

Energy Efficiency in West Virginia: Research for 5-Year Energy Plan

DRAFT REPORT

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Contact:

Christine Risch

christine.risch@marshall.edu

(304-696-5754)

Center for Business & Economic Research

Marshall University

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I. Introduction

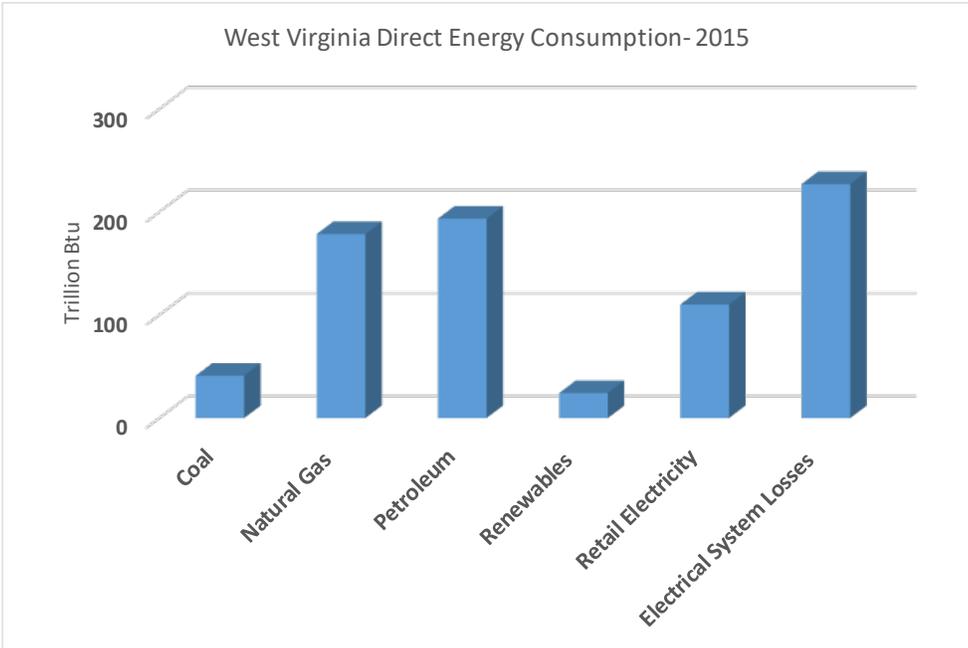
Energy efficiency is intertwined with many emerging technology trends such as grid modernization, smart consumer technology, modern management theory and increasing awareness of the origin of energy sources. Traditional efficiency improvements like thicker insulation, use of movement sensors for lighting and air-sealing are blending with communications, price signals, etc.

In West Virginia utilization of energy efficiency opportunities has expanded in all sectors of the economy, although at a somewhat sluggish/hesitant/slow pace. Noteworthy success stories have been shared at the 2013, 2015 and 2017 energy efficiency conferences, and other energy events hosted by the West Virginia Division of Energy (WVDOE). Several manufacturers have touted the economic benefits of efficiency investments at these events including Bimbo Bakeries, Simonton Windows, Homer-Laughlin China, Koppers, Steel of West Virginia and Quad Graphics. These businesses are pillars of economic activity for the State, and are examples of what is possible when efficiency is prioritized by management.

For the commercial sector, highlights of progress include new and upgraded energy systems at Berkeley County Schools and at the West Virginia Bureau of Prisons. Several of the State’s new buildings are certified by one of the LEED (Leadership in Energy and Environmental Design) standards, meaning the facility has achieved certain levels of sustainability with respect to water use, energy use, materials sourcing, waste management and indoor air quality (US Green Building Council).

Electricity constitutes the largest share of total energy consumption in West Virginia. This resource thus receives the most attention in terms of potential energy savings.

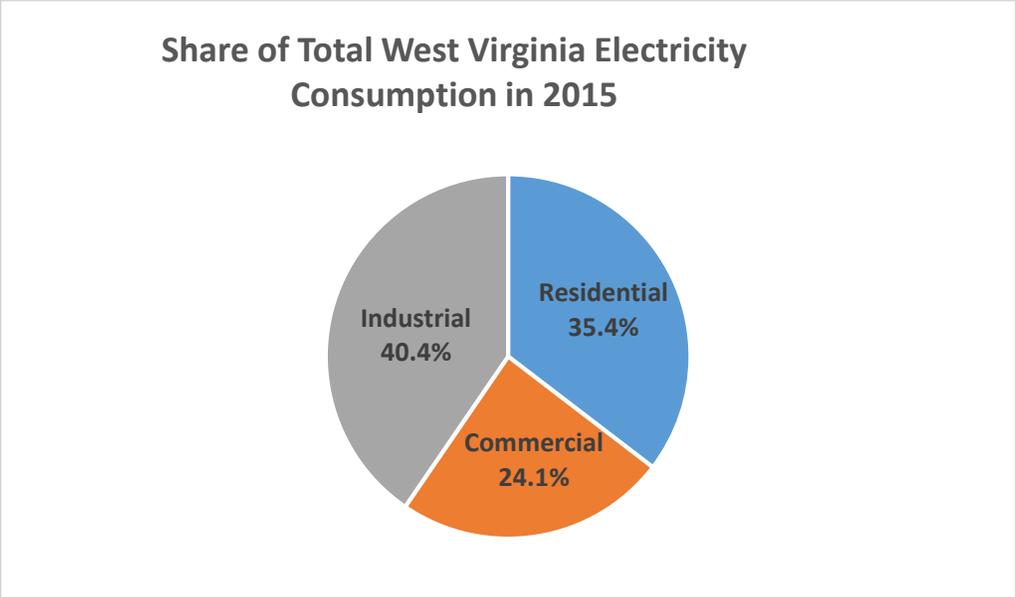
Figure 1 West Virginia Direct Energy Consumption by Resource (Tbtu in 2015)



SOURCE: US DOE’s Energy Information Administration, 2017.

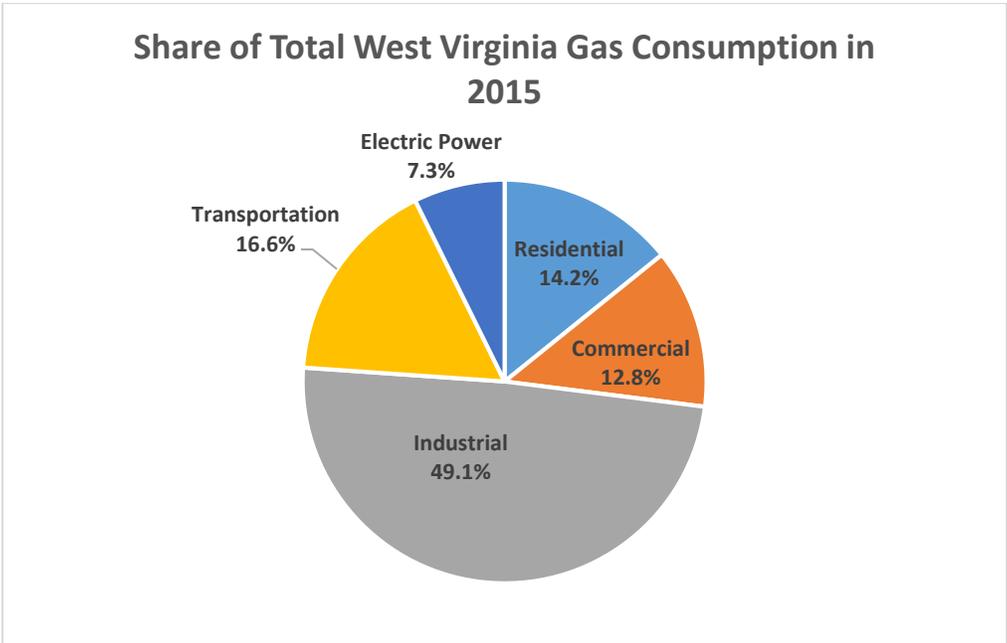
The State’s residential sector continues to have a high amount of total energy consumption relative to other states in the region. Although utility efficiency programs have expanded, there is still room for additional improvements in this sector.

Figure 2 Share of West Virginia Electricity Consumption by Industry in 2015



The industrial sector uses almost half of the natural gas consumed in the State and there are opportunities to increase the efficiency of this usage, as well as electricity and petroleum. About 23 percent of total industrial energy consumption is natural gas (EIA, 2016), a larger share than other sectors.

Figure 3 Share of West Virginia Natural Gas Consumption by Industry in 2015



National efficiency trends include increased market penetration of energy efficient appliances such as light-emitting diode (LED) bulbs, but adoption still is not near fulfilling energy-savings potential. As of 2014 only 143 of 4,896 TBtu (trillion Btus) in potential source energy savings from LEDs were being realized (USDOE, 2015). Most opportunities are in “linear fixtures”¹ and “low/high bay” indoor lighting.

a. State Policy

State energy policy, including that related to utility programs, is important because it represents the degree of official support for efficiency as a resource. State support can be a driver for public support and increased adoption of efficient practices. Primary areas of efficiency activity a state can affect regard: 1) utility program spending, by mandating and approving spending plans; 2) management of State buildings; 3) adoption of building codes, and 4) spending of U.S. DOE program funds to support efficiency.

The State has promoted efficiency via West Virginia Public Service Commission (WVPSC) approval of utility spending on efficiency programs. These programs are the most widespread efficiency initiatives in West Virginia as they are available to all electricity customers, outside of rural cooperatives. These connections make utility programs highly significant. Continuing these programs will spread the momentum and expertise that has been created over the last five years and hopefully allow increased levels of energy savings.

State and local government buildings also include outstanding examples of energy savings from performance contracting. Many of these projects have leveraged funds by also taking advantage of rebates available from the utility programs. In some cases, such as for the City of Morgantown, savings have exceeded expectations (West Virginia Energy Services Coalition, 2017). Other entities that have effectively utilized energy performance contracting include the City of Huntington and Cabell County.

Regarding building codes, West Virginia has adopted the 2015 versions of residential and commercial building codes at the State level. The residential energy code is the 2009 International Energy Conservation Code and the commercial energy code is ASHRAE 90.1-2007. However, because codes are voluntarily enforced at the local level, not all buildings are being built to the specification of these codes, which means the energy savings benefits are only being partially realized.

The WVDOE has also used discretionary SEP funds for efficiency upgrades and to promote efficiency. The WVDOE’s High Performance Schools initiative promotes performance contracting for county school systems and is working to develop a National Energy Education Development Project (NEED) curriculum that includes emphasis on high efficiency schools as well as general energy education. Another example is the State’s use of rebates from Appalachian Power to install lighting upgrades at State Parks in 2015 and 2016.

b. Federal Policy/Funding

West Virginia receives federal funding that increases the energy efficiency services the State can provide. These funds support low-income weatherization, via the West Virginia Office of Economic Opportunity, industrial efficiency auditing and engineering services via West Virginia University’s Industrial Assessment Center (IAC), Manufacturing Extension Partnership (MEP) and Projects with Industry (PWI), and West Virginia’s State Energy Program (SEP). The WVDOE uses SEP funds to support

¹ All troffer, panel, suspended, and pendant luminaires, as well as LED linear replacement lamps.

miscellaneous energy efficiency and renewable energy efforts, including annual conferences devoted to these activities in West Virginia. All the programs are funded by the USDOE's Office of Energy Efficiency and Renewable Energy (EERE).

The industrial efficiency initiatives are all managed by West Virginia University (WVU). These programs have provided energy efficiency advice to many manufacturers in the State and are at the forefront of regional industrial efficiency trends and best practices. The WVU IAC is one of 24 such centers around the country that provide free energy assessments to small and medium-sized manufacturers and is housed in WVU's College of Industrial and Management Systems Engineering. The WVU Department of Mechanical and Aerospace Engineering's "Projects with Industry" program is part of USDOE's former Industrial Technologies Program. Since 2005, the IAC has conducted more than 527 industrial assessments in West Virginia, and recommended more than 10 Tbtu in energy savings measures representing \$90 million in potential cost savings (USDOE, 2016).

In the FY 2018 budget proposal submitted by USDOE the funding request for the office of EERE is \$1.4 billion lower than in FY 2017. The Weatherization and State Energy subprograms are eliminated with a justification "to reduce Federal intervention in State-level energy policy and implementation (USDOE, 2017)." Funding cuts may also impact USDOE support for Regional Energy Efficiency Organizations (REEOs). REEOs work to "help drive the power of energy efficiency" (Southeast Energy Alliance, 2014), in part by promoting adoption of current energy code.

West Virginia and California are the only two lower-48 states that are not affiliated with a REEO (Building Codes Assistance Project, 2017). Although West Virginia may have been able to more actively pursue efficiency by partnering with a REEO, the State has advanced energy efficiency on its own via code adoption and promotion of efficiency through use of other USDOE funds.

c. Utilities

The utility programs are very important as they are the primary means of incentivizing efficiency investments for households and businesses outside of the manufacturing sector. Analysis of potential efficiency savings for West Virginia by the American Council for an Energy Efficient Economy (ACEEE) estimates that the most energy savings potential would come from utility programs (ACEEE, 2014).

In 2012, when the previous five-year energy plan was completed, the electric utility efficiency programs were brand new. Since then, the two programs have saved about 70 GWh of energy per year, equivalent to about 0.2% of total WV electricity consumption (Appalachian Power, 2016) (FirstEnergy, 2016). By comparison, other regional states have saved in the range of 0.1% to 1.0% in electricity from their utility programs (ACEEE State Scorecard). Of the 11 regional states, including West Virginia, six have saved between 0.5 percent and 1.0 percent of electricity annually while five save less than 0.5 percent. This is evidence that West Virginia's programs will also be able to increase savings, perhaps with more robust offerings, increased marketing and more experience.

The efficiency programs offered by the utilities are summarized below. Both utilities offer online energy checkups in addition to these options.

Appalachian Power

Appalachian Power and Wheeling Power, branches of American Electric Power (AEP), offer several efficiency incentives (Appalachian Power, 2017).

- Take Charge Efficient Products Program. A rebate program for lighting and electric appliances. Lighting costs can be reimbursed on up to 12 LED light bulbs purchased via in-store discounts or rebates. Eligible appliances include refrigerators, freezers, dehumidifiers, and air purifiers. Appliances must be Energy Star certified and purchased between January 1 and December 31, 2017. Refrigerators and air purifiers offer a \$50 rebate; freezers and dehumidifiers offer \$25.
- The HomeSMART Energy Assessment Program involves a specialist examining a residence and installing basic efficiency improvements. The assessment is free and takes 1-2 hours to complete. For electrically heated homes, an additional fee option is an air leakage assessment with a blower door test to identify serious air leaks. This test take 3-4 hours by a trained specialist and has a cost of \$50. HVAC equipment, insulation and sealing rebates are also available for electrically heated homes as part of this program.
- Residential AC peak reduction program. AC load is reduced by the utility when the greater electric system demand is experiencing a summertime peak. Participants receive a bill credit.
- Manufactured housing program. Offers a \$1,300 rebate to producers of ENERGY STAR Manufactured homes.
- Low-income weatherization. Provides funding to the State of West Virginia to supplement weatherization programs. Qualifying household income is up to 200% of the poverty guidelines.
- Take Charge WV for commercial and industrial (C&I) customers. This program offers the same incentives offered to residential customers, in addition to a custom incentive program. Standard projects include upgrading equipment to high efficiency models, upgrades to LED lighting, and single energy efficient projects for new buildings. Custom projects include more than one equipment upgrade, additions and new construction over 500,000 kWh, new buildings with more than one energy efficient project, and upgrades not included in the standard program. All custom projects must be pre-approved before construction begins. The standard projects receive \$0.06/kWh saved while the custom program offers \$0.07/kWh. The rebates for these projects cover up to 50% of the overall project cost. Various retrofits are offered in addition to these programs and rebates vary based on the type of facility (i.e. grocery store, manufacturing, etc.). Lighting retrofits can be fluorescents, LED, and high intensity discharge (HID).

Appalachian Power has proposed an expansion of its efficiency programs beginning in 2018. If approved, new programs will include a multifamily direct install, small business direct install, “bring your own thermostat” and expanded volt var optimization. Direct install programs combine energy assessments and installation of retrofits managed by a single contractor.

FirstEnergy

The efficiency programs of Potomac Edison and Monongahela Power, subsidiaries of First Energy, are comprised of the following incentive programs.

- Home Energy Analyzer, a low-income home checkup program, residential energy conservation kit and lighting rebates for C&I customers. The Home Energy Analyzer can be completed by registering online with a current electric bill which then is used to calculate energy use in the household.
- Rebates can be received for Energy Star appliances and for the purchase of LED lightbulbs. Residents can also apply for a free energy conservation kit that includes six LED lights of varying wattages, one CFL bulb, a furnace whistler, and two LED night lights.

- For low-income residents, lightbulbs, refrigerator testing, showerheads, faucets, power strips, and other items are also available.
- The FirstEnergy C&I lighting incentive program is managed by LEIDOS, the program implementation vendor, and offers rebates for a wide array of lighting measures. These include CFL fixtures, lighting controls, exit signs, LED fixtures (both internal and external), traffic signals and street and area lighting. Pre-approval is required for all new projects and incentives are offered on a first come, first serve basis. This and other FirstEnergy programs will run through May 31, 2018 (FirstEnergy, 2016).

II. Previous 5-Year Plan Recommendations and Actions Taken

The previous 5-year plan evaluation recommendations were (West Virginia Division of Energy, 2012):

- Support the adoption of the 2009 IECC and 2007 ASHRAE standards for state-funded construction and public buildings.

These standards were adopted via legislative and gubernatorial action. The West Virginia Legislature passed and Governor Tomblin signed the “Green Buildings Act” requiring “new building construction projects of public agencies and projects receiving state funds to be designed and constructed in compliance with these codes (WV Legislature, 2012).” The 2009 IECC and ASHRAE 90.1-2007 are effective for residential and commercial buildings, respectively, but are not enforced at the State level.

- Energy code adoption should be no further than one series of codes behind the most recent version.

The 2015 IECC is now in play, and the 2018 version will soon be released, making the adopted 2009 code three series behind the most recent. A code study undertaken by the Home Builders Association of West Virginia (HBAWV) in 2016 assessed the residential energy code compliance rate for West Virginia by measuring how closely new homes built in West Virginia meet the energy specifications within the 2009 IECC. The results revealed that, on average, code is being met for some criteria, e.g. windows, but not for others, e.g. installation of high efficacy lamps.

A more significant issue is the fact that code enforcement is voluntary by jurisdiction. Because codes are only adopted county-wide in eight West Virginia counties many new building do not have to comply. Due to these compliance issues, it is not practical for the State to adopt a more recent energy code until it is feasible (or mandatory) for builders to comply with the currently adopted version of the code.

- Consider the appointment of an energy management specialist to an ex-officio role with the State Fire Commission to provide the expertise and advocacy necessary to ensure the future promulgation of updated building energy codes in the rulemaking process.

No action was taken regarding this recommendation. The Commission does have an architect position who is knowledgeable regarding energy codes, but there is no dedicated efficiency specialist position.

- Make training on energy codes and energy efficient building components available to home builders, local governments, and the built community.

The WVDOE has supported training of residential builders using SEP funds. Training is currently underway via the HBAWV, including for HERS (Home Energy Rating Specialist) certification, one of the most recognized systems for inspecting, testing and calculating a home's energy performance. Local training will soon be conducted on the 2009 standards adopted by the State. This training will expand the number of builders who have received nationally recognized training and who are familiar with the details of the current energy codes.

- Continue providing energy services to West Virginia manufacturers in order to maintain a competitive advantage in energy costs. This enables West Virginia to preserve a low energy cost environment that has been a recruitment and retention incentive for energy-intensive industries.

This work has continued, via the Industrial Assessment Center and Manufacturing Extension Partnership at WVU. In addition to the recurring IAC grant, SEP funds are set aside for firms that are either below or above the energy consumption criteria established by DOE for the IAC centers. These additional funds have expanded the number of manufacturers that are eligible to receive energy assessments.

- Provide technical assistance to manufacturing and small businesses using the resources of Projects with Industry Program, Manufacturing Extension Partnership and Industrial Assessment Center.

Activity matching this recommendation is the same as above.

- Establish benchmark programs for state buildings, county school systems and local governments. Benchmarking programs, such as the ENERGY STAR[®] Portfolio Manager program, will allow decision-makers to effectively assess energy efficiency and take the necessary actions needed to increase energy savings in these facilities.

Mixed actions have been taken regarding this recommendation. Several State agencies have taken advantage of the Appalachian Power and FirstEnergy efficiency program rebate opportunities and have undertaken multiple upgrade projects at State-owned buildings throughout West Virginia. No formal energy benchmarking initiative has been undertaken, although energy usage is tracked by the General Services Division, using building square footage as the primary metric to track individual buildings and prioritize upgrades. These activities are a part of broader cost-savings efforts that include a reduction in the number of buildings leased by the State (West Virginia General Services Division, 2017).

- Establish, in concert with electric utilities, an energy savings target for utility energy efficiency initiatives. This will help reinforce the concept that energy efficiency is a quantifiable energy resource.

No action was taken regarding this recommendation. Utility and regulatory support for an energy savings target is low.

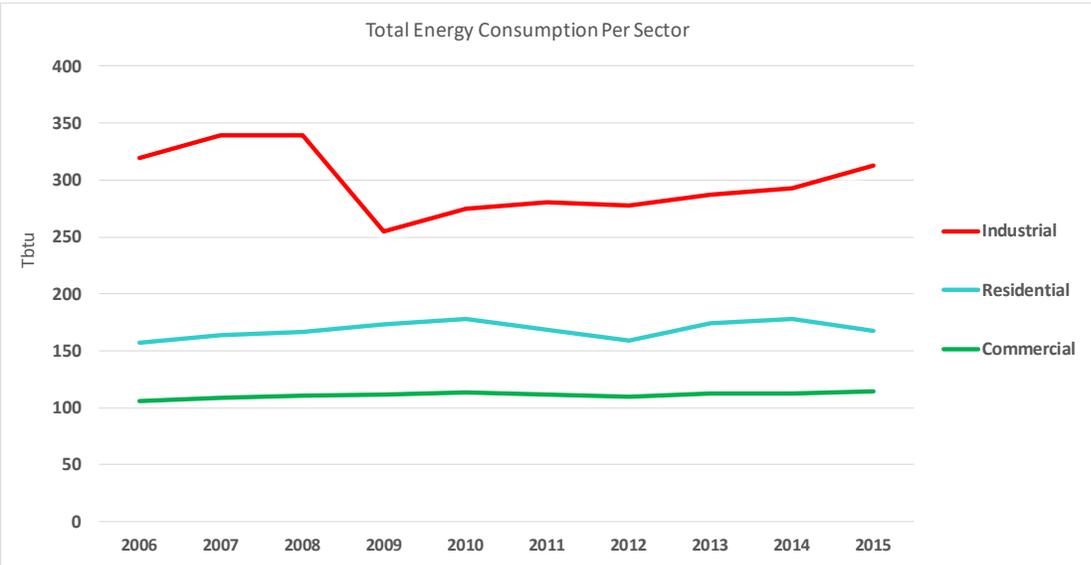
III. Energy Efficiency Opportunities

There are many opportunities to expand and initiate energy efficiency measures in West Virginia. Several opportunities recommended in the previous 5-year energy plan have not been acted on and are still opportunities. Examples are to appoint an energy efficiency expert to the State Fire Commission and to develop comprehensive benchmark programs for energy usage in State facilities. Additional opportunities have since been identified and are available in all sectors of the economy.

a. Opportunities by Sector

The following chart depicts total energy consumption for the residential, commercial and industrial sectors of the West Virginia economy. The industrial sector is more sensitive to economic trends, as shown by the decline in consumption during the Great Recession, while the commercial sector appears to be the least responsive.

Figure 4 Total West Virginia Energy Consumption by Sector, 2006-2015 (Tbtu)



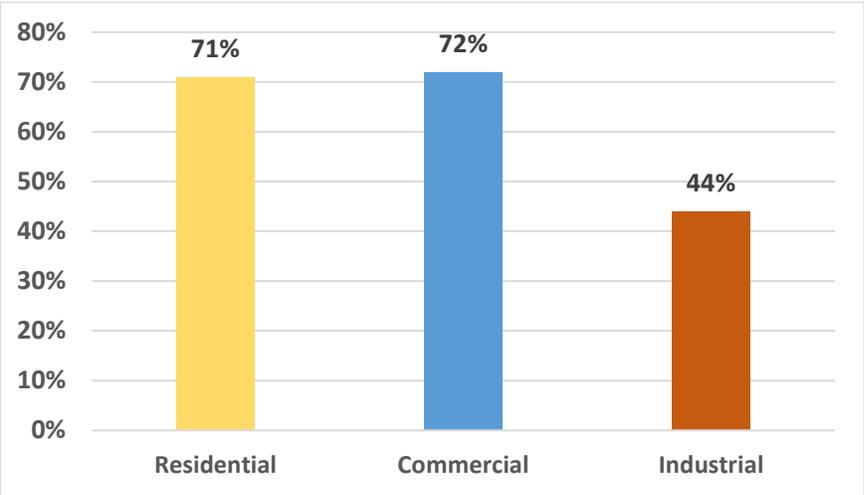
Industrial Sector

The impacts of implementing industrial energy efficiency may have the greatest overall effect on West Virginia due to the importance of that sector to the State’s economy. In 2015, manufacturing made up 7 percent of total direct private employment in West Virginia and 10 percent of the state’s total economic output (WVU School of Law, 2017).² Investments in efficiency are investments in operations, and can reduce costs, improve working conditions and extend the life of a facility.

West Virginia’s industrial sector consumes about 49% of natural gas and 40% of electricity used in the State. Overall, electricity is smaller share of the sector’s total energy consumption (44%) compared to the commercial (72%) and residential sectors (71%) while natural gas is a larger share.

² These percentages would be higher if including indirect employment and output.

Figure 5 Average Electricity Share of Total Energy Consumption by Sector, 2006-2015



West Virginia’s manufacturers also maintain positions in the supply chain for energy efficient products. These include chemical inputs to insulation manufacturing, various types of foam and sheet metal fabrication.

A report published by the WVU School of Law asserts that technological innovation associated with both implementing and selling industrial efficiency could have profound impacts for the State. Installing energy efficiency upgrades has cost-savings benefits to industrial facilities which in turn can improve a competitive position and allow expansion. Building businesses based on expertise in industrial systems and management is a potential export industry in sync with rising global demand for energy efficiency products (WVU School of Law, 2017).

The report’s recommendations for realizing these opportunities include:

- Development of ways to expand the State’s industrial EE sector and supply chain – This could include creation of an energy efficiency industry working group, strengthening the State’s foreign direct investment strategy and creating an anchor company tax credit.
- Promotion of a more innovative small business culture – Steps to do this could include creating a philanthropic foundation liaison to interface between funding groups and State government.
- Increasing access to capital – This could include establishing tax credits for investments in startups or creating a “fund of funds” to be a source of capital.
- Support of training in the EE industry, including at high schools and community colleges.
- Creation of demand for industrial EE technology via State policy – Options for this include creating an energy efficiency tax incentive for manufacturers, participation in a REEO, legislating Local Energy Efficiency Partnerships (LEEP) financing and establishing a utility energy efficiency resource standard (EERS).

WVU’s existing partnerships with industry can be a foundation for these efforts. The IAC, MEP and PWI programs already have experience surveying industrial facilities and recommending efficiency upgrades.

These relationships with manufacturers can allow sharing of expertise and know-how regarding potential cost savings.

Residential Sector

West Virginia has the highest residential energy consumption per capita in the 11-state region. Population data show that this is partly a function of the State having the lowest population density and fewest number of people per household. Consumption may also correlate with high demand caused by older, inefficient housing stock.

Table 1 Residential Energy Consumption by State in 2015

Regional State	Delivered Energy to Residential Sector (MMBTUs)	Population in Occupied Housing Units	Consumption Per Capita in Occupied Units (MMBTUs)	Regional Rank	Average Household Size (persons)	Population Density (people per sq. mi.)
Delaware	65,700,000	920,351	71.39	9	2.62	489
Indiana	532,500,000	6,431,175	82.80	4	2.55	185
Kentucky	363,300,000	4,296,254	84.56	2	2.50	112
Maryland	427,200,000	5,866,145	72.82	8	2.67	620
New Jersey	587,800,000	8,772,000	67.01	11	2.73	1,216
North Carolina	693,500,000	9,790,119	70.84	10	2.54	209
Ohio	890,300,000	11,301,278	78.78	5	2.46	284
Pennsylvania	933,500,000	12,372,146	75.45	6	2.49	286
Tennessee	534,000,000	6,446,573	82.83	3	2.53	161
Virginia	610,600,000	8,139,181	75.02	7	2.62	213
West Virginia	167,100,000	1,795,940	93.04	1	2.43	76

Sources: National Multifamily Housing Council, EIA and US Census.

Although West Virginia has adopted the 2009 International Energy Conservation Code (IECC) for new residential buildings, the standard is not fully represented in new housing. In addition, significant retrofit opportunities exist for existing housing.

Appalachian Power has stated that residential customers had been slower to take advantage of rebates offered for efficient appliances, although that this uptake improved after the utility began outreach to contractors (Appalachian Power, 2016). Part of this is likely due to an inability to afford new appliances, even with rebates. Eligibility limitations also restrict the number of households that can utilize the utility’s rebates that improve HVAC system efficiency.

In 2015, 41% of West Virginia households used natural gas as their primary heating fuel and 44% used electricity as primary heating fuel (US Census of Housing, 2015). The share of households using electricity is an increase over the year 2000, when only 32% of homes were primarily heated with electricity (US Census of Housing, 2000). Natural-gas heated homes are not eligible to utilize the Appalachian Power rebates through the utility’s HomeSMART program (Appalachian Power, 2017). Thus, only 44% of residential electricity customers are able take advantage of incentives for insulation, air sealing, and HVAC system maintenance and upgrades.

FirstEnergy's residential efficiency programs only offer rebates for Energy Star Appliances and LED lightbulbs. To date, HVAC systems and related upgrades are not part of the program.

Commercial Sector

The commercial sector of the economy is a portfolio of buildings with a wide range of functions and energy usage needs. The sector includes Federal, State, and local governments, other private and public organizations, such as religious, social, or fraternal groups, institutional living quarters and sewage treatment facilities (EIA, 2017). Like the residential sector, energy usage is dominated by electricity. As shown in the chart above, total commercial energy usage has ticked up by less than one percent per year in the last 10 years in West Virginia.

As with residential structures, although West Virginia has adopted the 2007 ASHRAE Standard 90.1 for new commercial buildings, the standard is not fully represented in new buildings. In addition, significant retrofit opportunities exist.

For Appalachian Power's efficiency program, rebate incentives have more heavily utilized by commercial customers than by the residential customers (Appalachian Power, 2015). The utility's commercial and industrial (C&I) program has resulted in more energy savings than any other program (Appalachian Power, 2016). This shows that demand exists for these opportunities to reduce costs via energy savings.

The former Director of the West Virginia Division of Energy, Jeff Herholdt, stated that "significant opportunities remain" when discussing energy efficiency opportunities in State government facilities (WVDOE, 2016). While efficiency improvements are ongoing within the State facilities, efficiency can be integrated more broadly.

b. Regional State Comparison

Regional states offer the opportunity to observe other formal efforts to deploy energy efficiency.

Employment Indicators

Tracking employment related to energy efficiency is a way to follow growth of the efficiency industry. Compared to regional states, West Virginia lags in terms of growth in several efficiency-related occupations. Since 2006 the State has seen an increase in the number of materials scientist occupations and a decline in the number of insulation workers, at rates like what the nation as a whole has experienced. However, for some growth occupations, e.g. HVAC technicians, business operations specialists, environmental engineers and machinists, West Virginia's employers are not in pace with the nation.

West Virginia is not the only state in the region with trends that differ from the U.S. The reasons for these differences are not all attributable to lack of efficiency but are likely due largely to the lack of economic growth in West Virginia.

Data on these select occupations is shown in the table below, for West Virginia and neighboring states. A brief description of each occupation is also provided, based on definitions from the U.S. Bureau of Labor Statistics. Some of these occupations are management positions where energy efficiency would be one of several areas of expertise that an individual would evaluate when making decisions, e.g. business operations specialists and industrial engineers and managers.

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Table 2 Trends in Efficiency-Related Occupations in Regional States (# jobs in 2007 and 2017)

State	Business Ops Specialists		Insulation Workers		HVAC Technicians		Environ. Engineers and Technicians		Industrial Engineers and Technicians		Industrial Production Managers		Machinists		Materials Scientists	
	2007	2017	2007	2017	2007	2017	2007	2017	2007	2017	2007	2017	2007	2017	2007	2017
WV	2,897	2,871	212	178	1,555	1,349	473	469	950	810	747	602	1,910	1,563	47	54
VA	29,006	31,468	2,460	2,011	11,124	10,142	1,755	1,846	5,452	4,785	2,729	2,191	6,747	6,625	281	269
KY	7,806	8,264	733	640	3,670	3,875	613	728	5,081	5,500	3,808	3,857	6,233	6,815	51	52
PA	19,435	18,423	1,636	1,304	12,777	13,055	3,803	4,305	12,217	11,328	7,146	6,218	19,990	19,506	326	328
MD	20,869	23,074	942	751	6,076	6,166	1,403	1,607	3,695	3,408	1,719	1,430	2,989	2,803	94	101
OH	29,625	32,087	1,753	1,560	10,323	11,219	1,581	1,628	18,003	17,531	11,922	11,190	28,613	28,504	355	400
US	889,563	970,522	66,477	57,300	283,047	296,603	65,037	73,350	323,448	316,653	184,517	172,259	384,711	394,228	6,396	7,130

Source: EMSI, 2017.

Business Operations Specialists: This occupation includes the subcategories of Energy Auditor and Sustainability Specialist. Energy Auditors improve the operation and efficiency of buildings and systems. Sustainability Specialists develop sustainability project goals and strategies.

Environmental Engineering Technicians: Implement plans developed by Environmental Engineers such as testing pollution control equipment, performing air quality tests, and removal of hazardous materials.

Environmental Engineers: Use principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems.

Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) Technicians: Perform repairs on HVACR systems in buildings.

Insulation Workers: Install and replace materials used to insulate buildings and the mechanical systems that heat, cool and ventilate buildings.

Industrial Engineers: Design and evaluate systems to manage industrial processes, including human factors, quality, inventory, logistics, and cost.

Industrial Engineering Technicians: Apply engineering principles to production problems, often to establish standard rates or improve efficiency.

Industrial Production Managers: Plan work activities and resources necessary to manufacture products in accordance with output specifications.

Machinists: Set up, fabricate, modify, repair and operate a variety of machine tools to produce precision parts and instruments.

Materials Scientists: Research the structures and chemical properties of natural and synthetic or composite materials, and determine ways to strengthen or lighten materials.

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Policy Comparison

Highlights of major types of energy efficiency policy or other indicators of efficiency initiatives are shown in the following table for the 11 regional states. The Effective Residential and Commercial Building Code Year columns refer to USDOE's assessment of the energy savings impacts caused by implementing a state's adopted energy code. An indicator of <2012/2015 means that the state is achieving a greater energy savings than what the 2009 code induces but that the amount saved is actually in between the 2009 and 2012/2015 code specification.

West Virginia is on par with several other regional states in implementation of residential code but lags other states, along with Indiana, in commercial code. The table also shows that utility efficiency programs can achieve good levels of energy savings both with and without an Energy Efficiency Resource Standard (EERS) although states with an EERS tend to have greater savings. Neighboring states offer many examples of State programs that promote and deploy efficiency in public buildings.

Table 3 Regional State Energy Efficiency Metrics as of 2016

State	Effective Resid. Building Code Year	Effective Comm. Building Code Year	ACEEE CHP Support Score	% of QECBs issued	ACEEE Score for State Gov't (max 7)	State Led Financial Incentives	Electric Utility Savings-% sales	Gas Utility Savings-% sales	Gas % of Heating Fuel (2015)	EERS Target Electricity Savings %	Electric Utility Perf. Incentives
Delaware	2012/2015	<2010	1.5	0	4.5	Yes	0.19	0.01	41%	NA	No
Indiana	2009	2007	0.5	36	1.5	Yes	0.76	0.35	61%	NA	Yes
Kentucky	2009	<2010	0.5	100	5	Yes	0.36	0.43	38%	NA	Yes
Maryland	2012/2015	<2013	4	18	5.5	Yes	1.01	0.08	45%	2.0%	No
North Carolina	<2012/2015	<2010	1	8	4	Yes	0.62	0.11	25%	0.4%	Yes
New Jersey	<2012/2015	2013	1.5	0	2	Yes	0.55	0.21	74%	NA	No
Ohio	2009	<2010	1.5	68	4	Yes	0.92	0	67%	0.6%	Yes
Pennsylvania	2009	<2010	2.5	32	5	Yes	0.64	0.02	51%	0.8%	No
Tennessee	<2009	<2010	1	53	6	Yes	0.19	0	33%	NA	No
Virginia	<2012/2015	<2010	0	23	5	Yes	0.06	0	34%	NA	No
West Virginia	2009	2007	0.5	0	0.5	No	0.19	0	41%	NA	No

Sources: ACEEE State Scorecard, PJM, USDOE.

Kentucky

Kentucky is a good example of what a state much like West Virginia has pursued with respect to energy efficiency. Kentucky has energy efficiency requirements for all public buildings, including LEED certification on all new buildings, benchmarking of energy use, and encourages the use of energy savings performance contracts (ESPCs). The Conn Center for Renewable Energy Research at the University of Louisville conducts research on renewable energy and energy efficiency.

Two financial incentives Kentucky offers are the School Energy Managers Project (SEMP) and Kentucky Home Performance with Energy Star (KHP). The SEMP provides matching funds to employ trained energy specialists or energy efficiency upgrades in schools. The program has a goal to reduce energy use by 5% from a 2012 baseline. The KHP promotes energy efficiency by funding retrofits. This program has completed almost 1,200 single family retrofits.

Maryland

Maryland currently ranks 9th highest in the ACEEE Scorecard for dedication to energy efficiency. The State offers a multitude of energy efficient tactics such as Property Assessed Clean Energy (PACE) Financing, requirements for public buildings, benchmarking of energy use, and encourages use of ESPCs. Maryland currently has two research centers dedicated to energy efficiency.

Maryland also maintains a Roadmap for Energy Efficiency in State Buildings. This program calls for 20% energy savings in state facilities by 2020. The state also has a High Performance Green Building Program, started in 2008, that requires all fully state-funded building projects, K-12 schools, and Community College buildings larger than 7,500 gross square feet to be LEED Silver certified and to achieve a 30% mandatory reduction in energy use.

The State of Maryland has also encouraged state agencies to reduce energy consumption by creating a competition between the largest energy-consuming agencies to reduce their energy use (USDOE Better Buildings Initiative, 2017).

Pennsylvania

Pennsylvania ranks 19th on the overall ACEEE Scorecard. This state achieves this in part due to its grant, loan, and financing incentives. The State maintains a goal for public building energy efficiency and recommends use of ESPCs to do so. About 39 public buildings utilize ESPCs. As of 2013, all new public buildings over 20,000 square feet must have high performance standards and receive an Energy Star score of 75 or higher. Pennsylvania has 4 facilities that are currently working on energy research.

An energy efficiency loan program offered through the State is the Green Energy Loan Fund. This fund offers funding for retrofits, installation of new, energy savings equipment, and high performance energy systems in buildings throughout the state.

Virginia

The State of Virginia has recently increased its support of energy efficiency through several high-level actions. These included establishing the Governor's Executive Committee on Energy Efficiency, creating the position of Chief Energy Efficiency Officer and streamlining the energy performance contract process by developing a guide for stakeholders, all recommendations of the State's 2014 Energy Plan (State of Virginia, 2016).

c. Policy Options

To expand energy efficiency in West Virginia, various policy options could be pursued. Fortunately, some of the most promising opportunities can leverage existing but nascent programs that are already in place in West Virginia, e.g. the utility programs.

The ACEEE estimates that WV could save up to 23 percent of 2012 electricity demand by the year 2030, by implementing four of its policy recommendations (ACEEE, 2014). These four policies are:

- 1) Energy savings target for utility programs – This is a State-directed policy like a renewable portfolio standard, where energy savings are mandated as a specific percentage of total electricity sales.

About 75 percent of estimated savings is believed to be from utility energy savings targets. ACEEE also estimates that utility savings in WV could be achieved for an average cost of \$46.18 per MWh saved (ACEEE, 2014). While a mandatory energy efficiency resource standard (EERS) does send a strong signal that efficiency is important to the public, significant energy savings can be realized without an EERS. Planning for the existing utility programs to become more permanent in nature, and to evolve to add more and different consumer options over time, will likely produce an increase in savings.

- 2) Enforcement of updated building codes – This is a State-led initiative, where current energy conservation standards are adopted state-wide and incorporated in all new homes and buildings via strict code enforcement.

About 19% of ACEEE's estimates of energy savings in West Virginia would come from code enforcement. As discussed above, it is currently impractical to adopt more recent versions of code due to inability to comply fully with current code. Efforts should be directed toward training builders to comply with current code before moving to more recent versions of the code.

- 3) Constructing combined heat and power systems

Combined heat and power (CHP) systems generate both electrical energy and useful thermal energy from one fuel source at a host customer's facility or residence (NREL, 2016). CHP systems are also referred to as cogeneration. While these systems are highly efficient, achieving up to 80% efficiency (NREL), the high cost is a persistent barrier to investment. The ability to achieve a desirable return on investment is often related to avoided electricity rates and the presence of incentives.

Recent years have seen more growth in CHP systems for multi-family residential buildings, a segment that saw capacity grow by 46% between 2011 and 2016. The trends driving this are development of smaller CHP systems, and the need to replace older boiler systems (Utility Dive, 2016).

State policies that encourage CHP include tax credits, low-interest financing and inclusion of CHP in portfolio standards. It is assumed that the WV manufacturing tax credit would apply to new or retrofitted CHP systems, but given the major investment that a CHP system requires the current 5% tax credit may not be enough to justify the expense.

- 4) Establishing equipment standards - These are State-mandated minimum efficiency levels for new appliances, equipment, and/or lighting. Products that do not meet the standard cannot be sold or installed in the State.

The only states in the U.S. that have their own appliance efficiency standards are California, Connecticut, Oregon and Colorado. Of these, only California has an extensive program to do so (ACEEE scorecard). This opportunity should not be a priority for West Virginia, given the larger opportunities in other areas. Encouraging purchase of Energy Star appliances, via incentives like tax holidays, as was done in the past, may be a good substitute.

Guidelines and Relevance to West Virginia

Guidelines are available to help governments decide how and which efficiency policies to pursue. The group of Regional Energy Efficiency Organizations (REEOs) has assembled a “how to” list of strategies for successful energy efficiency policy (Southeast Energy Alliance, 2014). Many of these strategies are at least somewhat in play in West Virginia, although many could be utilized more heavily.

1. Provide incentives to encourage utilities to capture as much cost-effective efficiency as possible, and link efficiency to broader public policy goals.

West Virginia allows electric utilities to earn a return on any EE/DR expenditures made using the utilities’ own funds. The WVPSC allows utilities to receive a return at the rate equal to each company’s weighted average cost of capital, provided such expenditures are declared prior to each calendar year, including the projected costs and benefits for these programs (WVPSC, 2014). Adding a performance incentive to this allowance may induce additional savings.

2. Ensure adequate, stable, long-term funding for efficiency programs.

While it may be assumed that the WVPSC will continue to approve expenditures on utility efficiency programs, there is no policy in place that ensures the programs have longevity.

3. Allow for robust stakeholder input and engagement — ideally through a standing advisory board with expert consultants — to help deliver long-term savings goals.

Both utility efficiency programs have stakeholder working groups that meet annually to provide feedback on programs.

4. Ensure that investor-owned utilities are not harmed financially when they help their customers to save energy.

The WVPSC allows utilities to recover lost revenues associated with efficiency programs, which ensures that expected rates of returns are realized.

5. Advance policies and programs that enable a whole-building approach with an eye to total energy savings.

Various State and local government agencies have utilized performance contracting to finance energy savings in new and existing buildings, an approach that is often whole-building. This type of approach could be more heavily utilized.

6. Support complementary public policies such as building energy codes, building energy rating and disclosure, appliance efficiency standards, and “lead by example.”

The State has made progress on building energy codes and has some buildings that are very good examples of efficient design but more can be done in this area.

7. Integrate energy efficiency into long-range state energy and air quality planning.

Efficiency has been partially incorporated into long-range electricity supply planning in West Virginia. The State’s electric utilities submitted their first integrated resource plans to the WVPSC in 2015, which incorporate estimates of demand savings due to efficiency. Appalachian Power’s IRP incorporates efficiency savings estimates through 2025, but FirstEnergy only addressed savings through 2018 (Appalachian Power, 2015) (FirstEnergy, 2015).

8. Foster a supportive and flexible regulatory framework on issues such as cost-effectiveness.

West Virginia’s electric utilities conduct cost-effectiveness tests for program spending and results and include that information in filings to the WVPSC. The results of these tests could be shared more broadly to promote understanding of the relationship between program expenditures and energy savings.

9. Support greater transparency and consistency in evaluation, measurement and verification (EM&V) of program savings.

EM&V results for West Virginia’s electric utility efficiency programs are included in filings to the WVPSC. The methods utilized by the EM&V contractors could be shared more broadly.

10. Continually demonstrate the value proposition of energy efficiency by sharing success stories.

The State of West Virginia organizes public conferences that highlight success stories and allow efficiency experts to share information. The Governor’s annual energy efficiency awards for Excellence in Industrial Energy Efficiency and Leadership in Advanced Green Manufacturing demonstrate a high-level appreciation of the role that efficiency plays in industrial innovation and competitiveness.

Building Codes

As discussed prior, the fact that code enforcement is voluntary by jurisdiction and because codes are only adopted county-wide in eight West Virginia counties means many new buildings do not have to comply with the currently adopted versions of the codes. Due to these compliance issues, it is not practical for the State to adopt a more recent energy code until builders can comply with the currently adopted version of the code. Efforts will be best spent working toward energy savings possible with current versions of code for private construction.

Training to current code is an important part of realizing energy savings. The 2009 IECC and ASHRAE 90.1-2007 are the effective codes for residential and commercial buildings, respectively. If adopted state-wide these codes apply to all new buildings constructed. The State should continue supporting the work currently being undertaken by the HBAWV and other organizations that are training building contractors to build to the 2009 IECC and ASHRAE 90.1-2007. Such training will expand the number of homes and businesses that are built to code and achieve the associated energy savings.

Public Facilities

For public buildings, the State can go beyond the 2007 commercial code. Newer State-owned buildings are LEED Silver certified and are exemplary examples of modern, efficient facilities. Over the last few years the State has also greatly reduced that average square footage of real estate managed per employee (WVGSA, 2017). State agencies do take advantage of Appalachian Power's energy efficiency program offerings for capital improvements and lighting, and have increased the integration of energy usage data with other building data, e.g. occupancy data.

There is room to implement additional energy efficiency and to elevate the importance of the resource. Some possible strategies are outlined below.

Reissue outreach materials to State employees regarding efficient practices.

To further reduce waste in government facilities, the WVDOE or the Governor's office could produce an outreach publication to promote energy efficiency in public buildings directed toward State employees. This could be an update to the 2008 "Energy Conservation Policy Guidance" memo sent from the Governor's Office to cabinet secretaries and department heads. The memo specified heating and cooling temperature standards, protocols for use of ancillary appliances, e.g. individual refrigerators, space heaters, etc. and lighting.

This type of program would send a message that energy efficiency is important to the State's leaders.

Modernize State contracting rules that pertain to utilization of energy performance contracting

While energy savings performance contracting is established in West Virginia, the statute governing the purchasing requires these contracts follow the same guidelines used for construction projects, in that the lowest bid must be accepted. This is problematic because the value of this type of contracting comes from the energy saved, not from the cost of the contract. The lowest bidder may not save the most in terms of avoided energy costs for the facility.

Removing the low bidder requirement would increase the value of such contracting. Allowing use of "job order contracting" may accomplish this.

Expand benchmarking and energy management in State buildings

Benchmarking programs are an easy way to track and maintain the energy usage of buildings. These programs can also be used to compare similar buildings to each other, i.e. a bank to other banks of the same size. Certain data must be collected for all buildings, such as gross floor area, irrigated area, construction beginning and end date, occupancy, and a year's worth of monthly energy usage data.

The General Services Division of West Virginia already tracks energy consumption per square foot for the buildings owned by the State (West Virginia General Services Division, 2017). Data is used to identify buildings with the highest energy costs and to prioritize upgrades to buildings where efficiency is most worthwhile. As not all older State buildings have had formal energy audits, scheduling such reviews for the State-owned buildings could add a lot of value, especially if funds are already available for retrofits.

The USDOE has developed a list of steps to design benchmarking programs. These are:

1. Establish a goal for benchmarking and ensure the data is collected in an appropriate manner.
2. Receive approval from upper management and develop a benchmarking team.
3. Determine the exact metrics and data needed so the benchmarking team knows what to collect.
4. Select the benchmarking tool that will be used to collect this data.
5. Once data has been analyzed, develop a plan to make the building more energy efficient.

One example is the cost-free Energy Star Portfolio Manager program offered by the USEPA. This program interfaces directly with building management systems to track energy use, identify savings measures that can reduce operating costs, and receive an Energy Star score for the building.

Marshall University uses Portfolio Manager to track energy usage in residence halls, teaching buildings, parking garages, and administration buildings. Tracked data includes weekly operating hours, enrollment, number of full-time workers, number of computers, and grant dollars. With this data, the program can calculate total building use while incorporating human activity. Universities tend to have a large amount of “phantom” energy usage, or load that is constantly plugged in but not always utilized, as well as large seasonal variation in building occupancy.

Financing

West Virginia is the only state in the broader 11-state region that does not have state-sponsored financing available for energy efficiency upgrades. In a 2009 report that focused on Appalachia, West Virginia was one of three states that did not have any financing policies or financial incentive policies for energy efficiency (Georgia Tech, 2009). At the time, Ohio and Pennsylvania also did not provide such financing but those states have now added these programs.

State financing most commonly takes the form of low-interest loans and grants. Other approaches include on-bill financing or on-bill repayment by utilities, operations that West Virginia’s utilities do not currently have.

While it is probably not feasible to develop a State financing program right now due to budget shortages, there are other financing tools available. These regard existing tax incentives and to-date unutilized tools like Qualified Energy Conservation Bonds (QECBs) and LEEP. Performance contracting is also considered financing, as project costs are paid for through energy savings rather than large up-front expenditures.

Qualified Energy Conservation Bonds

QECBs are very low-cost public financing tools that allow state, tribal, and local government issuers to borrow money at very low interest rates to fund energy conservation projects. These bonds are subsidized by the U.S. Department of the Treasury. West Virginia had been allocated \$18.8 million in funding, the State has not yet authorized use of its allocated funds (USDOE, 2014).

QECBs have been an alternative to state-financed funding as the funds come from USDOE rather than the state budget. That opportunity may have passed, as at least one organization was lobbying in 2016 for Congress to rescind all remaining QECB issuance capacity (The Heritage Foundation, 2016).

Local Energy Efficiency Partnerships

Local Energy Efficiency Partnerships (LEEP) financing is based on property value and is used to fund energy efficiency improvements to private property. Up-front costs are financed based on the value of a business's property tax ticket and the energy savings are used to pay off the investment. Authorizing LEEP financing in West Virginia would expand options for businesses to invest in energy efficiency facilities and equipment.

Property Assessed Clean Energy (PACE) financing is a very similar tool that is geared toward renewable energy as well as energy efficiency investments. PACE-enabling legislation is active in 33 states and D.C., and PACE programs are launched and operating in 19 states and D.C. (PACE Nation, 2017).

Legislation that authorized LEEPs was reintroduced in the 2017 Legislative session, but the bill did not become law (Energy Efficient West Virginia, 2017). Once authorized, local governments must opt into the program to allow businesses to utilize LEEP as it is a voluntary program. Authorizing governments are not economically liable for energy efficiency upgrades.

Manufacturing Investment Tax Credits

The West Virginia Legislature has already acknowledged the importance of investments in industrial capital. In WV State Code, an act titled "West Virginia Manufacturing Investment Tax Credit Act" states that "The Legislature finds that the encouragement of the location of new industry in this state, and the expansion, growth and revitalization of existing industrial facilities in this state is in the public interest and promotes the general welfare of the people of this state (State of West Virginia)."

A tax credit is available to any "industrial taxpayer who purchases new property for the purpose of industrial expansion or for the purpose of industrial revitalization of an existing industrial facility in this state." Per the code, "'Industrial revitalization' or 'revitalization' means capital investment in an industrial facility located in this state to replace or modernize buildings, equipment, machinery and other tangible personal property used in connection with the operation of the facility in an industrial business of the taxpayer including the acquisition of any real property necessary to the industrial revitalization." While not explicitly stated, the language does indicate that energy efficiency upgrades would qualify, as such investments should be considered modernization.

The amount of the credit is currently equal to five percent of the qualified manufacturing investment and is applied over a ten-year period. If the amount were to be increased, specifically when applied to efficiency, additional investments could be prompted. This would require a legislator sponsor to champion the opportunity.

Utility Programs

West Virginia's electricity utility efficiency program expenditures have been justified by the WVPSC to "enable utility customers to better manage their electricity usage to both reduce their own consumption and the impact of their electricity usage on the environment (WVPSC, 2014)." The importance of these programs has increased over the years, as the share of West Virginia households that use electricity as a primary source of heat has increased from 32 percent in 2000 to 44 percent in 2015 (US Census of Housing, 2015).

Both FirstEnergy and AEP/Appalachian Power offer efficiency programs in neighboring states that are somewhat different from what is offered in West Virginia. Lessons learned and examples of options for expansion can guide expansion of these utilities’ programs in West Virginia. The primary differences in rebate options for these states are shown in the table below.

Compared to the 2012 review, the rebate options West Virginia’s utilities offer are more broad. Appalachian Power’s rebate options are now quite comprehensive aside from excluding custom residential upgrades. FirstEnergy’s rebate options are still limited, as only lighting and residential appliances are included.

Table 4 Eligible Efficiency Technology Rebates for Regional Utilities

Utility Program	Sector	State	HVAC	Appliance	Lighting	Weatherization	Custom	Maint.
FE (P. Edison)	Res.	MD	Yes	Yes	Yes	Yes	No	No
FE (P. Edison)	C&I	MD	Yes	Yes	Yes	No	Yes	Yes
AEP Ohio	Res.	OH	Yes	Yes	Yes	Yes	Yes	No
AEP Ohio	Comm.	OH	Yes	Yes	Yes	No	Yes	No
FE (Ohio Edison)	Res.	OH	Yes	No	Yes	No	Yes	Yes
FE (Ohio Edison)	Comm.	OH	Yes	Yes	Yes	No	Yes	Yes
FE (W Penn)	Res.	PA	Yes	Yes	Yes	Yes	Yes	Yes
FE (W Penn)	C&I	PA	Yes	Yes	Yes	Yes	Yes	No
FE (M. Edison)	Res.	PA	Yes	Yes	Yes	Yes	Yes	Yes
FE (M. Edison)	C&I	PA	Yes	Yes	Yes	Yes	Yes	No
AEP (ApCo)	Res.	WV	Yes	Yes	Yes	Yes	No	Yes
AEP (ApCo)	C&I	WV	Yes	Yes	Yes	Yes	Yes	No
FE (P. Edison/ Mon. Power)	Comm.	WV	No	No	Yes	No	No	No
FE (P. Edison/ Mon. Power)	Res.	WV	No	Yes	Yes	No	No	No

Neither utility has yet proposed to increase rebate amounts, although overall program spending for both utilities is higher than in prior years. As shown in the above table, an addition of HVAC and commercial appliance rebate options for FirstEnergy would bring the utility on par with Appalachian Power in West Virginia and with most FirstEnergy programs in other states.

As mentioned earlier in this report, Appalachian Power has proposed an expansion of its efficiency programs beginning in 2018. If approved, new programs will include a multifamily direct install, small business direct install, “bring your own thermostat” and investment in expanded volt var optimization. Currently, FirstEnergy has not proposed any programs beyond May of 2018.

Another initiative FirstEnergy offers, due to a mandate, in Pennsylvania but not in West Virginia is a demand response program.

Demand Response

Demand response (DR) is a load management strategy that is often aligned with energy efficiency because it reduces demand for electricity. DR allows consumers to play a role in the operation of the electric grid by reducing their load during peak demand times in response to financial incentives (USDOE, 2017). The PJM definition of demand response is one of the most succinct - "demand response is the ability of retail consumers to respond to wholesale electricity prices (PJM, 2017)." Like efficiency, DR is tied closely to the communication capabilities of a "smart grid" and associated use of advanced metering infrastructure.

DR is a tool for utilities who do not have the capacity to serve demand during certain conditions and whose customers are thus subject to price variability in the wholesale market. The results of DR initiatives in regional states have been quite successful. For several states, such programs have reduced peak demand by at least 10 percent and greater, surpassing goals set by the states (ACEEE, 2017). Strategies used are interruptible rates, AC and water heater cycling programs and peak time rebates.

- Interruptible rates allow larger commercial and industrial entities to reduce electricity costs when wholesale prices rise. For most of the Mid-Atlantic region, this most often happens on hot summer days. Demand reduction can be achieved by turning off certain equipment or switching to standby power if available, with resulting reductions in wholesale power purchases (Rural Electric Convenience Cooperative, 2017).
- Air conditioner and water heater cycling programs temporarily interrupt outside units from normal electrical flow and in so doing reduce the consumer's electricity usage. Cycling programs are most active in the summer months between 12pm-3pm and can last up to seven hours. Appalachian Power operates an AC DR program for its residential customers.
- Peak time rebates allow consumers to receive monetary compensation for reducing electricity use during peak times, again, typically in the summer months when demand is the highest. This incentive may be more attractive to customers than energy savings because it is a credit on their bills (Power Systems Engineering, 2016).

Energy efficiency improvements also contribute to reductions in peak demand. A comparison of potential and actual DR peak demand savings conducted by the EIA show that for each 1% reduction in electric sales for a utility, on a median basis, peak demand reductions from efficiency programs are 0.66% of peak demand (ACEEE, 2017). This ratio would mean that for a 15% reduction in retail sales, peak demand savings could be about 10%. The study compared "potential peak demand savings" - assuming all a utility's in-place DR strategies are used - to actual savings achieved.

Utility DR programs in the region are more popular in areas with more electricity congestion and seasonally high wholesale power prices, e.g. the Mid-Atlantic region. For places like West Virginia that do not purchase very much wholesale power, the need for demand response is less consistent. In addition, peak demand for the State occurs in the winter rather than in the summer and utilities must procure capacity to meet maximum wintertime load.

However, West Virginia is located within PJM regional transmission organization (RTO), which coordinates the largest DR market in the world. Currently there are 89 demand response aggregators that operate within PJM (PJM, 2017).

Currently, West Virginia’s electricity consumers can participate in four demand response programs. Two of the programs are incentivized by PJM and two are via Appalachian Power.

- PJM’s emergency “capacity” supply program, part of its Reliability Pricing Model – participation is often coordinated via a curtailment service provider, and requires a consumer to pledge to reduce their load once notified, typically from one to two hours. The reduction is mandatory and penalties are substantial. Participants can also receive energy payments when and if a reduction is required (Federal Energy Management Program, 2015).
- PJM’s Economic Load Response Program - This program is voluntary and customers, or DR aggregators, participate by submitting load bids of at least 100 kW into the day-ahead energy market. If a bid is accepted, payment for load reduction is based on the customer’s baseline load (FEMP, 2015).
- Appalachian Power’s Emergency Curtailable Service Rider - offers \$.35/kWh or \$.50/kWh depending on whether the customer pledges a maximum four or eight hours of load reduction. This program is set for emergency conditions in the winter (December to February) or summer months (June to August). Credit is guaranteed for at least two hours and capped at 50 hours.
- Appalachian Power’s Curtailable Service Rider (PCSR) - offers credit to customers who participate in load reduction during high price periods. Participants set the minimum price and the maximum number of days they wish to participate. Payments are specified at the greater of the customer’s stated minimum price and 80% of the daily published price index for electricity.

The following table shows active participants in DR programs in the PJM region during 2016. The locations and megawatts (MW) represent the actual load management each utility zone(s) achieved.³

Table 5 Demand Reductions in PJM Demand Response Programs by State in 2016

State	Zone	Locations	MW
Washington DC	Potomac Electric Power (PEPCO)	112	44.8
Delaware	Delmarva P&L (DPL)	89	44.2
Indiana	American Electric Power (AEP)	101	302
Kentucky	E. KY Power Cooperative	10	138.1
Maryland	Allegheny Power (APS), Baltimore G&E, DPL, PEPCO	1,035	930.9
New Jersey	Atlantic City Electric, Jersey P&L, Public Service Enterprise Group, Rockland Electric	1,250	346.4
Ohio	AEP, American Transmission Systems (ATSI), Dayton Power (DAY), Duke Energy OH	1,842	1,288.5
Pennsylvania	APS, ATSI, Duquesne Lighting, Metropolitan Edison, Philadelphia Electric, PA Electric	2,509	1,068.4
Tennessee	AEP	7	2
Virginia	AEP, APS, Dominion Virginia Electric, DPL	1,171	804.5
West Virginia	AEP, APS	583	584.2

³ Some states are only partially within PJM, e.g. TN and IN, and MW reductions do not represent state totals.

IV. Summary and Recommendations

Energy efficiency opportunities in West Virginia are available for all economic sectors: industrial, commercial, and residential. Some of the most significant actions the State of West Virginia can take are to ramp up investments in efficiency in public buildings and elevate support for efficiency efforts. The State can help to leverage progress already made by the utility programs and plan for expanded and long-lasting initiatives.

Due to budgetary issues the State of West Virginia is probably not in a financial position to develop its own energy efficiency grant or loan programs right now. Such programs would align the State with others in terms of common types of incentives deployed by other states in the region. One of the State's best near-term opportunities may be to lead by example in deploying efficiency in public facilities and in so doing, reduce future energy costs for taxpayers. Other opportunities are to encourage expansion of electric utility programs and grow existing industrial expertise to bolster the manufacturing sector.

a. General Recommendations

The State can influence public perception and support for efficiency as a resource through outreach. Outreach can take the form of educational programs in public schools or communication with State employees.

RECOMMENDATION 1: Elevate the profile of energy efficiency opportunities, and examples of successful investments, via educational programs in schools.

The WVDOE has supported energy efficiency outreach activities since its inception, and a few West Virginia teachers have utilized curricula developed by national organizations in their classrooms. Expanding this activity will promote use of the resource.

RECOMMENDATION 2: Reissue State guidance on energy efficiency for State employees as an update to the 2008 Governor's memos.

This action will show that the State is a champion for efficiency and induce public employees to become mindful of opportunities to use energy more efficiently.

b. Utility Recommendations

In surveys of opportunities to utilize efficiency to save energy, many conclusions point to electric utility programs as having the most potential. This is the case in West Virginia as well.

RECOMMENDATION 1: Approve renewals of the utility programs, including multi-year plans for the programs to expand and innovate.

The electric utility programs reach nearly every household in the State and are thus in the best position to communicate information about efficiency options. The utilities are also the experts on electricity consumer behavior and can advise on the effectiveness of various initiatives.

RECOMMENDATION 2: Utilize utility-specific hourly load data for focused information-sharing, so more can be known about where and when peak demand occurs and the duration of peaks by time-of-day and season.

This activity most likely falls to the WVPSC due to its role in assimilating utility data and information in support of regulation and consumer protection. Hourly load data could be utilized internally by the WVPSC to support regulation or could be shared with other entities seeking to design and provide new services such as demand response programs. The utilities' databases contain valuable information about electricity demand that can help identify where and when peak shaving and other communications-based efficiency programs could be best deployed.

RECOMMENDATION 3: Implement an energy efficiency program by gas utilities.

This will allow businesses and households that heat with gas to participate more fully in efficiency programs.

c. Sector Recommendations

These recommendations apply largely to the commercial or industrial sectors, including government.

RECOMMENDATION 1: Increase the amount of the tax credit allowed under the "West Virginia Manufacturing Investment Tax Credit Act" to be applied specifically to EE investments to 10 percent or 20, from the current five percent.

This action would increase the economic incentive for manufacturers to invest in efficient equipment, and if utilized would increase the value of industrial property in the State.

RECOMMENDATION 2: Authorize Local Energy and Efficiency Partnership (LEEP) financing.

This legislation will enable local governments to provide private firms with a cost-effective way to finance energy efficiency upgrades.

RECOMMENDATION 3: Support additional efforts to train builders to the energy code currently adopted.

The State can work with the Homebuilders Association and other organizations to leverage and extend results from training already underway to encourage more homes and buildings to be built to these specifications.

RECOMMENDATION 4: Modernize State rules regarding performance contracting.

Removing the requirement that public facilities must follow the same guidelines used for construction projects, in that the lowest bid must be accepted, will allow the best value for a performance contract to be realized.

RECOMMENDATION 5: Authorize issuance of Qualified Energy Conservation Bonds (QECBs) for use by State and local government.

This financing option will increase the opportunity for State and local governments to cost-effectively finance energy efficiency upgrades.

RECOMMENDATION 6: Establish a robust benchmarking project to track energy consumption in State buildings that includes goals for program accomplishments.

An energy usage benchmarking program will build on the data collection and efficiency efforts already established under the direction of State facility managers. As recommended by USDOE, such programs should be developed with support of upper management and in conjunction with a plan for efficiency investments following data analysis.

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