy, NC Utilities Commission, University of North Carolina, NC State University, Duke University, Envision Charlotte, Sierra Club, E4 Carolinas, Ingersoll Rand, Advanced Energy, City of Atlanta, Schneider Electric, Climate Mobilization Fund, North Carolina Electric Cooperatives, Brasfield and Gorrie LLC, Fleishman Hillard, Cree, Office of Congressman Ellmers, North Carolina Rural Electrification Authority, Department of Energy, Brady Trane Services, and the North Carolina Department of Environment and Natural Resources. The Accelerate Energy Productivity Initiative will work with representatives from these organizations to ensure that the goal of doubling energy productivity by 2030 remains a priority in the region moving forward.

Overview of Energy Efficiency Policy in the Southeast

The Southeast region of the United States represents 36 percent of the nation's population and 44 percent of its energy consumption. These numbers mean there is great potential for increasing energy efficiency in the Southeast, and many states are taking innovative and proactive measures to increase the region's energy productivity.

On February 5, 2015, the Department of Energy, the Alliance to Save Energy, and the Council on Competitiveness hosted an event, "Accelerate Energy Productivity 2030 Raleigh: A State and Local Dialogue," as part of the Accelerate Energy Productivity 2030 initiative in Raleigh, North Carolina. The event brought together stakeholders from the region to initiate dialogues and garner endorsements for the goal to double our nation's energy productivity by the year 2030.

At this one-day forum, we examined the possibilities for increasing energy productivity in buildings and transportation, and the nexus between the two. Below is an examination of the efforts already underway in the southeast to advance energy productivity in buildings and transportation, including a description of the energy efficiency work done by the city of Raleigh to highlight the efforts of our host city.

BUILDINGS

North Carolina

With the passing of Senate Bill 668 and Senate Bill 1946, all state-owned buildings must surpass the energy efficiency requirements of ASHRAE 90.1-2004 by 30 percent for new construction and 20 percent for buildings undergoing major renovations. The state also set up a goal of reducing the amount of energy consumed per gross square foot for all state buildings, in total, by 30 percent of 2004 levels, by 2015. Additionally, North Carolina is a participant in the U.S. Department of Energy's (DOE) Better Buildings Challenge, and it has committed to reducing energy consumption in all state agency and UNC buildings by 20 percent.

Georgia

A 2008 executive order from Governor Sonny Perdue (R) created the Governor's Energy Challenge 2020 as part of the larger "Conserve Georgia" campaign. As part of the challenge, state agencies and departments must reduce energy consumption to 15 percent below 2007 levels, through energy efficiency or renewables integration by 2020. Reductions in energy use must come either from energy efficiency measures or from renewable energy development.

Funding from the American Recovery and Reinvestment Act of 2009 (ARRA) is being used by the Georgia Environmental Finance Authority (GEFA) to pay for state-agency retrofit projects. These projects will help state government entities meet the goal set by the Governor's Energy Challenge. GEFA is in charge of implementing this program. The challenge is mandatory for state entities, but local governments, schools, businesses, and individuals are encouraged to participate.

South Carolina

South Carolina has also implemented strong policies for state buildings and public schools. The State Energy Office has collected benchmarking data for over a decade from public agencies, K-12 schools, colleges, and universities, which allows the state government to implement energy conservation strategies and monitor progress. This led to H.B. 4766, which requires state agencies and public schools to reduce energy use by 20 percent from 2000 levels.

Tennessee

While Tennessee does not have any formal energy savings targets in place, it has made serious strides in gathering the background information necessary to implement these targets. The State Building Energy Management Program was created in 2009 to coordinate and implement energy efficiency efforts for the state government. This program began its efforts by gathering reliable consumption data from all state agencies, and it is working with other agencies to increase the amount of available data so that it will be available to the state government in the future.

Virginia

Virginia does not currently have an energy savings target for state buildings. Unlike other states that have implemented longer-term targets, Virginia has traditionally focused on short-term goals. For instance, an executive order signed in 2007 required state agencies to reduce annual non-renewable energy purchases by at least 20 percent below 2006 levels by 2010. A subsequent executive order from 2010 directed all state agencies to reduce annual energy consumption by at least 5 percent below 2010 levels for FY 2012.

TRANSPORTATION

North Carolina

In an effort to reduce congestion on roads in the state, in 2009 North Carolina passed House Bill 148 that established a fund to help finance projects that would alleviate congestion and incorporate multi-use capabilities. Efforts to accommodate other modes of transportation were further supported by the adoption of a Complete Streets policy by the State Department of Transportation in 2009. The state also examined current methods used for freight transportation so as to make the entire process more efficient.

Georgia

Georgia has implemented several separate plans relating to transportation in recent years. The Transportation Investment Act allows municipalities to pass sales taxes for the express purpose of generating funds to finance transit development and expansion. The state also decided to adopt a complete streets policy that incorporates bicycle, pedestrian and transit needs into all transportation infrastructure projects in 2012. Lastly, Georgia completed a freight and logistics plan in 2012 that aims to prioritize and coordinate key projects statewide through 2050.

South Carolina

South Carolina adopted Complete Streets legislation in 2003 to ensure that bicycle and pedestrian accommodations were sufficiently included within future State Department of Transportation planning activities. The state has also developed a freight plan to better coordinate and improve the efficiency of the statewide freight system.

Tennessee

In 1998, Tennessee enacted Public Charter 1101 Growth Policy Act that mandates coordination between local governments when it comes to municipal growth. The charter includes recommendations and guidelines on how to create efficient growth plans, but does so without implementing a statewide policy. To ensure coordination, the Charter also allows the state to withhold key economic development subsidies from city, county, and state offices if an agreement cannot be reached. Tennessee has also instated a policy that mandates the inclusion and integration of provisions for bicycles and pedestrians into any new construction or reconstruction of roads and highways. Lastly, Senate Bill 1471 created a Regional Transportation Authority in major municipalities that allows these authorities to design new funding streams for mass transit projects by law or through voter referendum.

Virginia

Virginia has required that every locality complete a comprehensive plan that coordinates land-use planning and future actions to effectively implement zoning requirements through its "Planning, Subdivision of Land and Zoning Code." In addition, the Commonwealth's Mass Transit Fund was created in 2013, and it receives 15 percent of all revenues generated from a 1.5 percent sales and use tax for transportation expenditures.

NOTABLE EFFORTS IN RALEIGH, NORTH CAROLINA

Energy Efficiency

The city of Raleigh has made great strides to improve the city's energy efficiency. One recently launched pilot project is examining the energy savings potential and feasibility of transitioning city-owned streetlights from traditional bulbs to more efficient LED bulbs. The city expects these bulbs to last between 15 and 20 years, which is significantly longer than the two-year average lifespan of a traditional bulb. Furthermore, if the pilot project proves to be successful, it is believed that replacing the roughly 35,000 streetlights in Raleigh could save the city millions of dollars over time.

The city of Raleigh has developed a partnership with Cree, Inc. of Research Triangle Park to test this new technology in municipal settings. In 2006, Raleigh agreed to become the first LED City, a program that Cree has expanded to municipalities across the world. The purpose of LED City is to encourage municipal governments to test this emerging technology in real world settings and share their experience with others.

Since 2006, Raleigh has installed over 40 separate LED projects across the city, including outdoor lighting for city parks, interior lighting, solar LED lighting, streetlights, and lighting in parking decks. These projects are estimated to be generating approximately $215,000 per year in energy and maintenance savings for the residents of Raleigh.

Raleigh has also worked to improve its efficiency in the transportation sector. In 2002, the city began to convert its fleet of vehicles to those powered by alternative fuels. Currently, the city fleet is comprised of approximately 461 alternatively fueled vehicles, which includes those powered by propane, compressed natural gas (CNG), electricity, and biofuels. More recently, Raleigh was chosen as one of three cities in the country to serve as a pioneer for the Rocky Mountain Institute's Project Get Ready. This project is designed as a test for the adoption of plug-in and electric vehicles (PEVs) and new PEV technology. As part of this project, Raleigh has added electric vehicles to its fleet, installed electric vehicle charging stations and removed or reduced barriers hindering the adoption of PEVs.

Furthermore, Raleigh has implemented policies to improve the efficiency of the city's buildings. The city now requires that all new municipal buildings over 10,000 square feet must meet the LEED Silver standards. Additionally, Raleigh has prioritized the completion of energy efficiency improvements to existing city-owned buildings. An example of a city-owned building that shows Raleigh's commitment to this effort is the Raleigh Convention Center that was built in 2008 and is LEED Silver certified.

Raleigh is also a fundamental component of the Research Triangle, which is composed of the cities of Raleigh, Durham, Cary and Chapel Hill as well as the substantial academic presence of North Carolina State University, Duke University, and the University of North Carolina at Chapel Hill. This area is well known for its work in the development of smart grid technologies that will create the electric grid of the future.

OTHER NOTABLE INFORMATION

Raleigh ranks first this year, moving up from third in 2013, on Forbes "Best Places for Business and Careers." The North Carolina capital previously ranked first in 2011 and had a three-year run in the top spot from 2007 to 2009. It is the only East Coast city that made the top 10. It is worth noting that Durham, NC often makes the list as well.

Fueling Raleigh's consistent results are business costs that are 18 percent below the national average, and an adult population where 42 percent have a college degree, the 12th best rate in the United States (30 percent is the national average). Raleigh is home to North Carolina State University, and nearby schools include Duke University and the University of North Carolina at Chapel Hill. The area's appeal has led to a strong inflow of new residents to the city, which boasts the sixth fastest net migration rate over the past five years.

Research Triangle Park (RTP) continues to fuel significant development in the area. The park is located at the core of the Raleigh-Durham-Cary Combined Statistical Area, and it is the largest research park in the country. It features roughly 170 companies that employ 39,000 full-time, mostly high-tech workers. There have been 1,800 start-up companies created at RTP since 1970.

Business Insider named Raleigh one of the "20 Cities Having an Awesome Recovery" in 2011, and Money magazine says Wake county (Raleigh/Cary) is one of the top 20 counties "Where the Jobs Are" this year. Clearly, the Triangle area is one of the best regions to work in thoughout the country.

For years, Raleigh, Durham, and Cary have been showered with placement in the top 10 lists of business-related accolades, and the reason is obvious. A number of different industries have a strong presence in the Triangle, including IT, telecom, pharmaceuticals, biotech, agrochemical, healthcare, and banking/financial services. This diversity makes for a healthy local economy.

RPT is a 7,000-acre campus that is home to more than 170 companies and organizations that employ about 50,000 Triangle residents. RTP has been around—and growing—for more than 40 years, and RTP employees have an average salary of $56,000.

The Triangle area is experiencing a solid job market and even new business growth, despite the recent recession's impact on the economy.

According to NerdWallet, out of 75 of the largest metro areas in the United States the Raleigh-Cary metro is the eighth best place for STEM graduates. With companies like SAS and North Carolina State University's STEM resources, the region is a "major center for technology and research," the financial website says.

NOTABLE EFFORTS IN CHAPEL HILL, NC

In 2006, the town of Chapel Hill became the first U.S. municipality to commit to a 60 percent reduction in carbon dioxide emissions by 2050 through the Carbon Reduction Program. The Council authorized the pledge to reduce carbon dioxide emissions from town municipal operations on a per capita basis, beginning with an initial goal of a 5 percent reduction by 2010.

The Council established a Green Fleets Policy in 2005 that requires the city to obtain energy-efficient vehicles and to operate its fleets in a manner that is energy-efficient and minimizes emissions. The town endeavors to decrease energy expenditures for its fleets by 3percent at the end of 2007–2008. The policy expresses the Council's commitment to reducing energy consumption and dependence on foreign oil, and to improving air quality.

APPENDIX 4

Accelerate Energy Productivity 2030 Regional Dialogue

REDMOND AND SEATTLE, WASHINGTON

EVENT SCHEDULE

Day 1 - Executive Roundtable Dialogue Overview

The focus of the events in Redmond and Seattle were smart power systems and the changing power grid. On the first day, 30 key private and public sector leaders convened for a private, moderated roundtable discussion on smart power systems. The sessions focused on exploring what participants view as the fundamental pillars needed to build a future smart power system, the game-changing opportunities on the horizon with the potential to achieve dramatic gains in energy productivity, opportunities to drive energy productivity through public-private partnerships, and what specific policy recommendations participants have that would foster accelerated development of a smart power system.

Alstom President Amy Ericson and PNNL Director Steve Ashby hosted the Day 1 Dialogue, with Council on Competitiveness President and CEO Deborah L. Wince-Smith, Alliance to Save Energy COO Gail Hendrickson, and Judith Greenwald, Deputy Director for Climate, Environment, and Energy Efficiency, U.S. Department of Energy, leading the discussion.

ACCELERATE ENERGY PRODUCTIVITY 2030:
Energy Productivity and Smart Power Systems

DATE	April 13th, 2015
LOCATION	ALSTOM FACILITY 10735 Willows Road NE Building C Redmond, WA 98052
8:00 AM	**CHECK-IN AND REGISTRATION**
8:30 AM	**OPENING REMARKS**
	The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

Ms. Gail Hendrickson, COO, Alliance to Save Energy

Ms. Amy Ericson, U.S. Country President, Alstom

Dr. Steven Ashby, Director, Pacific Northwest National Laboratory

8:50 AM

ACCELERATE ENERGY PRODUCTIVITY 2030: OVERVIEW

Ms. Judith Greenwald, Deputy Director for Climate, Environment, and Energy Efficiency, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

This introduction to the Accelerate Energy Productivity 2030 initiative will lay out the vision of the partnership, how the initiative supports the president's goal of doubling energy productivity, and how today's dialogue will feed into the U.S. Department of Energy's roadmap of strategies that will be released at a national summit on September 15th–16th in Washington D.C.

In addition to reviewing the work to date and the path toward the national summit, this introductory session gave a concise definition of energy productivity in the context of smart power systems and how a robust system acts as an enabler of a wide variety of energy productivity strategies.

9:00 AM

SESSION I – Energy Productivity and Smart Power Systems: Defining the Challenge

MODERATOR

Ms. Gail Hendrickson, COO, Alliance to Save Energy

This session began with participants introducing themselves and describing why energy productivity is important to them and their organizations. This was followed by an exploration of the fundamental pillars needed to build a future smart power system, what is needed to achieve this vision. Framing topics included:

- The "big" pieces needed for a robust and resilient smart power transmission and distribution system
- The role of the grid as enabler of efficiency—from generation to the end user
- The role of consumer decision-making and encouraging consumer participation ("prosumers") in maximizing system response
- The impact of two-way information flows, big data analytics and the overlay of IT infrastructure on the power system
- Gaps and bottlenecks that will inhibit development and deployment of smart grid technology.

10:00 AM

NETWORKING AND COFFEE BREAK

10:15 AM

SESSION II – Game-Changing Innovations and Pathways to an Energy-Productive Future

MODERATOR

The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

This session explored the game-changing opportunities on the horizon with the potential to achieve dramatic gains in energy productivity if developed and deployed effectively in the right policy environment. Examples include technologies that anticipate system shocks, "self-healing" components, real-time information flows, integration of advanced distributed sources into the grid, and IT infrastructure that optimize efficiency across the entire network. In the context of the goal to double energy productivity by 2030, the discussion explores what levels of adoption of these new strategies might be possible in the next 15 years, and the potential energy and economic impact that can have.

Participants discussed the most important technological or systematic challenges that, if addressed, would dramatically push the realization of a robust and dynamic smart power system. Framing topics included:

- Specific technologies—on the horizon but not yet commercially viable—that will enable dramatic shifts in energy productivity
- Shaping technologies and systems to inform consumer decision-making and enhance awareness around energy productivity and its benefits
- Projections of possible load reductions over the next 15 years, the cost, and what technologies and investments are needed to achieve this
- Policy frameworks, public-private partnerships and enabling pathways to develop and deploy these technologies over a 15-year time frame.

11:15 AM

OPPORTUNITIES TO DRIVE ENERGY PRODUCTIVITY THROUGH PUBLIC - PRIVATE PARTNERSHIPS

DISCUSSION LED BY

Ms. Amy Ericson, U.S. Country President, Alstom
Dr. Steven Ashby, Director, Pacific Northwest National Laboratory

The United States saw a tremendous investment in grid technologies over the past 5 years, most notably through significant American Recovery and Reinvestment Act of 2009 (ARRA) investment that funded a number of demonstration projects. As we enter the next phase—where market dynamics begin to drive technology choices—we must find ways to harness the nation's innovation infrastructure to develop next generation technologies. Framing topics include:

- The role of demonstration projects in pushing new technologies to market and linking research investments with high-priority, industry-defined problem sets.
- Challenges and barriers to effective public-private partnerships—what makes a successful partnership and leads to concrete technology outcomes.
- Policies to stimulate commercialization of power system innovations from national labs and help move them to market.

11:45 AM

LUNCH

12:30 PM

SESSION III – Policy Recap: Opportunities and Challenges, and Building a Strategic Roadmap

MODERATOR

Ms. Judith Greenwald, Deputy Director for Climate, Environment, and Energy Efficiency, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

This session reviewed and synthesized previous discussion, analyzing the major themes through a policy lens in order to draw out specific recommendations for the Roadmap. Policy gaps that, if addressed, would foster accelerated development of a smart power system- or policy hurdles that hinder such development— discussed in greater detail in order to close the dialogue with concrete ideas for an enabling policy framework. Framing topics included:

- Industrial strategies and best practices to accelerate smart grid development and deployment over a 15 year time horizon
- Policy actions at the state, local, and federal level that can catalyze change and support smart grid technologies and investments
- How federal policy can inform consumer decision-making
- Next steps in turning recommendations into policy action.

1:30 PM

CLOSING REMARKS

Ms. Amy Ericson, U.S. Country President, Alstom

Dr. Steven Ashby, Director, Pacific Northwest National Laboratory

Ms. Gail Hendrickson, COO, Alliance to Save Energy

The Honorable Deborah L. Wince-Smith, President and CEO, Council on Competitiveness

PARTICIPANTS

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EVP, McKinstry

Dr. Steven Ashby
Director, Pacific Northwest National Laboratory (Battelle)

Mr. Michael Atkinson
Vice President, Alstom Grid North America, Alstom

Mr. Jesse Berst
Chairman, Smart Cities Council

Dr. Anjan Bose
Regents Professor, Washington State University

Dr. Michael Bragg
Dean of the College of Engineering, University of Washington

Mr. Jeffrey Burleson
Vice President, System Planning, Southern Company

Mr. Jorge Carrasco
General Manager and Local Dialogue: CEO , Seattle, WA City Light

Mr. John Di Stasio
President, Large Public Power Council

Dr. Sid England
Assistant Vice Chancellor, Environmental Stewardship and Sustainability, UC-Davis

Ms. Amy Ericson
President and CEO, U.S., Alstom Inc.

Mr. Chad Evans
EVP, Council on Competitiveness

Mr. Bill Gaines
Director and CEO, Tacoma Park Utilities

Ms. Judith Greenwald
Deputy Director for Climate, Environment, and Energy Efficiency, U.S. Department of Energy

Dr. Bryan Hannegan
Associate Laboratory Director for Energy Systems Integration, National Renewable Energy Laboratory

Ms. Gail Hendrickson
COO, Alliance to Save Energy

Mr. David Kaplan
CEO and Founder, 1 Energy

Mr. Steve Klein
CEO and General Manager, Snohomish County PUD

Mr. Doug Macdonald
Vice President North America, Grid Network Management Solutions, Alstom Grid Inc.

Mr. Robert "Rob" MacLean
President, California and Hawaii, American Water

Mr. Mark McCullough
EVP, Generation, American Electric Power

Mr. Matt O'Keefe
Director of Market Development Regulatory Affairs, West, Opower

Mr. John Plaza
President, CEO and Founder, Imperium Renewables

Mr. Mark Reddemann
CEO, Energy Northwest

Ms. Ann Rendahl
Commissioner, Washington Utilities and Transportation Commission

Mr. Eric Schmitt
Vice President, Operations, California ISO

Mr. Bob Stolarski
Director, Customer Energy Management, Puget Sound Energy

Dr. Jud Virden
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Dr. Chandu Visweswariah
IBM Fellow and Director, Smarter Energy Research Institute

The Honorable Deborah L. Wince-Smith
President and CEO, Council on Competitiveness

Mr. Gary Yang
President and CEO, UniEnergy Technologies, LLC

Mr. Brian Young
Governor's Clean Technology Industry Sector Lead,
Washington Department of Commerce

Day 2 - A State and Local Dialogue Overview

ACCELERATE ENERGY PRODUCTIVITY 2030:
Energy Productivity and Smart Power Systems

DATE — April 14th, 2015

LOCATION — PERKINS COIE
1201 THIRD AVENUE, SUITE 4900
SEATTLE, WASHINGTON 98101

8:30 AM — **REGISTRATION & CONTINENTAL BREAKFAST**

9:00 AM — **WELCOME & OPENING REMARKS**

Jorge Carrasco, General Manager & CEO, Seattle City Light

9:15 AM — **KEYNOTE REMARKS**

Ms. Judith Greenwald, Deputy Director for Climate, Environment, and Energy Efficiency, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

9:15 AM — **KEYNOTE REMARKS**

Dow Constantine, King County Executive, King County

9:40 AM — **PANEL 1: Energy Productivity's Role in the Changing Power Grid**

MODERATOR

Ms. Judith Greenwald, Deputy Director for Climate, Environment, and Energy Efficiency, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

PARTICIPANTS

Michael Atkinson, Vice President of Alstom Grid North America Alstom

Kimberly J. Harris, President and CEO, Puget Sound Energy

Jeffrey Burleson, Vice President, Systems Planning, Southern Company

10:30 AM — **NETWORKING BREAK (snacks and drinks)**

10:50 AM — **PANEL 2: Driving Energy Productivity through Technological Innovation and Consumer Decision-making**

MODERATOR

Susan Betcher, Partner and Co-Chair, Clean Technology Practice, Perkins Coie

PARTICIPANTS

Matt O'Keefe, Director of Regulatory Affairs for Western North America, Opower

Brian Young, Director of Economic Development for the Clean Technology Sector

Dr. Liesel Hans, Economist, Electricity Markets and Policy Group at LBNL

11:40 AM — **KEYNOTE REMARKS**

David Danner, Chairman, Washington Utilities and Transportation Commission

12:00 PM — **LUNCH & NETWORKING BREAK**

12:30 PM — **PANEL 3: Public Perspectives on Doubling Energy Productivity in the Northwest**

MODERATOR

Susan Stratton, Executive Director, Northwest Energy Efficiency Alliance

PARTICIPANTS

Michael O'Brian, Councilmember, Seattle City Council

Tony Usibelli, Director of the Washington State Energy Office, Washington State Department of Commerce

Daryl WIlliams, Tulalip Tribes of Washington

1:20 PM **BOTTOM LINE DIALOGUE: Technology Pathways to an Energy Productive Power Portfolio**

MODERATOR **Deborah Wince-Smith,** President & CEO, Council on Competitiveness

PARTICIPANTS **Dr. Jud Virden,** Associate Lab Director for the Energy and Environment Directorate, PNNL

Jim West, Assistant General Manager, Snohomish County Public Utility District

1:50 PM **CLOSING REMARKS**

Deborah Wince-Smith, President & CEO, Council on Competitiveness

Summary

On April 14, 2015, the Department of Energy (DOE), and Council on Competitiveness (Council) joined the Alliance to Save Energy (Alliance) in co-hosting our latest roundtable in Seattle, Washington focused on smart power systems as part of the Accelerate Energy Productivity 2030 initiative.

More than 75 attendees gathered at Perkins Coie law firm in downtown Seattle for the half-day event sponsored by Alliance Associate Members Puget Sound Energy and Snohomish County PUD, and co-hosted by Seattle City Light and the Northeast Energy Efficiency Alliance (NEEA). The agenda for the dialogue was primarily populated with public and private-sector energy experts from the region with the goal of discussing challenges and opportunities associated with advancing energy efficiency and energy productivity in power generation, distribution, and transmission.

Speakers included representatives from the U.S. Department of Energy, Seattle City Light, King County, Alstom, Puget Sound Energy, Southern Company, Perkins Coie, Opower, Washington Department of Commerce, Lawrence Berkeley National Lab, the Washington Utilities and Transportation Commission, the Northwest Energy Efficiency Alliance, the Seattle City Council, the Council on Competitiveness, Pacific Northwest National Laboratory, and Snohomish County Public Utility District.

The event enjoyed audience participation from an especially strong showing of high-level experts in the energy space, a true testament to the importance of the subject of smart power systems for the region and the timeliness of the event in that regard.

To start things off, participants heard from Jorge Carrasco, the outgoing General Manager and CEO of Seattle City Light;

Judi Greenwald, the Deputy Director for Climate, Environment, and Energy Efficiency at the Department of Energy; and Dow Constantine, County Executive for King County about the changing power grid and the leadership role Seattle and the region are taking in advancing smart power systems of the future.

Speakers from all stakeholder groups including representatives from state and local government, academic institutions, businesses, utilities, advocacy organizations, and manufacturers all touched on what they are doing to drive energy productivity within their respective organization, and the areas they serve. Equally as important, the dialogue benefitted from a robust and engaged audience of an equally diverse background.

The panelists' discussions centered on several important themes as they relate to smart power systems including energy productivity's role in changing the power grid, driving energy productivity through technological innovation and consumer decision-making, public perspectives on doubling energy productivity in the Northwest, and technology pathways to an energy-productive power portfolio. With respect to the changing power grid, panelists discussed the importance of connecting distributed energy resources to the grid, the need for evolving grid technologies and software, and the need for more interoperability and interactivity between the grid and the end user. Additionally, participants heard from all levels of government about what they are doing to drive investment and collaboration on energy efficiency implementation and the adoption of new technologies.

The Accelerate Energy Productivity 2030 goal of doubling U.S. energy productivity by 2030 resonated with the panelists and audience alike as both engaged in a dialogue regarding the specific approaches taken and challenges encountered in advancing energy productivity at the local, state, and regional levels. The initiative partners look forward to fostering lasting relationships with the diverse set of participants in the Seattle meeting to ensure they remain engaged and proactive in their efforts to drive energy productivity within their spheres of influence.

ATTENDEE BREAKDOWN: SEATTLE

The stop in Seattle brought together a diverse audience from Washington State and the greater Pacific Northwest region. A total of 91 people registered for the State & Local Dialogue and 80 attended. Registrants included 12 advocacy group representatives, 24 business representatives, 28 government officials or staff members, 16 utility representatives, and 13 representatives of research and academic institutions. Organizations represented included the Pacific Northwest National Laboratory, Alstom Grid, City of Mercer Island, City of Seattle, Alaska Airlines, Smart Cities Council, CleanTech Alliance Washington, Washington State University, University of Washington, King County Wastewater Treatment Division, City of Port Angeles, Seattle City Light, Southern Company, Seattle Pacific University, Large Public Power Council, University of California–Davis, Office of Congressman Adam Smith, Alstom Inc., Distributed Energy Management, Snohomish PUD, City of Redmond, Emerald Cities Seattle, Seattle University, Chelan PUD, King County, Gussin Climate Action Fund, National Renewable Energy Lab, Western Washington University, 1energy Systems, Oregon BEST, Bonneville Power Administration, Tacoma Power, California American Water, Cisco Systems, American Electric Power, International Living Future Institute, Opower, Imperium Renewables Inc., Northwest Energy Efficiency Alliance, Boeing, Puget Sound Energy, and the Washington Department of Commerce. Representatives from the Accelerate Energy Productivity 2030 partnership will continue to engage these organizations in the goal of doubling energy productivity by 2030.

Overview of Energy Efficiency Policy in the Pacific Northwest

The Pacific Northwest region has long been a leader in energy efficiency, with state and local governments, utilities, and businesses alike implementing programs and incentivizing investment in energy-efficient technologies in order to meet the region's growing demand for electricity. As part of the Accelerate Energy Productivity 2030 initiative, the initiative partners are hosting a State and Local Dialogue in Seattle, Washington, bringing together leaders from state and local government, utilities, business, academia, and nonprofit organizations to discuss smart power systems and ways to enhance energy productivity in the region and across the nation. Given the focus of the event on the power grid and smart power systems, the following information primarily focuses on the efforts made in the Pacific Northwest region that relate to these topics. While there is still more to be done, the information below provides a quick overview of some of the efforts that have been made to promote energy efficiency and energy productivity in the Pacific Northwest and Seattle.

NOTABLE EFFORTS IN SEATTLE, WASHINGTON

Seattle's local government has established several policies to improve energy management and use, which are coordinated by the Office of Sustainability and the Environment. This office also controls a resource conservation fund for energy efficiency projects, including building audits and maintenance improvements. Policies and codes designed to improve buildings efficiency are among the strongest in the country, and include requirements for LEED Gold certification for city-funded buildings and benchmarking of public, multi-family and commercial buildings of specific sizes. Seattle is also a partner with the U.S. Department of Energy's (DOE) Better Buildings Challenge and has committed to reduce energy use in municipal buildings by 20 percent by 2020. Additionally, the Office of Sustainability and Environment offers a Community Power Works program, which was once funded through DOE, to help consumers make energy-efficient upgrades to their homes.

Aside from its strong buildings policies, Seattle has committed to using its own purchasing power to choose energy-efficient products. Municipal vehicles must be alternative-fuel vehicles or hybrid-electric vehicles with at least a 25 percent higher fuel economy rating than a comparable vehicle. In 2013, all 41,000 residential street lights in Seattle were replaced with LEDs that are activated with photo sensors. Currently, the city is undergoing the replacement of 31,000 arterial lighting fixtures with LEDs, to be completed by 2018.

At the moment, Seattle is pursuing a district energy project in three neighborhoods where waste heat from sewer lines, hospitals, and data centers can be harnessed to power energy systems, specifically for the heating and cooling of multiple buildings. An agreement has been made with a private district energy utility, Corix Utilities, to conduct a feasibility analysis of the project. The city and Seattle Housing Authority have also agreed to provide district energy for one housing development, provided a positive feasibility analysis.

To encourage greater energy efficiency in its transportation system, Seattle has incorporated an Urban Village Strategy into its Comprehensive Plan, which guides zoning by encouraging development in neighborhoods most capable of supporting growth and reducing greenhouse gas emissions. Neighborhood planning also considers walkability and accessibility to public transportation. The city has implemented policies to achieve a goal of reducing passenger vehicle miles traveled 14 percent by 2020, and 20 percent by 2030, from a 2008 baseline. Similarly, Seattle has a Commute Trip Reduction plan and provides Transportation Demand Management programs for employers in the city.

KING COUNTY INITIATIVES

King County, which includes Seattle and is the most populous county in Washington, has been proactive in issuing policies that accelerate energy efficiency projects throughout the county. King County Executive Dow Constantine, a keynote speaker at the Accelerate Energy Productivity 2030: A State and Local Dialogue in Seattle, issued his biennial budget proposal that will speed up county energy efficiency projects while reducing overall costs. "By investing in projects that pay for themselves over time through lower utility bills, we can meet our climate targets faster and save money at the same time," said Executive Constantine, who released his proposed 2015–2016 budget last September.

As part of operating King County as a best-run government, the Executive's budget proposes a Fund to Reduce Energy Demand that would provide county agencies with a new tool to meet long-term goals for both energy reduction and climate change. Under the program, the county could issue bonds to provide loans to departments for equipment upgrades that reduce the use of energy or other resources. The savings on utility bills would be used to pay back the bonds. Additional bonds could be issued to fund future energy-, water-, or waste-reduction projects and initiatives—creating even more savings.

The Executive’s proposed budget will include loans totaling $2.2 million for eight energy and water efficiency projects across five county agencies. About 20 percent of the total project costs are expected to be repaid through utility rebates. The combined projects would reduce the county’s output of carbon dioxide emissions by nearly 1,000 metric tons every year.

WASHINGTON STATE POLICIES

The Washington State government is strongly committed to leading by example by requiring energy-efficient public buildings and fleets, benchmarking energy consumption, and encouraging the use of energy savings performance contracts (ESPCs). In fact, Washington’s programs are so impressive that the state was ranked eighth on the American Council for an Energy-Efficient Economy’s State Energy Efficiency Scorecard, which assesses energy efficiency policies and programs for every state.

Washington State offers several financial incentives for energy efficiency projects, including grants, rebates, loans, tax credits, and reductions. Among these is the Community Energy Efficiency Program, which identifies and funds projects for community-wide residential and commercial energy efficiency retrofits. It is estimated that these retrofits produce $1.7 million in savings on energy costs each year. Another financial incentive is the Energy Efficiency Grants for Higher Education and Local Governments, which provides $38 million in funding for energy efficiency upgrades to facilities of institutions of higher education and local governments.

Washington has extensively used ESPCs as a means of financing retrofits for state and municipal facilities. The ESPC Program, in the Department of General Administration, assists entities seeking to use an ESPC, by offering no-cost preliminary audits, a list of pre-qualified energy service companies, model documents, and low-interest financing options. Washington also has an energy performance contracting program provided by the Washington Department of Enterprise Services, and available for state agencies, colleges, towns, counties, school districts, hospitals, libraries, and ports. Since the program’s inception in 1986, it has supplied more than $350 million in public facility efficiency projects, including $288 million in public building energy efficiency upgrades in the last five years alone, and has saved $22 million in energy costs annually.

Like Seattle, the state of Washington is also characterized by having strong policies on buildings efficiency. Of note, Washington is one of the few states to require commercial buildings to disclose their energy use, using an Energy Star rating system. State buildings have required energy savings targets, as mandated by a Washington executive order. State agencies must achieve a 20 percent reduction in building energy use by 2020, compared to a 2009 baseline. The same executive order also requires that state agency buildings be benchmarked, and if found to consume more energy than average for that building type, undergo an audit and implement efficiency improvements. A previous executive order and state statute mandate that major state construction projects and major facility projects receiving any funding from the state budget must be designed in accordance with LEED Silver standards. The current building energy code in Washington was developed in 2012, is compliant with the 2012 IECC, and contains codes applying to both residential and commercial buildings.

In terms of transportation efficiency policy, Washington, like Seattle, requires that state agencies phase in fuel economy standards for motor pools and conventional vehicles by 2015. State agencies must also purchase ultra-low carbon fuel vehicles or achieve an average fuel economy of 40 miles per gallon for light passenger vehicles, and 27 miles per gallon for light-duty vans and sport utility vehicles. The Washington Department of Transportation operates the largest ferry system in the United States, which also consumes the most fuel in the state government. However, the Washington Department of Transportation installed bio-fuel blending systems for its fleet in 2013, and has been honored by Government Fleet magazine as one of the most sustainable and efficient public fleets in the United States. Washington has also committed to reducing vehicle miles traveled per capita 18 percent by 2020, 30 percent by 2025, and 50 percent by 2050, compared to 1990 levels.

UTILITIES LEAD THE WAY

Washington's private and public utilities have a long history of offering customer energy efficiency and conservation programs supported by regional organizations including the Northwest Energy Efficiency Alliance (NEEA), the Large Public Power Council (LPPC), the Northwest Power and Conservation Council (NPCC), and the Bonneville Power Authority (BPA).

In Washington, energy efficiency is considered as a resource for planning and investment decisions by utilities. For example, NPCC designed its Sixth Power Plan, a regional energy blueprint, to guide the largest electricity supplier in the area, BPA. The plan, which aims to save 5,900 megawatts over 20 years, must be updated every five years, in accordance with federal law. NPCC even reports that energy efficiency, as a resource, is the largest power source in the Pacific Northwest behind hydroelectric power, based on a survey of almost 90 percent of the region's retail electricity sales. The report finds that energy efficiency has saved 5,570 MW since 1978 and met almost 62 percent of the Pacific Northwest load growth since 1980. These energy savings directly translate into monetary savings. The NPCC estimates that electricity consumers in the Pacific Northwest saved $3.5 billion in 2013 due to high investment in energy efficiency, which amounts to roughly twice the national average of its share in electricity revenues, totaling $375 million in 2013.

Washington has its own energy efficiency resource standard, established by the Energy Independence Act ballot initiative, which requires that Washington electricity utilities achieve specific gains in energy productivity and conservation each year, roughly 1.4 percent in electricity savings. The act also requires utilities to use methodologies consistent with those of NPCC to assess and plan their ten-year cost-effective conservation potential, which is updated every two years. Utilities also must create biennial acquisition targets, which are also updated every two years. Any utility that fails to meet conservation and productivity goals faces a fine.

Puget Sound Energy, a utility serving the Pacific Northwest region, offers many different types of programs and incentives to encourage energy efficiency, including rebates for homeowners using energy-efficient appliances, engineering consulting for commercial and industrial projects, and grants for retrofits and upgrades to buildings. In 2013 alone, Puget Sound Energy's energy efficiency programs saved enough electricity to power over 25,000 homes and enough natural gas to heat more than 6,000 homes.

Alliance Associate Member Snohomish County Public Utility District also provides a strong energy conservation program that covers weatherization and heating, efficient lighting and appliances, audits, heat pumps, and more, for both commercial and residential applications. Jim West, an assistant general manager for customer and energy services at Snohomish County PUD, has stated that though some utilities "might view energy efficiency offerings as more of a customer service, we very much make the investment as a strategic approach for meeting load growth on the system."

Seattle City Light, the primary utility providing electricity to the Seattle area and an endorser of Accelerate Energy 2030, offers substantial incentives and programs to encourage residential and commercial consumers to use energy more efficiently. These programs have been largely successful and have generated considerable savings. In 2013, Seattle City Light reported net electricity savings of 138,160 megawatt-hours, 1.46 percent of its retail sales, as a result of their energy efficiency programs. To ensure the long-term sustainability of improvements in energy productivity, Seattle has committed to achieving 0.90 percent energy savings, approximately 122,640 megawatt-hours each year.

OTHER NOTABLE EFFORTS IN THE REGION

In addition to these policies, new technology is also being used throughout the Pacific Northwest region as a means of advancing energy efficiency for utilities. Over the past three years, DOE has been testing smart grid technology in five states in the Northwest. In Washington, Seattle City Light and the University of Washington collaborated to create a micro-smart grid to serve the University of Washington campus. Smart grid technology has the potential to produce significant savings; in 2014, a representative of the University of Washington reported that the smart grid had saved the University $130,000 in annual energy costs. While smart grid technology has not yet been adopted citywide, Seattle City

Light has plans to provide 400,000 homes with advanced meters within the next year. These smart meters will be able to show customers and utilities more detailed information regarding energy use, allowing utilities to better identify and resolve any malfunctions while allowing consumers to control and monitor their usage.

Seattle also boasts the greenest commercial building in the world. The Bullitt Center is designed to have a 250-year lifespan. The building is designed to be energy and carbon neutral, with a water and sewage processing system that allows the building to be independent of municipal water and sewage systems. Energy neutrality is achieved with a large solar panel array on the roof of the building along with energy conservation measures that will cut the building's energy consumption to approximately one-third of the consumption of a typical office building of similar size.

The partners learned a great deal about the progress that Seattle, Washington, and the Northwest, have made toward realizing a more energy-productive future at the Accelerate Energy Productivity 2030 event in Seattle on April 14.

APPENDIX 5

Accelerate Energy Productivity 2030 Regional Dialogue

ST. PAUL, MINNESOTA

EVENT SCHEDULE

Day 1 - Executive Roundtable Dialogue Overview

The focus of the events in St. Paul was growing U.S. industrial competitiveness through smart manufacturing processes. On the first day, 20 key private and public sector leaders convened for a private, moderated roundtable discussion on advanced manufacturing. The sessions focused on the role of advanced manufacturing in driving energy productivity, what energy productivity means to the participant's respective organizations, and the challenges, opportunities, and strategies to drive energy productivity through advanced manufacturing processes.

Dr. Gayle Schueller, Vice President of Global Sustainability at 3M, was joined by Kateri Callahan, President of the Alliance to Save Energy, Bill Bates, Chief of Staff and EVP of the Council on Competitiveness, as well as senior Department of Energy leaders—Assistant Secretary Dave Danielson from the Office of Energy Efficiency and Renewable Energy, and Dr. Jonathan Pershing from the Office of Energy Policy and Systems Analysis—in leading the day's discussion.

ACCELERATE ENERGY PRODUCTIVITY 2030:
Growing U.S. Industrial Competitiveness through Smart Manufacturing Processes

DATE — April 15th, 2015

LOCATION — 3M INNOVATION CENTER
2350 Minnehaha Ave. East
Maplewood, MN 55119

11:00 AM — **CHECK-IN AND LUNCH**

12:00 PM — **OPENING REMARKS**

Mr. Bill Bates, Chief of Staff and EVP, Council on Competitiveness
Ms. Kateri Callahan, President, Alliance to Save Energy
Dr. Gayle Schueller, VP, Global Sustainability, 3M

Dr. Dave Danielson, Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

12:25 PM

THE ROLE OF ADVANCED MANUFACTURING IN DRIVING ENERGY PRODUCTIVITY

Dr. Dave Danielson, Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Advanced manufacturing—efficient, productive, highly integrated, tightly controlled technologies and processes that can increase competitiveness across the spectrum of U.S. manufacturers and suppliers—is uniquely capable of dramatically improving the energy productivity of the U.S. manufacturing sector. This session provided an overview of the advanced manufacturing activities currently ongoing in the Office of Energy Efficiency and Renewable Energy and their role in meeting the energy productivity goals of the U.S. Department of Energy.

12:40 PM

SESSION I – What does Energy Productivity Mean to Your Organization?

FACILITATOR

Dr. Gayle Schueller, VP, Global Sustainability, 3M

New technologies, systems and processes are increasingly being implemented in the advanced manufacturing sector that can enable superior device and process control, tighten and reduce barriers along supply chains, drive energy productivity, and lend significant competitive advantage to the organizations and nations that embrace them. In particular, the use of information and communications technology to integrate all aspects of manufacturing—Smart Manufacturing—can achieve significant improvements in energy efficiency while delivering added competitive advantage to organizations that leverage it.

In this session participants introduced themselves and spoke briefly on the opportunities and challenges in driving energy productivity from the perspective of their organization. Participants responded to the following questions:

- What successes have your organizations seen, either in achieving gains in energy productivity, or assisting others in doing so?
- Are there success stories that can be quantified (e.g. implementation of a certain system that enabled a new process, reduced costs associated with energy use, or led to a specific competitive advantage)?
- What is the single biggest role DOE can play in facilitating the adoption of smart manufacturing techniques by the U.S. industrial sector?

1:30 PM

NETWORKING AND COFFEE BREAK

1:45 PM

SESSION II – Challenges and Opportunities to Drive Energy Productivity through Advanced Manufacturing Processes

FACILITATOR

Ms. Kateri Callahan, President, Alliance to Save Energy

Due to the maturity of the installed base of many industrial plants and its frequently changing structural composition, there is considerable opportunity to drive energy productivity throughout the U.S. industrial sector. An energy-efficient industrial sector increases productivity, enhances global competitiveness, and creates jobs. Because the industrial sector has a wide variety of large and small energy users and extensive supply chains, dissemination and replication of energy saving technologies, projects, and best practices can yield significant energy savings.

This session explored challenges and opportunities that participants have observed throughout their own experience and within their own organizations.

- What is the biggest obstacle to wider adoption of energy-productive advanced manufacturing approaches? What barriers are specific to large OEMs versus the barriers facing SMEs?
- Are the barriers primarily technological, cultural, or financial?
- What are the respective roles of the public and private sectors in disseminating smart manufacturing techniques across OEMs and through supply chains?

2:45 PM

STRATEGIES TO DRIVE ENERGY PRODUCTIVITY IN THE U.S. MANUFACTURING SECTOR

PRESENTER

Dr. Jonathan Pershing, Principal Deputy Director, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

In September, Secretary Moniz will release a strategic roadmap—based on the Accelerate Energy Productivity 2030 dialogues—to achieve the President's vision of doubling energy productivity by 2030. This roadmap will include strategies that private firms, and federal, state and local governments can take to improve energy productivity in the U.S. manufacturing sector. This session featured a set of potential strategies specific to the advanced manufacturing sector that are being considered for the roadmap—that were discussed and vetted by participants in the later sessions.

3:00 PM

SESSION III – Input on Advanced Manufacturing Strategies

FACILITATOR **Dr. Jonathan Pershing,** Principal Deputy Director, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

In this session participants discussed and vetted the concepts from the preceding presentation—with the goal of developing specific recommendations to inform the sections of the policy roadmap that are relevant to the U.S. industrial sector.

- What are the key features of a strategic policy roadmap that can successfully facilitate improvements in energy productivity in the U.S. industrial sector?
- Does the suggested strategy broadly capture these elements? What gaps exist and what elements could be refined to better facilitate the private and public sectors in meeting its energy productivity goals?
- How can we ensure that this strategy is additive—not duplicative—to existing efforts in driving energy productivity for U.S. manufacturers?

3:45 PM **NETWORKING AND COFFEE BREAK**

4:00 PM **SESSION IV – Policy Recap: Next Steps and Building a Strategic Roadmap**

FACILITATOR **Dr. Dave Danielson,** Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

This session reviewed and synthesized previous discussions, analyzing the major themes through a policy lens in order to draw out specific recommendations for the roadmap. Policy gaps that, if addressed, would foster accelerated uptake of energy-productive manufacturing solutions—or policy hurdles that hinder such development—were discussed in greater detail in order to close the dialogue with concrete ideas for an enabling policy framework.

- Pathways and best practices to accelerate energy-productive manufacturing technologies over a 15 year time horizon
- Policy actions at the state, local, and federal level that can catalyze change and support advanced manufacturing technologies and investments
- How federal policy can enable advanced manufacturing solutions across supply chains
- Next steps in turning recommendations into policy action.

4:45 PM **CLOSING REMARKS**

Mr. Bill Bates, Chief of Staff and EVP, Council on Competitiveness
Ms. Kateri Callahan, President, Alliance to Save Energy
Dr. Gayle Schueller, VP, Global Sustainability, 3M

PARTICIPANTS

Mr. Bill Bates
Chief of Staff and EVP, Council on Competitiveness

Ms. Kateri Callahan
President, Alliance to Save Energy

Dr. Sujeet Chand
CTO and SVP, Advanced Technology, Rockwell Automation

Dr. David Danielson
Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy

Mr. Terry Gallagher
SVP and General Manager, Global Water and Process Services, Heavy Operating Division, Nalco

Mr. John Galyen
President, Danfoss North America

Dr. Bruce Hedman
Technical Director, Institute for Industrial Productivity

Dr. Mark Johnson
Director, Advanced Manufacturing Office, Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy

Dr. Martin Keller
Associate Laboratory Director, Energy and Environment Directorate, Oak Ridge National Laboratory

Ms. Stacey Paradis
Executive Director, Midwest Energy Efficiency Alliance

Dr. Jonathan Pershing
Principal Deputy Director, Office of Energy Policy and Systems Analysis, U.S. Department of Energy

Mr. Jim Phillips
Chairman and CEO, Nanomech

Ms. Susan Rochford
Vice President, Sustainability & Public Policy, Legrand

Mr. Todd Rytting
CTO, Panasonic Corporation of America

Dr. Gayle Schueller
Vice President, Global Sustainability, 3M

Dr. George Wan
Vice President, Engineering and Technology, Ingersoll Rand

Mr. Aldie Warnock
SVP, External Affairs, Communications and Public Policy, American Water

Mr. Geff Wood
Director, GPM IPS Manufacturing & Process Control, and Automation, Alcoa

Day 2 - A State and Local Dialogue Overview

ACCELERATE ENERGY PRODUCTIVITY 2030:
Energy Productivity and Smart Power Systems

DATE	April 16th, 2015
LOCATION	3M INNOVATION CENTER 2350 Minnehaha Ave. East Maplewood, MN 55119
8:30 AM	**REGISTRATION & CONTINENTAL BREAKFAST**
9:00 AM	**WELCOME & OPENING REMARKS**
	Ms. Kateri Callahan, President, Alliance to Save Energy
9:10 AM	**KEYNOTE REMARKS**
	Dr. Gayle Schueller, VP, Global Sustainability, 3M
9:20 AM	**KEYNOTE REMARKS**
	Dr. David Danielson, Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy
9:35 AM	**PANEL 1: Advanced Manufacturing: Creating More Goods, Using Less Energy**
MODERATOR	**Dr. Mark Johnson,** Director, Advanced Manufacturing Office, Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy
PARTICIPANTS	**George Wan,** VP Engineering and Technology at Thermo King, Ingersoll Rand **Bruce Hedman,** Technical Director, Institute for Industrial Productivity **Barri Gurau,** Senior Engineer for Corporate Energy Initiatives, Lockheed Martin

10:35 AM	**BOTTOM LINE DIALOGUE: Exploring the Energy-Water Nexus**
MODERATOR	**Dr. Jonathan Pershing,** Principal Deputy Director, Office of Energy Policy and Systems Analysis, U.S. Department of Energy
PARTICIPANTS	**Terry Gallagher,** SVP and General Manager, Global Water and Process Services, Heavy Operating Division, Nalco **Aldie Warnock,** SVP, External Affairs, Communications and Public Policy, American Water
11:05 AM	**LUNCH AND NETWORKING BREAK**
1:05 AM	**PANEL 3: Public Perspectives on Doubling Energy Productivity in the Midwest**
MODERATOR	**Stacey Paradis,** Executive Director, Midwest Energy Efficiency Alliance
PARTICIPANTS	**Janet Streff,** Manager of State Energy Office, Division of Energy Resources, Minnesota Department of Commerce & Chair of National Association of State Energy Officials Board of Directors **Sheldon Strom,** Founder and President, Center for Energy and Environment **Al Juhnke,** State Agriculture & Energy Advisor, Office of Senator Al Franken and Former Minnesota State Representative **John Hoffman**, Senator and Vice Chair of Environment and Energy Committee, Minnesota Senate

Summary

On July 16, 2015, the U.S. Department of Energy (DOE), and Council on Competitiveness (Council) joined the Alliance to Save Energy (Alliance) in co-hosting their third and final roundtable in St. Paul, Minnesota focused on the manufacturing sector and growing industrial competitiveness through increased energy productivity as part of the Accelerate Energy Productivity 2030 initiative. The initiative, officially launched by Secretary of Energy Ernest Moniz in September 2014, seeks to build momentum and support for energy productivity by catalyzing action in the public and private sectors through a series of dialogues aimed at co-creating a road map for doubling U.S. energy productivity by 2030.

More than 80 attendees gathered at 3M Innovation Center in St. Paul for the event sponsored by Alliance Associate Members Lockheed Martin and Ingersoll Rand, and co-hosted by 3M and the Midwest Energy Efficiency Alliance (MEEA). The agenda for the dialogue was primarily populated with public and private-sector energy experts from the region with the goal of discussing challenges and opportunities associated with advancing energy efficiency and energy productivity in the manufacturing sector.

Speakers included representatives from 3M, the Department of Energy, Ingersoll Rand, and the Institute for Industrial Productivity, Lockheed Martin, Nalco, American Water, Minnesota Department of Commerce, the Office of Senator Al Franken (D-MN), the Minnesota State Senate, the Center for Energy and Environment, the Midwest Energy Efficiency Alliance, the Council on Competitiveness and the Alliance to Save Energy.

Speakers from all stakeholder groups including representatives from state and local government, academic institutions, businesses, utilities, advocacy organizations, and manufacturers all touched on the challenges and opportunities facing their particular sectors and on what they are doing to drive energy productivity within their respective organization, and the areas they serve. Equally as important, the dialogue benefitted from a robust and engaged audience of an equally diverse background.

Dr. Gayle Schueller, VP of Global Sustainability at 3M, kicked things off with some background on 3M's role in the manufacturing space and their history in the region. The first panel followed, moderated by Mark Johnson, Director of the Advanced Manufacturing Office at DOE, who focused on the innovative advanced and additive manufacturing technologies that have allowed private companies to create more goods using less energy. The audience heard from representatives from Ingersoll Rand, the Institute for Industrial Productivity, and Lockheed Martin about the importance of driving continued advancements in advanced manufacturing and increasing energy productivity in manufacturing processes in order to keep our manufacturing sector prosperous and competitive with other nations.

The second panel focused on the ever-increasing importance of the energy-water nexus and the need to look at energy and water as inextricably linked. Dr. Jonathan Pershing, Principal Deputy Director of the Office of Energy Policy and Systems Analysis at DOE, moderated a discussion between a representative from Nalco, a water-heavy manufacturer of chemicals and other products, and an American Water representative, the nation's largest water utility. Both spoke of the importance of water conservation, increasing water efficiency, and the dual benefits for increased energy savings and energy productivity.

The final panel focused on the public perspectives from the region, featuring a current and former member of the state legislature, a representative from the State Energy Office of Minnesota, and the president of a regional energy and environment nonprofit. This panel discussed the state's long history of bipartisan support for energy efficiency and renewable energy and the need to continue to make strides in increasing state and local policies that promote them.

The event featured particularly strong audience participation from a high-level group of energy stakeholders, with a particularly large presence from the public sector in the state and region. The Accelerate Energy Productivity 2030 goal of doubling U.S. energy productivity by 2030 resonated with the panelists and audience alike as both engaged in a dialogue regarding the specific approaches taken and challenges encountered in advancing energy productivity at the local, state, and regional levels.

ATTENDEE BREAKDOWN

As with previous events, the State & Local dialogue in St. Paul brought together a diverse range of stakeholders from around Minnesota and the upper-Midwest. In all, 125 people registered for the event and 90 people attended. Registrants included 24 advocacy group representatives; 45 business representatives; 41 government officials or staff members; 6 utility representatives; and 9 research or academic institution representatives. Organizations represented included Indiana NAACP, Ever-Green Energy, Center for Energy and Environment, Great Plains Institute, Minnesota Department of Commerce, City of Maplewood, Metropolitan Council, Benton County, Neighborhood Energy Connection, Evolve technologies, Ever-Green Energy, Frederick County, NALCO, Minnesota Power, Cook County Minnesota, City of St. Paul, City of Ruchfield, City of Vadnais Heights, Lockheed Martin, 3M Company, Institute for Industrial Productivity, Environmental Quality Board, State of Minnesota, Xcel Energy, Humphrey School of Public Affairs, Process Technology LLC, Oneida County Wisconsin, Franklin Energy, Home Scan, University of Minnesota, Earthtech Energy, Ingersoll Rand, City of Northfield Minnesota, Fresh Energy, Fulton County Board, Minnesota GreenCorps, Minnesota Interfaith Power & Light, Midwest Energy Efficiency Alliance, CenterPoint Energy, American Water, City of White Bear Lake, Minnesota Trade Office, Metropolitan Airports Commission, Office of Senator Al Franken, Office of Senator Klobuchar, Majestic Custom Electric, Smiths Medical, Delano Municipal Utilities, City of Highland Park, and Eaton. The initiative partners look forward to fostering lasting relationships with the diverse set of participants who participated in St. Paul to ensure they remain engaged and proactive in their efforts to drive energy productivity within their spheres of influence.

Overview of Energy Efficiency Policy in the Upper Midwest

As part of the Accelerate Energy Productivity 2030 initiative, a collaborative effort to help achieve the resident's goal of doubling U.S. energy productivity by 2030, the initiative partners hosted the final State and Local Dialogue in St. Paul, Minnesota, on July 16 at 3M's Innovation Center. The half-day event brought together leaders from state and local government, utilities, business, academia and nonprofit organizations to discuss the importance of increasing energy productivity in the region, with a focus on growing industrial competitiveness through advanced manufacturing and smart manufacturing processes.

This event could not have come at a more appropriate time, as strides are being made toward a more energy-efficient community at the local, state, and regional levels of the Upper Midwest area. Government clunkers are being traded in for fuel-efficient hybrids and charging stations, St. Paul citizens are witnessing their city being transformed into the "Most Livable City in America," and private businesses are seeing growing returns on their investments in retrofitted buildings. Learn more below about St. Paul and the ways in which citizens and organizations can improve upon the foundation the Upper Midwest community has built for an efficient future.

INNOVATIVE PROGRESS FOR ST. PAUL

As part of the American Recovery and Reinvestment Act, in 2009 the Department of Energy (DOE) awarded the City of St. Paul $2.7 million in funding from the Energy Efficiency and Conservation Block Grant. The City of St. Paul has since been able to invest millions of dollars in energy efficiency projects. Among these have been improved efficiency of municipally owned facilities, LED retrofitted streetlights and investments in 23 electric vehicle charging stations with plug-in electric fleet vehicles. The city government has been able to provide homeowners with loans to conduct energy audits and make energy management system installations. The city has projected that it will achieve $395,705 of aggregate yearly energy savings solely through replacing lights and installing new energy management systems in local libraries, parking ramps and recreational centers.

The federal stimulus has also enabled a partnership between the St. Paul Port Authority (SPPA), the Center for Energy and Environment (CEE) and Xcel Energy through the Trillion BTU program in which SPPA uses the grant funding through the Minnesota Department of Commerce to create a business loan program. Businesses first voluntarily agree to energy audits paid for by Xcel Energy; engineering studies are then performed on facilities with conservation opportunities—25 percent of the cost paid for by the participating business and 75 percent paid by Xcel. Based on these studies and audits, installation of necessary physical improvements is implemented and covered by a Port Authority loan and an Xcel Energy rebate, making the loan repayment less than estimated energy savings.

St. Paul also has the nation's largest wood-fired Combined Heat and Power plant to serve a district energy system. St. Paul Cogeneration produces approximately 65 megawatts of heat and up to 33 megawatts of electricity, making it more than twice as efficient as a conventional electric power plant. The system is fueled by clean urban wood residue and primarily uses wood from storm events, commercial tree trimmings and removals, and municipal and private tree and brush sites. The plant's reduced impact on the environment includes a 70 percent reduction in the use of coal, a 50 percent reduction in particulates, and a reduction of up to 280,000 tons of greenhouse gases yearly.

To promote further efficiency in an area with projected population growth of 34 percent between 2000 and 2030, the state-of-the-art Energy Innovation Corridor was established in 2010 along the 11-mile light rail transit route between downtown St. Paul and downtown Minneapolis. The Corridor not only features “one of the most sophisticated energy and transportation infrastructure systems ever developed,” but also serves residents with smart energy technologies, renewable energy sources, and advanced efficiency programs. Between 2010 and 2014, the Corridor avoided about 3.3 billion pounds of carbon emissions, equating to over $66.2 million in economic savings.

MINNEAPOLIS: A TOP CITY FOR EFFICIENCY

This year, the American Council for an Energy-Efficient Economy ranked Minneapolis seventh in the country for having strong energy efficiency policies. Minneapolis has been rising in the ranks for its progress in energy efficiency, largely due to its strides in promoting energy-efficient buildings and new efforts in reducing carbon emissions. According to data in Minneapolis' Sustainability Indicators, the city reduced it greenhouse gas emissions from local government operations by 18 percent between 2008 and 2012, an average annual reduction of over 4 percent.

Regarding transportation, The Green Fleet Policy requires the city of Minneapolis to obtain highly efficient vehicles that emit the lowest levels of pollutants. The city also has an anti-idling policy to deter city fleets and other automobiles from unnecessarily polluting the air. Public lighting has also undergone updates, particularly in the last months of 2014 when the city purchased 1,000 LED fixtures for replacing HID streetlights. For building standards and energy codes, Minneapolis continues to raise the bar. LEED silver standards must be implemented in every phase of the building or significant renovation process for city municipal complexes. City financed buildings must also be outfitted with ENERGY STAR appliances if applicable under the Environmentally Preferable Purchasing Policy.

Among all of these excellent programs, the city's Climate Action Plan and Clean Energy Partnership are perhaps the most exceptional. The Climate Action Plan aims to reduce greenhouse gas emissions 30 percent by 2025 with 2006 as a baseline. As a part of this goal, Minneapolis intends to use renewable sources for 10 percent of its electricity, raise the bicycle-commute mode share to 15 percent, double regional transit ridership and reduce overall energy use by 17 percent. Additionally, the Climate Action Plan commits the city to recycling half of all waste with an added composting rate of 15 percent.

To work toward achieving the city's Energy 2040 Vision of providing “reliable, affordable, local and clean energy services for Minneapolis homes, businesses and institutions,” and “sustaining the city's economy and environment and contributing to a more socially just community,” Minneapolis has established the Clean Energy Partnership with natural gas and electric utility companies Xcel Energy and CenterPoint Energy. Through these utility franchise agreements, Xcel and CenterPoint will have access to run distribution lines on the public right of way under an assurance that their services will meet the city's energy efficiency goals.

MINNESOTA LEADS MIDWEST IN SAVINGS PROGRAMS

Minnesota leads the way in energy efficiency by offering technical, contractual, and financial resources to institutions at each level of government as well as by instituting programs that incentivize efficiency, conservation, and innovative technology. Through the Guaranteed Energy Savings Program implemented in 2010, school districts, universities, local governments and state agencies are enabled to engage in Energy Savings Performance Contracts through the state's Division of Energy Resources. These contracts not only create jobs and save on operational costs, but also effectively reduce overall energy consumption with the goal of a 20 percent aggregate reduction in state agencies. All investor-owned utilities in the state operate under a shared savings model in which they are incentivized to reach efficiency targets: utility companies receive an increased percentage of net benefits in direct proportion to their increased energy savings.

Overall, "Minnesota has been very progressive in terms of clean energy policy, promoting efficiency and renewables" said Kyle Aarons, senior fellow at the Center for Climate and Energy Solutions and producer of a study tracking energy savings and energy efficiency gains across the United States.

Minnesota's government agencies have been intentional about creating projects and programs to meet federal goals. In response to the EPA's 1.5 percent recommendation, the Minnesota Department of Commerce, Office of Energy Security and Minnesota Environmental Initiative coordinated to form a stakeholder initiative called "The 1.5 Percent Energy Efficiency Solutions Project". Through the initiative, nonprofit, environmental and public groups came together on a short term basis to connect with contractors, trade groups and utilities companies to brainstorm the policy barriers that were currently blocking the path to reaching 1.5 percent yearly energy efficiency savings. Since issuing a final report in 2011, stakeholders have continued to work with agencies to promote progress in energy efficiency and reach the goal of 1.5 percent annual savings.

Manufacturing is yet another sector in which Minnesota has promoted high standards of efficiency. With the help of grant funding, the Minnesota Technical Assistance Program (MnTAP) now helps two manufacturing facilities each year on a three-year cycle to determine where energy efficiency opportunities exist and which strategies would be best for effective implementation. The impetus for this program came from a report by MnTAP in 2010 that revealed potential gas and electric savings in Minnesota's industrial sector of over 2.5 million MCF (8 percent) and 271.4 million kWh (7 percent). As a result, MnTAP's work with individual manufacturing companies each year could eventually lead to an effective statewide Conservation Improvement Program based on their case studies with individual companies about which strategies and implementation programs are most effective.

Minnesota's most recent initiative issues new state residential and building energy codes, effective last February and this June, respectively. The new state residential energy code alone has been projected to save over 880,000 MMBTU annually compared to the old code, according to the Midwest Energy Efficiency Alliance (MEEA) and DOE. This energy savings translates to about $540 less in utility bills each year for the average homeowner and over $8 million in aggregate savings for homeowners.

UPPER MIDWEST INITIATIVES

In addition to the significant progress Minnesota has made in energy efficiency, surrounding states in the region have also taken measures to implement efficiency programs.

Illinois Energy Now, a program that offers grants for low-income housing and public sector programs as well as recommendations on market transformation and technical assistance programs, has now saved almost $585 million in aggregate energy costs through the Illinois Department of Commerce and Economic Opportunity. Since 2008, the program has created and sustained over 17,800 jobs, saved 7.8 billion kWh in electricity equipment, and conserved over 218 million therms in natural gas equipment. Looking ahead, Energy Now is expected to reach $1 billion in public sector savings in the next 10 years.

Wisconsin's Focus on Energy Program funded by the state's investor-owned energy utilities, has been instrumental in facilitating energy savings of more than $730 million for over 2.8 million residents and businesses. The incentive program focuses on renewable resources and energy efficiency for the state's many utility companies and their consumers. Success stories so far include consumers ranging from school districts and apartment complexes, to breweries and pizza shops; each receiving incentives and expertise based on their own unique business models and industries.

Iowa in particular has had a focus on renewable energy sources with a program established in 2012 for solar tax credits available to residential and commercial consumers through the Iowa Department of Revenue. Just in the first five months of this year, the system has been able to provide over $1.15 million in credits. Additional efforts include Iowa's Alternate Energy Loan Program in which individuals or businesses are able to obtain one, low-interest loan (often zero percent) of half the cost of the project (up to $1 million) to help cut down on the costs of financing the construction of a renewable energy facility featuring solar, wind turbine, small hydro or biomass technologies.

Michigan has made clean energy a top priority as it reaches its goal of generating 10 percent of its total energy uses from renewable sources this year; however, Governor Rick Snyder continues to press for further conservation measures using efficiency methods for waste reduction. As of March, Snyder presented his plan for Michigan to meet up to

40 percent of its energy needs primarily through waste reduction, a shift away from coal, and the continued development of renewables. According to the governor, "The most affordable energy you can ever get is the energy you never use. You didn't need to build the power plant; you didn't need to buy the fuel; you didn't need the transmission system." Because Michigan residents use 38 percent more energy than the national average, there is significant potential for improvement through efficiency techniques.

The Accelerate Energy Productivity 2030 team looks forward to engaging in meaningful conversations regarding the steps that state and local policy officials, business owners, industry, and households have made in St. Paul and in the Upper Midwest.

APPENDIX 6

Organizations Committed to Accelerate Energy Productivity by 2030

A total of 122 organizations have committed to the goal of doubling U.S. energy productivity by 2030, pledging to (1) improve energy productivity within their own organizations, (2) share success stories, (3) encourage other organizations to endorse and (4) participate in Accelerate Energy Productivity 2030 educational outreach activities. Similarly, nine international organizations have endorsed the goal of doubling global energy productivity by 2030.

3M Company

5 Lakes Energy, LLC

Acuity Brands Lighting

Advanced Energy Economy

Advanced Power Control, Inc.

Alliance for Industrial Efficiency

Alliance to Save Energy

American Council for an Energy-Efficient Economy

American Council on Renewable Energy

American Public Transportation Association

Artfox

American Society of Heating, Refrigerating, and Air-Conditioning Engineers

Big Ass Solutions

Bombard Renewable Energy

BSH Home Appliances Corporation

Business Council for Sustainable Energy

Business Efficiency Consulting Services, Inc.

CALMAC Manufacturing Corporation

Center for Energy and Environment

Center for Environmental Innovation in Roofing

Center for the New Energy Economy at Colorado State University

City of Ann Arbor

City of Grand Rapids

Clean Energy Project

Conservation Services Group, Inc.

Copper Development Association

Council on Competitiveness

Cree

Danfoss

Design AVEnues, LLC

The Dow Chemical Company

Downtown DC Business Improvement District

Duke Energy

EcoValuate, LLC

EES Consulting

Efficiency Valuation Organization

Efficient Windows Collaborative

Encap Development

Energetics, Inc.

Energy Future Coalition

Energy Insight, Inc.

Energy Network

Energy Systems & Installation

EnergyFit Nevada

Environmental Defense Fund

EPS Capital Corp.

Exelon Corporation

Field2Base, Inc.

Galligan Energy Consulting, Inc.

Georgetown University Energy Prize

Geos Neighborhood

Green Building Initiative

GreenerU

GreenLaw

Grundfos

Habitat for Humanity International

Hampton/NASA Steam Plant

Hannon Armstrong

Herty Advanced Materials Development Center

ICLEI USA

Illuminating Engineering Society

Ingersoll Rand

Institute for Industrial Productivity

Institute for Market Transformation

International Copper Association, Ltd.

Johns Manville

Johnson Controls, Inc.

Knauf Insulation

Large Public Power Council

Legrand

Light and Energy International, LLC

Lime Energy

Lockheed Martin Corporation

Los Angeles Department of Water and Power

Masco Corporation

Nalco, an Ecolab Company

National Association for State Community Services Programs

National Fenestration Rating Council

National Grid US

National Insulation Association

Nebraskans for Solar

Nevada Energy Star Partners GREEN Alliance

Nevada Governor's Office of Energy

New Jersey PACE

New York Power Authority

North American Insulation Manufacturers Association

Natural Resources Defense Council

NV Energy

Ohio Energy and Advanced Manufacturing Center

Opower

Owens Corning

Panasonic Corporation of North America

Pacific Gas & Electric Corporation (PG&E)

Philips Lighting Company

Pierce Energy Planning

Polyisocyanurate Insulation Manufacturers Association

Potential Difference, Inc.

Rebuilding Together

Schneider Electric

Seattle City Light

Siemens Industry, Inc.

Snohomish County Public Utility District

Solar Habitats, LLC

South-central Partnership for Energy Efficiency as a Resource

Southeast Energy Efficiency Alliance

Southern California Edison

Southface Energy Institute

Southwest Energy Efficiency Project

The Stella Group

UC Davis Policy Institute for Energy, Environment, and the Economy

United Nations Foundation

United Technologies Corporation

Vermont Energy Investment Corporation

Vinyl Siding Institute

Vitandra Business Solutions

Washington Gas

Washington State Energy Office

Wisconsin Energy Conservation Corporation

Western Washington University

Whirlpool Corporation

This list represents endorsements as of Aug. 12, 2015. For more information, see http://www.energy2030.org/.