



The West Virginia Jobs Project

A Guide to Creating Jobs in Industrial Energy Efficiency

A Letter from the American Jobs Project

It is no secret that America's middle class is in crisis; indeed, "the hollowing out of the middle class" has become a well-worn phrase, causing politicians to rail, bloggers to rage, and citizens to reel. Polls consistently reveal that jobs and the economy are at or near the top of citizen concerns. Of the millions of jobs lost during the recession, most were good-paying, middle-class jobs. Unfortunately, many of the jobs created during the recovery have been in low-skill, low-paying occupations. These trends are not going to reverse themselves unless there is a targeted focus on high-growth, advanced industries. Leadership is needed, but the gridlocked U.S. Congress has failed in recent years to adopt robust policies to stoke middle-class jobs in America.

In President George W. Bush's autobiography, *Decision Points*, the former president recounts a conversation he had with then-President of China, Hu Jintao. "What keeps you up at night?" President Bush asked President Hu as an icebreaker. As we can easily guess, what kept President Bush up at night was concern over terrorism. Hu Jintao's response was telling—what kept him up at night was "creating 25 million new jobs a year" for his people.

Is it possible to create good-paying American jobs in today's global economy? And what if the solutions did not involve Congress at all? What if there were creative middle-class job creation strategies being developed and tested in the laboratories of democracy—the states and cities? The American Jobs Project seeks to answer these questions and provide a research-based guide to action for state and local leaders who are kept up at night trying to figure out how to create jobs for the people they serve.

Our quest starts with identifying the biggest market opportunity of our era: the global demand for advanced energy and advanced energy enabling solutions. The world has embarked on a historic energy transformation and the United States plays a crucial role in accelerating the energy transition. Whether borne out of a need for diverse, reliable, and clean power or to achieve energy independence from unstable regimes, the growing demand for advanced energy and its enabling technology creates "the mother of all markets" for local U.S. businesses to build and sell those solutions. Strategically minded businesspeople looking

at global growth projections in advanced energy demand are making major investments and reaping large revenues. In 2015, the private sector reported nearly \$1.4 trillion in global advanced energy revenues. Advanced energy investments are now bigger than the global apparel sector and nearly twice the size of the global airline industry. And jobs? At least 9.4 million people were employed in the global advanced energy sector in 2015, and doubling the share of renewables could nearly triple employment. The question for the United States is: Where will those new jobs be created?

The American Jobs Project is focused on finding ways to make our states the answer to this question. If countries across the globe, including the United States, are seeking technical products and solutions for growing energy needs, how can U.S. businesses take advantage of this demand and build products locally that can be exported to the world? And how can we equip Americans with the skills those businesses need to build their advanced energy products?

It is true that the United States will not likely be able to attract the traditional manufacturing jobs of the past; those jobs are gone—either to low-wage countries or to automation—and we must accept the fact that they are not coming back. But our research shows that with innovative policies and a smart focus on industrial sectors, states can become global hubs of innovation and create new jobs in advanced industries that capitalize on each state's strengths.

The American Jobs Project gives policymakers the tools to spur economic growth and create good-paying jobs in their states. Our analyses chart pathways designed to accelerate and expand a state's advanced energy economy. We propose innovative solutions built on extensive research and tailored to each state. Many are best practices, some are new, and all are centered on a state's business ecosystem. These solutions are written with an eye towards streamlining bureaucracy and are seasoned with the principles of competition, local control, and fewer regulations.

The American Jobs Project will empower state leaders to build prosperous and equitable advanced energy economies that will transform our nation's energy future. If these recommendations are adopted, the beneficiaries will be those hard-working Americans looking for the dignity of a good-paying job.

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About Us

The American Jobs Project

The American Jobs Project is a nationally focused, research-based project managed by the American Jobs Initiative, a nonprofit organization dedicated to U.S. economic growth through advanced industries. The organization is driven by six core team members and has received support from nearly one hundred student researchers with a broad range of expertise, including law, business, engineering, and public policy. The American Jobs Project brings best practice strategies and innovative ideas from around the globe to local and state governments and stakeholders, developing bottom-up strategies that create good-paying jobs in the advanced energy industry.

West Virginia University, Center for Energy and Sustainable Development

The Center for Energy and Sustainable Development is based in the West Virginia University College of Law and conducts research on energy and environmental public policy issues pertinent to West Virginia and its residents. The Center focuses its efforts on training the next generation of energy and environmental lawyers, promoting sustainable practices and the development of clean energy technology, and encouraging utility leadership in clean energy deployment.



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Executive Summary

The American Jobs Project was borne of two tough problems: loss of middle-class jobs in America and congressional paralysis. It seeks to address these problems by taking advantage of one of the biggest market opportunities of our era—the advanced energy and enabling technology sectors—and to do so at the state, not the federal, level. State and local leaders who leverage the unique strategic advantages of their state to grow localized clusters of interconnected companies and institutions are poised to create quality jobs. This report serves as a strategic guide to support those efforts.

Extensive research and more than twenty interviews with stakeholders and experts in West Virginia have identified industrial energy efficiency as showing particular promise in the state. Industrial energy efficiency is an extremely versatile industry, with vast technological applications and services for energy and cost savings within large energy-consuming facilities. Moreover, energy efficiency can enable technological innovation, thereby elevating West Virginia's companies in the marketplace and creating middle-income jobs for West Virginians.

West Virginia is well positioned to benefit from rising global demand for industrial energy efficiency products given its large industrial manufacturing base with chemical and energy efficiency manufacturers, collection of energy-focused research institutions conducting cutting-edge research on fuel and energy efficiency, readily available workforce, and incentives for businesses located in the state. Opportunities to leverage these strengths to further serve growing regional, national, and global markets offer real benefits for the state economy and West Virginia's residents.

However, there are several barriers hindering West Virginia's energy efficiency industry and preventing its supply chain companies from reaching their full potential. These barriers to growth range from inadequate access to capital for innovators and entrepreneurs looking to start a business in the advanced energy sector to limited energy efficiency incentives targeted at the unique needs of industrial customers. West Virginia must address these roadblocks in order to become a competitive hub for energy efficiency.

To take full advantage of these opportunities, state leaders can pursue strategies to create a strong foundation for industry growth and to help West Virginia businesses grow, innovate, and outcompete regional, national, and global competitors. With forward-thinking policies, West Virginia's energy efficiency industry could support 6,100 direct, indirect, and induced

manufacturing and supply chain jobs, on average, annually from 2017 through 2030. Jobs in the energy efficiency sector and related industries will spark local job growth and economic development as employees spend their earnings in the local economy.

Summary of Recommendations

The analysis presented in this report culminates in recommendations for West Virginia's leaders based on best practices in the United States and abroad. Each recommendation identifies opportunities for barrier removal and future growth in the industrial energy efficiency sector. The recommendations are intended to be complementary and would be more powerful if adopted as a package. Alternatively, each recommendation can also be viewed as a stand-alone option.

Strategically Expanding West Virginia's Industrial Energy Efficiency Sector and Supply Chain Companies

Partner with Industry Associations to Create an Energy Efficiency Industry Working Group: Leveraging the strong, existing industry associations in West Virginia to expand awareness of West Virginia's emerging industrial energy efficiency cluster.

Strengthen and Expand West Virginia's Foreign Direct Investment Strategy: Establishing West Virginia as an international hub for industrial energy efficiency manufacturing.

Create an Anchor Company Tax Credit: Providing in-state anchor companies with strategic incentives to help recruit companies to the state to bolster the industrial energy efficiency supply chain in West Virginia.

Fostering a Strong Innovation Ecosystem

Leverage Philanthropic Funding Via a Foundation Liaison: Partnering with private foundations to fund advanced energy incubators and university programs devoted to industrial energy efficiency.

Co-Sponsor a Hackathon to Ignite West Virginia's Entrepreneurial Culture: Promoting and growing an innovation culture within West Virginia's research institutions.

Encourage Commercialization of Cutting-Edge Research: Streamlining the commercialization process for small businesses, researchers, and entrepreneurs to facilitate more rapid technology transfer to market.



Leveraging Local Assets to Increase Access to Capital for Growing Companies

Develop Relationships with Foundations Engaging in Program-Related Investment: Leveraging the resources and missions of large, national foundations to support in-state advanced energy companies.

Create Tax Incentives for Investment in Startups: Providing a capital gains tax exemption to investors in West Virginia's small businesses to foster growth.

Coach Businesses on How to Solicit Capital: Training entrepreneurs to create effective pitches to raise capital.

Establish a State Fund of Funds to Stimulate the Investment Environment: Reducing investment barriers for early-stage companies by improving access to patient capital.

Aligning Training Programs to Meet the Needs of Industry and Serve Students

Support Career-Connected Learning: Expanding opportunities for career-connected learning through early college programs and youth apprenticeship programs to increase the number of skilled graduates.

Encourage High School Partnerships with Community and Technical Colleges: Providing students with the resources necessary to better understand all their postsecondary education options.

Align Community College Efforts with Private Sector Needs: Creating strong partnerships between employers and local community colleges to increase the number of skilled workers in the state and ensure that students have the skills necessary to succeed in today's economy.

Creating Demand for Industrial Energy Efficiency Technology by Increasing Deployment

Offer Industrial Energy Efficiency Tax Incentives to Manufacturers: Reducing the upfront cost of energy efficiency investments while also encouraging manufacturers to expand and upgrade facilities.

Participate in a Regional Energy Efficiency Organization: Tapping into regional network-based organizations to advance West Virginia's industry potential through information sharing and collaboration.

Incentivize Industrial Energy Efficiency Using Energy Performance Indicators: Establishing energy efficiency targets as a way to encourage utilities to invest in load reduction practices such as energy efficiency and lower the financial burden on ratepayers in the long run by reducing utility investments in new generation.

Implement a Utility Energy Efficiency Resource Standard: Establishing energy efficiency targets to reduce the financial burden on ratepayers.

Enable Local Energy and Efficiency Partnership Programs for Commercial and Industrial Energy Efficiency: Establishing a comprehensive energy financing option to help industrial customers who want to invest in energy efficiency equipment.



Introduction

The American Jobs Project aims to spur job creation in the advanced energy sector by identifying innovative and state-specific policies and non-legislative solutions. This national initiative takes advantage of the emerging global demand for advanced energy and related products. The American Jobs Project team analyzed the advanced energy economy in West Virginia and designed recommendations specifically tailored to the state. These recommendations are informed by extensive research and over twenty interviews with local stakeholders and experts.

This report identifies opportunities to stimulate growth in an advanced energy economic cluster that leverages the state's legacy industries, current investments, and entrepreneurial business development activities. State and local leaders who are seeking to build upon the state's resources to create skilled, good-paying jobs can use this report as a foundation for action.

What is Advanced Energy?

Advanced energy diversifies energy sources, uses energy more productively, and reduces health and environmental costs. All sources, technologies, products, and services that help meet the need for affordable, secure, and clean energy are advanced energy. For example, advanced energy encompasses renewable energy sources, such as solar, wind, hydro, geothermal, and biofuels. Advanced energy also incorporates technologies and services that improve energy efficiency or make energy available when needed, such as photonics, smart buildings, energy storage, demand response, and smart grids. Other technologies and products that reduce energy consumption include electric vehicles, efficient industrial processes, and airplane bodies made of lightweight composites.



Heating, Ventilation, and Air Conditioning Repairman

Why Advanced Energy?

Demand for advanced energy has soared in recent years and is poised for continued growth. In 2015, investment in the advanced energy sector totaled \$329 billion worldwide, more than five times the total in 2004. In the United States alone, over \$323 billion was invested in advanced energy between 2010 and 2015. In nationwide polls, Americans increasingly support renewables over other forms of energy. Projections show that by 2030, renewables could account for 27 percent of the U.S. energy mix and roughly 50 percent in the power sector alone. These trends point to a clear market signal: demand for advanced energy will continue to grow substantially and create opportunities for investment and job growth.

Furthermore, the advanced energy sector fosters many good-paying, middle-class jobs. In 2016, nearly 3.3 million employees were engaged in the national advanced energy industry, including low-carbon generation (800,000), energy-efficient products and services (2.2 million), and alternative fuel vehicles (259,000). In particular, in 2016, solar and wind employment grew by 25 percent to 374,000 workers and 32 percent to 102,000 workers, respectively.

Many advanced energy jobs are in the manufacturing sector, which offers higher wages for the U.S. workforce and stimulates local job growth. Manufacturing jobs average an hourly wage of \$26, over three times the federal minimum wage. Thus, the average manufacturing worker in advanced energy is in the middle class. For each U.S. job created in manufacturing, 1.6 new jobs in local goods and services are supported.

Why Economic Clusters?

“Clusters are geographically close groups of interconnected companies and associated institutions in a particular field, linked by common technologies and skills.”

– Michael E. Porter, *Clusters of Innovation*

Economic clusters encompass a variety of linked industries and institutions—including suppliers of specialized services, machinery, and infrastructure—which form a supply chain. Clusters also extend to manufacturers of complementary products and to industries related in skills and technologies. By placing themselves near industry allies, companies can benefit from each other’s unique expertise and a trained workforce. Companies in a cluster enjoy access to specialized assets, which helps increase productivity and efficiency.



Geographic proximity and repeated exchanges of information help foster an environment of coordination and cooperation among these companies and institutions. Business clusters are shown to increase the productivity of companies, drive innovation in the field, and facilitate the commercialization of this innovation by increasing communication, logistical support, and overall interaction between cluster entities. By having a close network of suppliers and partners, companies can reap the benefits of greater operational efficiency and reduce costs. Clusters also help build a strong foundation for creating employment opportunities and retaining jobs.

Economic Cluster

Economic Clusters are created when industries and institutions become linked with suppliers of specialized services, machinery, and infrastructure that are within close proximity, forming a supply chain. Key elements to a successful cluster include Policy Certainty, Workforce Development, Innovation Ecosystem, and Access to Capital.



Policy Certainty

- Provides a clear market signal
- Reduces business risk
- Allows for long-term planning

Workforce Development

- Invests resources in people
- Bridges skills gap
- Develops training programs and industry partnerships

Innovation Ecosystem

- Promotes research and development
- Facilitates new technology to market
- Incubates early-stage businesses

Access to Capital

- Provides funding for new and growing businesses
- Connects investors with market opportunities
- Attracts entrepreneurs

Key Cluster Elements

Economic clusters require several critical assets to coordinate for growth. In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem, provide fertile grounds for capital investment, and boast a highly skilled workforce. A successful innovation ecosystem bridges the gap between the knowledge economy and the commercial economy, while access to capital programs provide the necessary funds to facilitate commercialization and expansion of businesses. Seamless connections between researchers, entrepreneurs, and investors are vital to the success of advanced energy technology companies—bringing innovative ideas to the marketplace quickly and efficiently. Trained and skilled workers are also fundamental to the success of an economic cluster. A thoughtful, sector-based workforce development approach that engages industry and related nonprofits can ensure businesses are equipped to identify employment needs and schools prepare workers with the skills needed to fill available jobs.

Local Demand

Local demand is not essential for cluster development, but it can help to establish a geographic base. In the energy efficiency industry, a state may benefit from having robust energy codes and standards to build a local company base that could then expand to regional, national, and global markets. However, if local adoption of energy efficiency products is slow, the state can tap into broader markets to drive cluster development.



Jobs Potential of Cluster Growth

Clusters can foster a large number of direct, indirect, and induced jobs by stimulating economic activity in a region. Maximizing job creation is highly dependent on local activity. Workers in manufacturing clusters earn income from sales made throughout the region or nation, bringing out-of-state dollars into the local community. Increased local demand supports additional local jobs and income at other value chain companies in areas such as installation, operations, and maintenance. These dollars are spent and re-spent in the local economy, creating and maintaining additional jobs in grocery stores, restaurants, medical providers, and other sectors. Because energy efficiency technologies typically generate cost savings, more money is available to spend in the local economy. The result is the multiplier effect where a dollar of earning in a cluster circulates throughout local businesses and their employees, creating an impact greater than the initial injection. Therefore, promoting an economic cluster by recruiting manufacturers and their suppliers will result in an economic impact many times greater than the direct earnings impact.

Report Structure

The West Virginia Jobs Project: A Guide to Creating Jobs in Industrial Energy Efficiency begins by highlighting West Virginia's economic opportunity to build a globally competitive industrial energy efficiency cluster. The next section gives an overview of the industrial energy efficiency industry and specific technologies that West Virginia could leverage. Then, the report outlines West Virginia's cluster development assets to support the innovation ecosystem, access to capital, and workforce development. The analysis culminates in an assessment of the job growth potential of the state's industrial energy efficiency industry and policy recommendations tailored to West Virginia. A fully cited version of the report is available on the American Jobs Project website at <http://americanjobsproject.us/>.

The Opportunity for Industrial Energy Efficiency in West Virginia

What is Industrial Energy Efficiency?

Industrial energy efficiency is the process of reducing the amount of energy needed to manufacture and distribute products. Energy efficiency measures can range from installing efficient technologies and equipment to adopting energy-saving practices. In energy-intensive industries, such as chemical manufacturing, energy is often wasted via heat loss and inefficient technology, driving up costs for businesses. On average, 30 percent of the energy used in U.S. commercial and industrial buildings is used inefficiently or unnecessarily. Improving the energy efficiency of those buildings by just 10 percent would save building owners a combined \$40 billion annually. Increased industrial energy efficiency improves business competitiveness by lowering production costs.

Industrial vs. Commercial

The industrial sector comprises the goods-producing segment of an economy and includes manufacturing and construction. Commercial establishments encompass all other workspaces that do not produce goods, including stores, hotels, offices, and restaurants.

The industrial sector consumes the largest share of energy in the United States and this share is expected to grow. Energy supports numerous technologies and processes in the industrial sector. Five percent of energy is used as electricity to maintain a facility's lighting, appliances, and heating, ventilation, and air conditioning (HVAC) system. Fifteen percent powers equipment-handling applications and motor-driven equipment like pumps, air compressors, fans, and combined heat and power (CHP) generation. The remaining energy goes into process-related applications, such as process heating or chemical processes. Optimizing these energy-intensive components could drive down operational costs, increasing the potential for improved profitability for manufacturers. Industrial energy efficiency products and services primarily target energy reductions in building maintenance and motor-driven equipment.

Across the country, nearly 200,000 factories, refineries, and other plants consume more than 30 quadrillion BTUs of energy, nearly one-third of the total energy powering the nation. Eighty-five percent of that industrial energy use is attributed to manufacturing.

Technologies Relevant to Industrial Energy Efficiency

- Motors and variable frequency drives
- Efficient air compressors
- Heating, ventilation, and air conditioning (HVAC)
- Equipment and facility insulation
- Facility monitoring devices
- Lighting
- Combined heat and power (CHP)

Least-cost Energy Resources

Energy efficiency is a least-cost energy resource, meaning it is less expensive for utilities to invest in than traditional system resources, such as new power plants or transmission and distribution infrastructure. Large commercial and industrial energy efficiency programs are the cheapest energy resource available, typically between 2 and 3 cents per kWh.

What Does Industrial Energy Efficiency Mean for West Virginia?

Revenue for West Virginia Exporters

Global market trends present an opportunity for West Virginia's industrial energy efficiency industry to sell its products in a growing market. Global energy efficiency investment reached \$221 billion in 2015, an increase of 6 percent from the year before. The global industrial energy efficiency services market is projected to grow by more than 6 percent between 2016 and 2020, and growth in the services market suggests similar trends for products that service providers will implement and install. Within the United States, building efficiency is the largest sector in the advanced energy economy, and many building efficiency products have industrial applications.

Demand for Insulation

In 2016, advanced materials and insulation accounted for approximately 292,000 employees, or over 15 percent of total energy efficiency employment. The insulation industry is projected to grow as well; the urethane foam manufacturing industry alone is expected to grow at an annualized rate of 1.5 percent to \$12.3 billion through 2022. Twenty-six percent of foam products contribute to insulation. Demand for residential and nonresidential construction is expected to increase sales of urethane products for insulation.



Cost Savings for West Virginia Companies

In addition to reaping the economic benefits of growing global demand by becoming a major exporter of industrial energy efficiency technologies, West Virginia could benefit from lowering the operating costs of its industrial companies through energy efficiency. With an average of 30 percent of the energy used in U.S. commercial and industrial buildings used inefficiently or unnecessarily, industrial energy efficiency presents significant energy and cost savings opportunities for West Virginia's large energy customers. Improving the energy efficiency of West Virginia's industries could help eliminate capital and resource waste and make West Virginian products more cost competitive in regional and national markets.

In 2014, West Virginia's industrial sector accounted for 293 trillion BTUs, which is 40 percent of all energy consumed in the state. Although West Virginia ranks thirty-eighth in total energy consumption nationally, the state ranks eleventh in per capita consumption. This is due, in part, to the state's industrial sector, which consumes the most energy in the state. Some of West Virginia's largest industries, such as chemical manufacturing, are the most energy-intensive industries in the United States. Optimizing the energy efficiency of industrial processes could result in both energy and cost savings for companies.

Cost Savings for West Virginia Utility Customers

Investing in energy efficiency could decrease costs for utility ratepayers as well. The electricity saved through energy efficiency displaces the need for utilities to invest in new electricity generation. At 2 to 3 cents per kWh, industrial energy efficiency programs are substantially less expensive than generation, which typically costs utilities double or triple the price. Utilities could transfer these cost savings to customers in the form of lower utility bills.

Energy Efficiency Measures Meet Demand Growth

In the Pacific Northwest, utilities have met over half of the region's electricity demand growth since 1978 with energy efficiency.

Good-Paying Jobs for West Virginia Residents

West Virginia has historically struggled with persistently low median household income and high levels of poverty, and this trend continues today. In 2015, West Virginia had the second-lowest median household income in the country at \$42,824 and more than one in six West Virginians lived below the poverty level. Moreover, labor force participation fell to 53 percent in 2015, the lowest level seen in the state since the late 1980s, and almost 10 percentage points below the national average.

Lost Coal Jobs

Compared to other states, West Virginia lost the most coal mining jobs in 2014 and 2015, decreasing by an average of 1,951 employees (9.6 percent) and 2,840 employees (15.5 percent), respectively. The decline in the coal industry has not affected communities uniformly across the state. Rather, the majority of the industry's decline has been felt in the southern coalfields, where production has fallen by as much as 67 percent. Coal production in the north, on the other hand, has increased slightly.



Mining for Coal

In 2015, manufacturing made up 7 percent of total employment in West Virginia and 10 percent of the state's total economic output. Chemical manufacturing, in particular, accounts for 20 percent of those manufacturing sector jobs and nearly 40 percent of the sector's total manufacturing output. Over the last ten years, West Virginia's manufacturing sector lost 14,200 jobs. However, recent growth in natural gas production has improved prospects for the chemical and polymer manufacturing sector, which includes nearly 140 companies in West Virginia that employ 12,800 workers. As the state's second-largest exporting industry after coal, chemicals and polymers make up approximately 25 percent of West Virginia's \$4.8 billion export market. Industrial energy efficiency presents a significant end-use market opportunity for these businesses, as chemicals and polymers serve as inputs for a number of energy-efficient products, such as polyurethane spray foam. Therefore, growth in industrial energy efficiency could lead to growth in chemical and polymer industries as well.

Manufacturing's Multiplier Effect

Manufacturing creates a multiplier effect, meaning that manufacturing activity in West Virginia helps create jobs and economic opportunities in other parts of the economy. West Virginia's polymer industry, for example, directly employed 8,000 people in 2009, and was indirectly responsible for an additional 14,630 jobs as a result of the multiplier effect.

Interstate Competition for Labor

West Virginia's unique geography forces the state to constantly compete with neighboring states to retain businesses. Most of West Virginia's largest cities are close to neighboring states, including Huntington, Morgantown, Parkersburg, and Wheeling. When the business climate is not accommodating enough in one area, businesses can relocate to another state without leaving the metro area. The proximity means that West Virginian workers sometimes have to compete with residents of neighboring states for jobs in the same metro area.



Changing Energy Economy

Coal production in West Virginia dropped by **55%** between 2008 and 2016

The decline in the coal industry is not felt uniformly across the state.

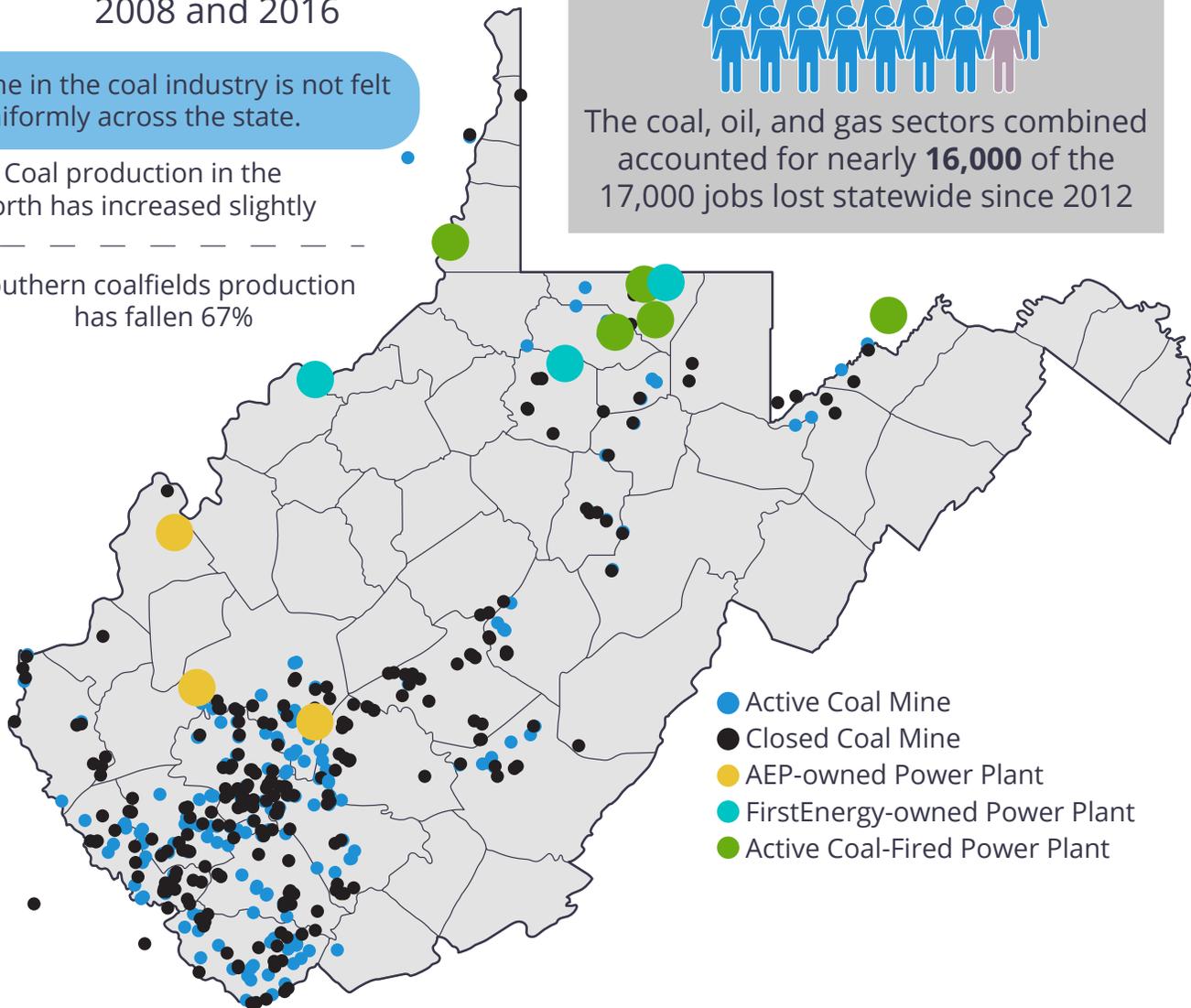


Coal production in the North has increased slightly

Southern coalfields production has fallen 67%



The coal, oil, and gas sectors combined accounted for nearly **16,000** of the 17,000 jobs lost statewide since 2012



8th largest **natural gas** producer in the U.S., with more than **1.3 trillion cubic feet** of natural gas production.

GDP from Natural Gas

will soon =

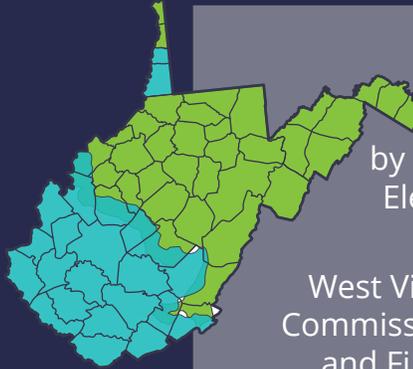
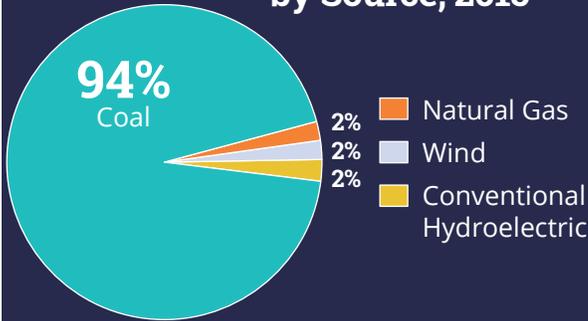
GDP from Coal

A significant climb from a total GDP that equaled one-tenth of coal less than a decade ago.



West Virginia Electricity Infrastructure

Net Electricity Generation by Source, 2015



Utilities

West Virginia is served by subsidiaries of American Electric Power (AEP) and FirstEnergy.

West Virginia's Public Service Commission (PSC) regulates AEP and FirstEnergy. The PSC is comprised of 3 members, each serving 6-year staggered terms.

FirstEnergy service providers:
Potomac Edison & Mon Power

AEP service providers:
Appalachian Power & Wheeling Power

Energy Production Powerhouse

4th largest energy-producing state in the U.S.

#2 producer of coal in the U.S.

7th largest natural gas producer

West Virginia exports **3/4** of its coal to **24** states and several counties.

Renewable Energy Generation

West Virginia is ranked **23rd** for installed wind capacity with 686 MW of installed wind.

The state gets less than **0.02%** of its electricity from biomass and solar resources, combined.

Electricity Exports

West Virginia ranks 3rd in the U.S. in net interstate sales of electricity, exporting 56% of electricity generated in 2012.

Changing Coal Landscape

6 coal plants have been deactivated since 2012, representing a loss of capacity of about **17%**.

West Virginia's coal industry has seen production decline approximately **55%** since 2008.

KEY ACTIONS

2007

West Virginia Division of Energy
Department of Commerce establishes the Division of Energy to run energy-related government programs, including energy efficiency programs.

2011

Energy Savings Performance Contracting
County boards of education and state agencies may enter into energy-savings contracts.





West Virginia Energy Economy

The **industrial** sector consumes the largest amount of energy in West Virginia.



Manufacturing

Manufacturing makes up **10%** of total output and employs **6.2%** of total workforce in West Virginia.

There were **47,100** manufacturing employees in West Virginia in 2016.

Manufacturing employees earned an average annual compensation of **\$67,399** in 2015.

Cost of Energy

West Virginia ranks **11th** in terms of highest per capita energy consumption.



West Virginia residents spend a larger percentage of median income on electricity than **80%** of the country.



Chemical Manufacturing and Energy Efficiency



- Chemical and polymer manufacturing in West Virginia is home to nearly **140** companies that employ **12,800** workers.
- Chemicals and polymers manufactured in West Virginia serve as inputs for a number of energy-efficient products.

Energy Efficiency Jobs

In 2016, approximately 20,500 West Virginians worked for businesses along the local energy efficiency supply chain.



2012

2013 - 2017 State Energy Plan

State releases an energy plan to review energy development for all facets of energy including fossil fuels, renewable energy sources, and energy efficiency.

2012

Green Building Energy Standards for Public Buildings

Public buildings or buildings receiving public funds built after 2012 must comply with the ICC International Energy Conservation Code, and the ASHRAE Standard 90.1-2007.

2013

Energy Code Adopted for Residential and Commercial Property

State adopts 2009 ICC International Energy Conservation Code for residential buildings, and the ASHRAE Standard 90.1-2007 for commercial properties.

2015

Integrated Resource Planning

Public Service Commission requires investor-owned utilities to publicly disclose their integrated resource plan.

West Virginia's Competitive Advantage

West Virginia's natural resources, strong industrial base, and legacy as an energy-producing state make it a prime location for industrial energy efficiency product manufacturing and energy efficiency retrofits.

Robust Chemical Industry

The West Virginia chemical industry is already a driver of economic activity in the state due to a local abundance of natural resources, such as the Marcellus and Utica shale natural gas deposits. The chemical industry uses this readily available feedstock to manufacture critical inputs for energy efficiency products. West Virginia chemical companies could become the largest input providers for energy-efficient products, such as insulation. In addition, the chemical industry is one of the most energy-intensive industries, meaning it could be a significant market for these products. Performing energy efficiency upgrades would create more cost-competitive chemical products and reduce energy waste.

Large energy consumers such as chemical manufacturers and energy producers could improve the efficiency of their industrial facilities through a variety of technologies and processes. For example, they could:

- Apply equipment, pipe, wall, and ceiling insulation to reduce energy required to maintain temperatures
- Install sensors, energy meters, and monitors to identify leaks and inefficiencies, in order to better optimize energy usage
- Replace inefficient motors with premium efficiency motors
- Substitute inefficient lighting with LED lighting

Strong Regional Market

West Virginia's location within the Ohio River Valley region creates an opportunity for the state to become a leader in the industrial energy efficiency sector as well. The regional supply chain is rich with manufacturers, creating a sizeable and easily accessible market for West Virginian companies. West Virginia's central location—within overnight trucking distance of approximately 50 percent of the U.S. population and about 30 percent of Canada's—provides in-state manufacturers and distributors the flexibility to tap into these regional energy efficiency markets.

Natural Gas Boom in West Virginia

Natural gas production continues to increase in West Virginia, thanks to highly productive wells in the Marcellus and Utica Shale. GDP from natural gas will soon equal that of coal, a significant climb from only one-tenth of GDP from coal less than a decade ago. In 2015, West Virginia was the eighth-largest natural gas producer in the United States, producing more than 1.3 trillion cubic feet of natural gas.



Tri-State Shale Coalition

The Tri-State Shale Coalition includes public and private partners from Ohio, Pennsylvania, and West Virginia and seeks to build a petrochemical hub within the three states. Drawing upon the unique expertise and natural resources of each region, the Coalition hopes to attract more industry partners and expand the possible end-use markets for petrochemicals, such as energy efficiency.

High-Performance Computing for Energy Efficiency

Energy efficiency researchers use high-performance computing (HPC) to examine energy efficiency technologies through complex modeling and simulations. In May 2017, the DOE allocated nearly \$4 million to study the specific capabilities of HPC in improving energy efficiency across the manufacturing sector. West Virginia is home to four supercomputers—at NETL, NOAA, WVU, and Marshall University—bolstering the state's eastern and western innovation hubs. This impressive resource could be leveraged to drive innovation in the industrial energy efficiency sector.

Tapping into a Burgeoning Regional Energy Efficiency Cluster

Industrial energy efficiency activity in nearby states, such as Ohio and Pennsylvania, contributes to an active regional energy efficiency cluster. Johnson Controls, a large manufacturer of industrial energy efficiency products, including industrial air compressors and control devices, operates facilities in neighboring Ohio, Pennsylvania, and Maryland. Moreover, the Consortium for Building Energy Innovation based at the Philadelphia Naval Yard is an innovation hub for building energy efficiency solutions.

Energy Production Legacy

West Virginia's legacy as an energy-producing state has resulted in a firm foundation of research institutions, universities, and industry partners dedicated to optimizing fossil fuel technology and developing the next generation of energy resources and technologies. Cutting-edge energy research at West Virginia University, Marshall University, and the National Energy Technology Lab in Morgantown has expanded in recent years to include advanced energy fields, including industrial energy efficiency, and robust collaboration with neighboring research institutions.

Energy Efficiency Initiatives

West Virginia and its investor-owned utilities operate a limited range of energy efficiency programs, from financial incentives to no-cost energy assessments. These programs help lower the upfront cost of energy efficiency upgrades and/or shorten payback periods on equipment, reducing a common barrier to energy efficiency upgrades and increasing the demand for industrial energy efficiency technology. While the state offers a range of energy efficiency programs, there is an opportunity to expand them to be competitive with neighboring states and incentivize greater in-state efficiency.

Energy Efficiency Programs in West Virginia

Benefits of Energy Efficiency Programs

Financial Incentives

Lower the upfront costs associated with industrial energy efficiency upgrades and thus shorten the investment payback period for industrial customers.

Information Services

Ensure that building professionals are up to date on energy efficiency building standards so that new projects and retrofits optimize energy usage.

Energy Assessments

Pinpoint inefficient building energy use and energy waste to prioritize cost-effective improvement opportunities that save utility customers money.

How West Virginia is Using These Benefits

Utility Programs

Public Sponsored Programs Through the Division of Energy



AEP Appalachian Power and Wheeling Power

COMMERCIAL AND INDUSTRIAL PROGRAM



- Offers rebates for eligible, non-residential energy efficiency projects that equal between \$0.06 and \$0.07 per kWh saved annually, depending on the project and contingent upon review.
- Applies to lighting upgrades, sensors, variable frequency drive installation, HVAC upgrades, and energy-efficient appliances.
- AEP will pay up to 50% of a project's incremental cost. Customers may be capped at \$150,000 in total incentives per year, depending on availability of funds.

FirstEnergy: Mon Power and Potomac Edison



BUSINESS LIGHTING PROGRAM

Offers rebates for energy-saving lighting equipment and controls in non-residential buildings that equal \$0.05 per kWh saved annually, regardless of the lighting products or technologies used.

Industrial Assessment Center

Energy auditor for small- and medium-sized industrial facilities.

Has conducted over 500 energy assessments for qualified, small- and medium-sized industrial facilities within 250 miles of WVU since its inception in 1993.

West Virginia Manufacturing Extension Partnership

Aids small- and medium-sized industrial manufacturers in their energy efficiency efforts via lean manufacturing, process optimization, growth planning, sustainability management, and more.

Building Professionals Energy Training Program

Provide the latest information on energy efficiency construction to West Virginia's building professionals.

Free seminars and courses on building energy codes



Industrial Energy Efficiency Technologies with Growth Potential in West Virginia

Insulation

West Virginia has the potential to carve out a competitive advantage in insulation given its unique base of companies along the manufacturing supply chain. In 2016, nearly 600 West Virginians manufactured insulation in the state. Moreover, there are a number of large chemical manufacturers in the state that manufacture inputs for insulation, such as polyurethane. Dow Chemical Company, for example, has a facility at the South Charleston Technology Park that has developed leading urethane technologies for building foam applications.

Increasing the number of insulation manufacturing firms in West Virginia could drive significant economic activity in the state. Utilizing the existing resources and input manufacturers and working to attract new companies could make West Virginia an insulation manufacturing hub in the region.

What is Insulation?

Insulation reduces the exchange of heat through many surfaces in homes and businesses, reducing energy use and operational costs. Insulation is an easy and inexpensive way to increase the efficiency and performance of an industrial facility and lower production costs. Industrial insulation targets heat transfers to minimize any thermal losses in bare equipment, pipes, tanks, and other mechanical systems. Insulation can also optimize steam distribution systems. Industrial facilities can benefit from improved air quality and less moisture in the air, both of which provide health benefits to workers.

Combined Heat and Power

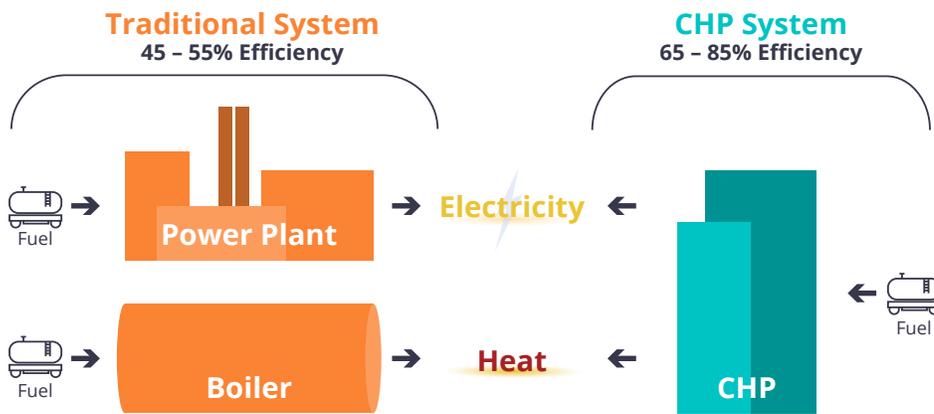
Combined heat and power (CHP) presents an opportunity for economic growth in West Virginia, given the state's energy-intensive industries, its existing base of CHP installations, and the in-state metal manufacturing necessary for construction. The large industrial manufacturing base that could benefit from CHP could drive in-state demand for the technology. Moreover, the large supply of low-cost natural gas in West Virginia could help make CHP more cost-effective for industrial users. Some West Virginia companies are already realizing the benefits of CHP. As of 2013, West Virginia had 382 MW of installed CHP, with the largest CHP facilities at PPG Industries, Inc. in Natrium, American

Bituminous Power LP in Grant Town, Weirton Steel Corp in Weirton, and West Virginia University in Morgantown. Similar to chemical manufacturing, the metal manufacturing industry has a well-established place in West Virginia's economy. In 2015, fabricated metals accounted for 11 percent of total manufacturing employment in the state.

What is Combined Heat and Power?

Combined heat and power (CHP), also referred to as cogeneration, is the concurrent production of electricity and heat from a single fuel source. CHP captures the heat that is typically wasted in a conventional power-generating system and utilizes it to provide process heat, improving the energy efficiency of a facility by up to 40 percent.

Combined Heat and Power



CHP Systems Are 50 Percent More Efficient Compared to Traditional Generation Systems

West Virginia could become a leading manufacturer of CHP systems and tap into this growing market, which is expected to reach an annual market value of nearly \$30 billion by 2023. The state is poised to capitalize on this opportunity because West Virginia's metal manufacturing industry could contribute the necessary facilities, equipment, and highly trained workforce. West Virginia's metal manufacturing workforce is skilled in metal machinery operation, machine assembly, and metal fabrication, all skills important to working in CHP.

Metal Manufacturing in West Virginia

The metal manufacturing sector in West Virginia has experienced levels of instability in recent years, due to its inextricable connection to the coal industry. However, new markets, such as CHP manufacturing, present opportunities to revitalize and strengthen this legacy West Virginia industry.



West Virginia's Strengths, Weaknesses, Opportunities, and Threats in the Industrial Energy Efficiency Industry

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Over 20,000 West Virginians currently employed in the energy efficiency industry • Strong existing chemical industry ecosystem with companies that manufacture energy efficiency products and/or critical input materials • High-quality Industrial Assessment Center provides free energy assessments for qualified industrial customers • Growing global and national demand for industrial energy efficiency in industries where West Virginia can participate, such as insulation • Readily available, skilled workforce • State-sponsored energy efficiency programs 	<ul style="list-style-type: none"> • No state policies designed to ramp up energy efficiency programs • No legislative requirement for utilities to provide energy efficiency programs • Small state budget with limited to no funds to support energy efficiency projects • Limited pipeline of investment-ready entrepreneurs and businesses
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Significant cost savings available in the local industrial sector • Potential to collaborate on new product development with the regional energy efficiency innovation cluster that includes Pennsylvania, Maryland, Virginia, and New Jersey • Regional energy efficiency markets offer an avenue to supply out-of-state demand 	<ul style="list-style-type: none"> • Neighboring states acting quickly to seize industrial energy efficiency opportunities • Limited financial incentives for energy efficiency upgrades prevent widespread adoption • Risk of losing federal funding, which supports current state-run energy efficiency programs

West Virginia Assets to Support Industrial Energy Efficiency

Innovation Ecosystem

Innovation Ecosystem

- Promotes research and development
- Facilitates movement of new technologies to market
- Incubates early-stage businesses

In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem. Innovation ecosystems promote research and development (R&D), bring new technologies to market, and incubate early-stage businesses. Innovation leads to high-skilled, local job creation, and the streamlined transfer of ideas from the lab to the marketplace accelerates further entrepreneurship and job creation. Robust innovation ecosystems include efficient intellectual property protection mechanisms, mentoring for entrepreneurs, and engagement of business and venture capital. State and local government institutions, as well as private entities, can take action to maximize the impact of innovation and support new and expanding businesses in West Virginia.

Research and Development Institutions

West Virginia boasts two public universities, West Virginia University (WVU) in Morgantown and Marshall University in Huntington, both of which are important resources for the industrial energy efficiency field. The Energy Institute at WVU acts as a hub for energy-related innovation and connects researchers from across campus and Marshall University to collaborate on challenges faced by the energy sector, including industrial energy efficiency. Through the Energy Institute, researchers work together in research hubs, such as the Energy Materials Science and Engineering Program that studies energy-efficient materials and the National Research Center for Coal and Energy that engages over one hundred WVU faculty members and research professionals on energy efficiency and other energy topics.

What is Solid-State Lighting (SSL)?

SSL uses light-emitting diodes (LEDs) as a source of illumination, which require less energy and produce a brighter bulb. SSL will reduce lighting electricity consumption in the United States by 75 percent by 2035.

The National Energy and Technology Lab (NETL) is an energy laboratory that conducts research on the efficient use and clean production of abundant fossil fuel resources, in addition to managing partnerships associated with energy efficiency innovation. Partnerships focus on energy efficiency in the building, transportation, and industrial sector. For example, the Solid-State Lighting Project Portfolio researches methods for increasing lighting efficiency. NETL is owned and operated by U.S. Department of Energy (DOE) and is a part of the DOE national laboratory system.

Resources to Bring New Technologies to Market

The development and commercialization of energy-efficient technologies require specific equipment and highly qualified researchers, which can be costly and difficult to obtain. Fortunately, West Virginia hosts a few incubators and accelerators with the necessary facilities. The Mid-Atlantic Technology, Research, and Innovation Center (MATRIC) possesses the technical capabilities in industrial chemical R&D to create new materials with improved properties, establish more efficient chemical processes, and reduce environmental impacts of existing technologies. MATRIC's multi-disciplinary staff contributed to eighty-nine patent applications between 2008 and 2011.

The West Virginia Regional Technology Park (WVRTP), a 258-acre research facility in South Charleston, boasts 800,000 square feet of premier laboratory space, specialized chemical plant facilities for production-scale development, engineering and data processing capabilities, and office and conference space. WVRTP strives to support the development and commercialization of technologies in the energy and chemical industries, both of which have direct ties to energy efficiency innovation. Multiple tenants reside in WVRTP, including Alpha Technologies and the Advanced Technology Center. The Marshall University Graduate College is located adjacent to the property. Created as part of West Virginia's strategic plan for economic transformation through technology and innovation, WVRTP focuses on energy technologies, including clean, efficient, and renewable technology.

The Robert C. Byrd Institute for Advanced Flexible Manufacturing (RCBI) at Marshall University, South Charleston, and Bridgeport is the only statewide facility that provides manufacturers with regional access to advanced flexible manufacturing equipment. The Institute allows individuals and businesses to lease high-tech equipment, access affordable and customizable technical training programs, and gain assistance with electronic networking and procurement to create, sustain, and grow their businesses.

Resources to Support Early-Stage Businesses

Small businesses can flourish and grow when they are connected to resources that boost collaborative learning, such as mentors, networks, forums, and workshops. TechConnect West Virginia (TechConnect) is a nonprofit organization dedicated to promoting entrepreneurship, innovation, and commercialization in science and technology in West Virginia. TechConnect's areas of focus include advanced energy, chemicals, and advanced materials. In 2015, TechConnect launched ScaleUp West Virginia to help accelerate the commercialization process for new products and

ChemCemption at WVRTP

ChemCemption, formed by the Chemical Alliance Zone and situated at WVRTP, is the only chemical-based innovation incubator in the United States. ChemCemption relies upon the advanced chemical manufacturing facilities at WVRTP to execute cutting-edge research.

Rubberlite and RCBI Partnership

Rubberlite manufactures high-quality polyurethane foams and cellular rubber and composite materials. The company has worked with RCBI since the 1990s to meet management system standards. Over the years, RCBI assisted Rubberlite with a range of services, from assisting with product certification to developing quality management systems. Rubberlite products provide a range of beneficial properties, including insulation. With manufacturing facilities in Huntington, the company has grown from two employees in 1986 to 140 employees with over 1,000 customers in forty-three countries across the world.



WVU's TransTech Energy Business Development Conference

- Regional business development conference in Appalachia designed to promote transitional technologies for a low-carbon future
- Startups pitch companies or projects in specific subject areas
- Winners receive monetary prizes and technical assistance
- Opportunity to network with investors

Access to Capital

- Provides funding for new and growing businesses
- Connects investors with market opportunities
- Attracts entrepreneurs

Dilutive and Non-Dilutive Capital

Dilutive capital, such as venture capital, reduces shares of ownership in a company. Non-dilutive capital, such as grants and loans, do not dilute firm ownership.

technologies. Members of the organization include educators, researchers, industry, and public leaders.

The WVU BrickStreet Center for Innovation and Entrepreneurship hosts an annual business plan competition, with STEM/Technology designated as a new emphasis. The competition brings college students from across the state together to pitch their business ideas to conference attendees in hopes of winning \$10,000, accounting and legal assistance, and an incubator space to grow. In addition, the TransTech Energy Research and Business Development Program (TransTech) at WVU hosts an annual conference dedicated to promoting businesses in the advanced energy sector. The conference is part of a larger effort made by TransTech to strengthen and promote innovation geared towards the advanced energy industry.

Access to Capital

Access to affordable capital is essential for entrepreneurs to develop new products, grow their businesses, bring products to market, and create new jobs. Having access to investors and non-dilutive capital can be the difference between success and failure. Capital pricing can make the bottom-line difference in product affordability and market viability, yet many businesses are unable to secure the necessary capital to survive the commercialization phase. In 2015, 77 percent of venture capital funding went to companies in California, New York, and Massachusetts; businesses in the other forty-seven states had to compete over the remaining 23 percent, stifling innovation across the country and highlighting the importance of state policies for new venture capital investments.



Access to Affordable Capital Helps Companies Grow

Programs and Resources for West Virginia Entrepreneurs

In 2015, West Virginia had the second-lowest amount of venture capital per capita in the country. Thirteen venture capital deals occurred from Q1 2009 through Q4 2016 totaling \$27 million, while neighboring Kentucky saw seventy-one deals exceeding a total of \$300 million during the same period. The state also experiences a limited amount of startup activity, with roughly 5 percent of West Virginia businesses categorized as startups—the lowest concentration among other smaller U.S. states. However, the rate of new entrepreneurs in West Virginia has been experiencing an upward trend since 2012. To ensure the success of as many new and growing businesses as possible, West Virginia’s lawmakers could consider creating policies to attract more diverse capital investments to the state.

West Virginia Growth Investment, LLC (WVGI) is a \$1.6 million angel fund created in 2013 by twenty-eight individuals and WVU. WVGI has invested all of its available funds and is not seeking new investments. Rather, the fund hopes to transition to a larger funding model, Mountain State Capital. Still in development, Mountain State Capital aims to be a \$25 million venture capital fund that is dedicated to investing in West Virginia businesses.

Formed in late 2011, the West Virginia Capital Access Program (WVCAP) leveraged over \$13 million from the U.S. Department of the Treasury to fund a small business lending program. WVCAP authorized several organizations to administer the funds, two of which are the West Virginia Jobs Investment Trust (JIT) and INNOVA Commercialization Group. Established in 1992, JIT is a venture capital entity affiliated with the West Virginia Department of Commerce. JIT invests in small- and later-stage companies and favors investment opportunities that create jobs and facilitate economic diversification. The High Technology Foundation operates the INNOVA Commercialization Group, a nonprofit investment capital and business support program that provides a small amount of seed- and early-stage funding to entrepreneurs and startup businesses, focusing on West Virginia enterprises. To date, INNOVA has invested in seventeen West Virginia companies and provided technical assistance to over 400 companies and entrepreneurs. Natural Capital Investment Fund is a nonprofit debt fund that typically invests in environmental projects, using federal Community Development Financial Investment (CDFI) resources. Woodlands Community lenders, another CDFI-funded institution, focuses on a three-county region in central West Virginia.

Appalachian Regional Commission

The Appalachian Regional Commission (ARC) is an economic development agency dedicated to reinforcing communities and strengthening economic growth throughout the thirteen Appalachian states. Over the years, the ARC federal-state-local partnership has invested over \$24 million to support fifty-five projects in West Virginia, creating or retaining nearly 2,750 jobs and training and educating over 16,000 West Virginians. Over half of ARC’s investment in West Virginia has gone into entrepreneurial and business strategies to strengthen the state’s economy.



For companies needing affordable non-dilutive capital, the state offers a Loan Insurance Program to its businesses. West Virginia's Economic Development Authority (EDA) can insure up to 80 percent of a bank loan, not to exceed \$500,000 with a maximum term of four years. Loan proceeds may apply to fixed assets, inventory, and working capital, but they may not be used for construction loans and lines of credit. In the 2016 legislative cycle, the EDA lost \$3.5 million in funding for its program, reducing its loan insurance capabilities by about 50 percent. While the budget cut did not eliminate the loan insurance program entirely, it reduced its future potential.

Equity Crowdfunding

Equity crowdfunding is a mechanism for raising capital that enables a wide span of individuals to invest in early-stage, unlisted companies, typically using an online portal, in exchange for a small ownership share in the company.

West Virginia approved equity crowdfunding in 2016. To be eligible for fundraising, a company must be organized and principally located in West Virginia, and it must sell exclusively to West Virginia residents. Companies cannot raise more than \$1,000,000 in aggregate annual sales via crowdfunding unless they file quarterly financial statements with the state, in which case the limit is \$2 million. Non-accredited investors may not invest more than \$10,000 annually. Finally, all transactions must go through a West Virginia-based internet portal.

Workforce Development

Workforce Development

- Invests with resources in people
- Bridges skills gaps
- Develops training programs and industry partnerships

Trained and skilled workers are fundamental to the success of an industrial energy efficiency cluster. Sector-based workforce development goes hand in hand with cluster development. If firms in the same cluster are able to coordinate with the government, schools, and related nonprofits on policies and programs to train workers, they will be better equipped to identify employment needs and find qualified workers with the necessary skills to fill available jobs.

With high variation in unemployment and underemployment rates across the state and firms in low employment areas unable to find workers with the right skills, prioritizing workforce development is essential for the state's emerging industrial energy efficiency cluster. West Virginia's unemployment rate was 5.6 percent in January 2017, above the national average of 4.8 percent. Unemployment, though, varied greatly across the state. In Jefferson County—located in the eastern panhandle with close access to Washington, D.C.—the unemployment rate was much lower than the state average, at 3.4 percent. In Calhoun County, the unemployment rate was a staggering 15.7 percent.

In order to capitalize on opportunities in the industrial energy efficiency space, West Virginia's policymakers can take proactive steps to address skills gaps and structural challenges in its workforce. A thoughtful sector-based workforce development approach can include industry best practices for recruiting, hiring, training, promotion, and compensation; education and training infrastructure (including community colleges, project-based learning experiences, and apprenticeship programs); and public policy, specifically rules, regulations, and funding streams related to workforce and education. Leaders in West Virginia can focus efforts on regions and populations still experiencing high unemployment. The potential for manufacturing, installation, and maintenance of industrial energy efficiency products offers the residents of West Virginia the opportunity for good-paying jobs.



Installing Insulation



Workforce Strengths

College Partnerships with Toyota and Dow Chemical

BridgeValley and Toyota collaborated to launch the Advanced Manufacturing Technician, a work-based, associate degree program. Each week, students spend two days in class and three days working in Toyota's Buffalo plant. During the five-semester program, students are able to earn over \$40,000. A similar BridgeValley program for Accelerated Chemical Processing Technology allowed students to work two days per week at Dow Chemical. After the seven-month program, the first five graduates began working full-time at Dow Chemical.

West Virginia's existing workforce development programs, K-12 education system, and higher education institutions offer a base for professional and technical skill development, including skills needed in industrial energy efficiency and related fields.

Through the Simulated Workplace program, high school students are able to gain practical skills by joining a student-run, simulated company. The program requires that students adhere to common workplace rules, with a focus on attendance, safety, and random drug testing. Roughly 24,000 students participate each year in over 1,200 workplaces.

Two of West Virginia's community colleges house Advanced Technology Centers (ATCs), where students can learn state-of-the-art technology in programs tailored to meet the needs of regional employers. At BridgeValley Community and Technical College's ATC, programs are based on in-state manufacturing industries such as chemicals and energy. The North Central ATC at Pierpont Community and Technical College facilitates training in several pathways, including advanced manufacturing and energy systems operations.

While there are workforce development strengths, West Virginia has significant room for improvement. Low numbers of postsecondary-educated residents, limited visibility of energy efficiency job opportunities, and lack of coordination between businesses and community and technical colleges make planning for the jobs of tomorrow a challenge.

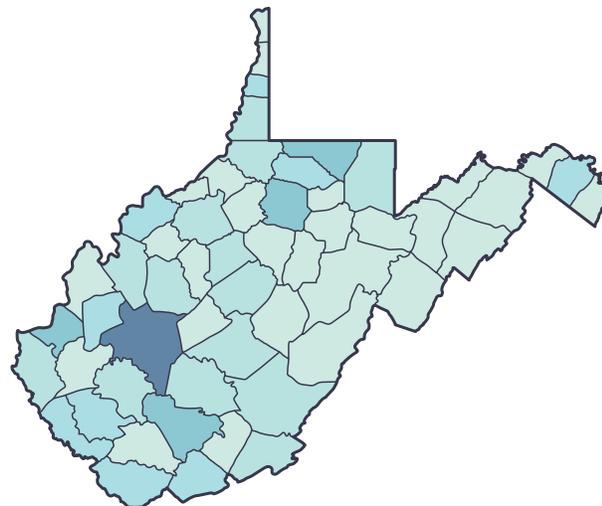
The Impact of West Virginia's Industrial Energy Efficiency Sector

Companies in West Virginia's Industrial Energy Efficiency Supply Chain

In 2016, approximately 20,500 West Virginians worked for businesses along the local energy efficiency supply chain, providing a solid base from which to grow the industry. Businesses across the state focus on product development, manufacturing, distribution, installation, operations, and maintenance. The advanced materials and insulation sector accounted for 25 percent of employment in the state's energy efficiency industry, while traditional HVAC businesses accounted for nearly 33 percent. Sky Insulation in Charleston manufactures and installs spray foam insulation for buildings, including industrial facilities. The Tri-State Service Roofing and Sheet Metal Group fabricates custom metal HVAC systems for industrial customers and caters to a broad range of industrial customer needs.

U.S. Energy Efficiency Industry Employment

As of 2016, the U.S. energy efficiency industry employed approximately 1.9 million workers in 165,000 businesses across the country. Eight percent of those businesses focus directly on energy efficiency manufacturing.



0 3,180

Energy Efficiency Employment by County

West Virginia's Energy Efficiency Employment by County

Global chemical leaders Dow Chemical, Covestro, Bayer Corporation, Chemours, and Addivant are primary manufacturers of chemical inputs that are essential to the insulation manufacturing process, and all have locations in West Virginia.

Analyzing the existing in-state supply chain to identify strengths and gaps is an essential first step toward growing the industry. Bringing in companies to fill gaps through foreign direct investment or expanding existing operations could strengthen the cluster and keep revenue in the local community.

Company Snapshots

West Virginia's industrial energy efficiency industry benefits from a diverse group of businesses, ranging from small supply chain firms to large anchor companies. The following vignettes showcase two West Virginia companies.

Carbon Innovations (CFOAM Ltd.)

- Founded in 2016 in Triadelphia following Carbon Innovations' acquisition of the intellectual property and production facilities used to make CFOAM
- CFOAM is a carbon-based foam product with applications in industrial, aerospace, and commercial energy efficiency markets as high-performance insulation
- R&D was performed at Touchstone Research Laboratory, an independent facility near Wheeling, offering outsourced R&D services to commercial and government customers
- \$70 million in research costs were funded by federal grants and internal funds

Tri-State/Service Roofing & Sheet Metal Group

- Founded in 1923 in Wheeling with service and metal fabrication locations now across West Virginia, Maryland, Virginia, North Carolina, and Kentucky
- Contractor offering roofing, mechanical, and HVAC services to industrial and commercial customers
- Manufactures HVAC systems and other metal products at in-house metal shops
- Roofing services include consultations to ensure maximum energy efficiency for new roofing systems
- Mechanical services include audits of existing HVAC units to identify inefficiencies and installation of new units to ensure low-cost operation

Industrial Energy Efficiency Jobs Beyond Manufacturing

Other possible occupations in industrial energy efficiency include energy management specialists, energy efficiency project designers, construction workers, and wholesale and manufacturing sales representatives. Moreover, there are many industrial energy efficiency deployment jobs such as energy auditors, equipment and insulation installers, industrial energy monitors, and construction and building inspectors. Unlike manufacturing, deployment jobs can occur in every county, providing much-needed employment opportunities for residents of small or rural communities.



Job Opportunities in Industrial Energy Efficiency

Manufacturing industrial energy efficiency products depends upon a variety of trained professionals, including engineers, technicians, assemblers, machinists, and operations managers. To ensure all positions are filled, a state must have comprehensive workforce development and education programs in place. These are good-paying jobs that require workers with everything from a high school diploma to an advanced degree. The following tables give a snapshot of the types of jobs available in the industrial energy efficiency sector.

Industrial Energy Efficiency Jobs Snapshot

Examples of Available Jobs in Industrial Energy Efficiency	
Manufacturing Occupations	
Industrial Engineers	Design and develop systems for industrial production management
Industrial Engineering Technicians	Assist head industrial engineers with design, production, and testing
Energy Engineers	Design and develop energy-related projects for energy and cost savings during construction
Industrial Production Managers	Oversee daily operations of manufacturing
Machinists	Operate computer-controlled and mechanically-controlled machine tools to produce precision metal parts
Materials Scientists	Research chemical properties of composite materials to develop and test products
Materials Handlers	Ensure correct assembly of finished goods and assist with line operations of insulation production
Monitoring Occupations	
Construction and Building Inspectors	Evaluate compliance with building codes and regulations
Energy Auditors	Identify energy conservation measures in building systems
Industrial Machinery Mechanics	Install and repair machinery for industrial production and processing
Energy Efficiency Project Managers	Plan, organize, and supervise energy efficiency projects to completion
Installation Occupations	
Mechanical Insulation Workers	Apply insulating materials to pipes, ductwork, and other mechanical systems
Floor, Ceiling, and Wall Insulators	Apply insulating materials to building structures
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Install and repair temperature and air quality control systems for buildings

*Data from U.S. Bureau of Labor Statistics, 2015 Occupational Outlook Handbook and May 2015 State Occupational Employment and Wage Estimates

Spotlight on Industrial Energy Efficiency Jobs

Industrial Engineering Technician

Assists head industrial engineers with design, production, and testing



Wage: \$22.28

Training: Associate degree

Industrial Production Manager

Oversees daily operations of manufacturing



Wage: \$51.17

Training: Bachelor's degree

Materials Scientist

Researches chemical properties of composite materials to develop and test products



Wage: \$45.13

Training: Bachelor's degree or higher

Energy Auditor

Identifies energy-saving measures in building systems



Wage: \$29.89

Training: Certification, on-the-job training

Mechanical Insulation Worker

Applies insulating materials to pipes, ductwork, and other mechanical systems



Wage: \$26.92

Training: High school diploma or equivalent, apprenticeship

*Data from U.S. Bureau of Labor Statistics, 2015 Occupational Outlook Handbook and May 2015 State Occupational Employment and Wage Estimates



Direct, Indirect, and Induced Jobs

To estimate the potential economic impact of West Virginia's industrial energy efficiency supply chain, we distinguish direct, indirect, and induced jobs.

- **Direct jobs:** reflect jobs resulting from initial changes in demand in West Virginia's industrial energy efficiency industry.
- **Indirect jobs:** reflect jobs resulting from changes in transactions as supplying industries respond to increased demand from West Virginia's industrial energy efficiency industry.
- **Induced jobs:** reflect jobs resulting from changes in local spending as a result of increased demand in West Virginia's industrial energy efficiency and indirect industries.

Technologies Included in Analysis

The range of technologies covered in our analysis includes:

- Motors, transformers, and variable frequency drives
- Pumps and compressors
- Boilers, heat recovery steam generators, and CHP systems
- Air sealing and insulation for building shells, machinery, and equipment
- Industrial "Internet of Things" sensors
- Lighting fixtures
- HVAC systems

Potential Job Growth from Industrial Energy Efficiency Cluster Development

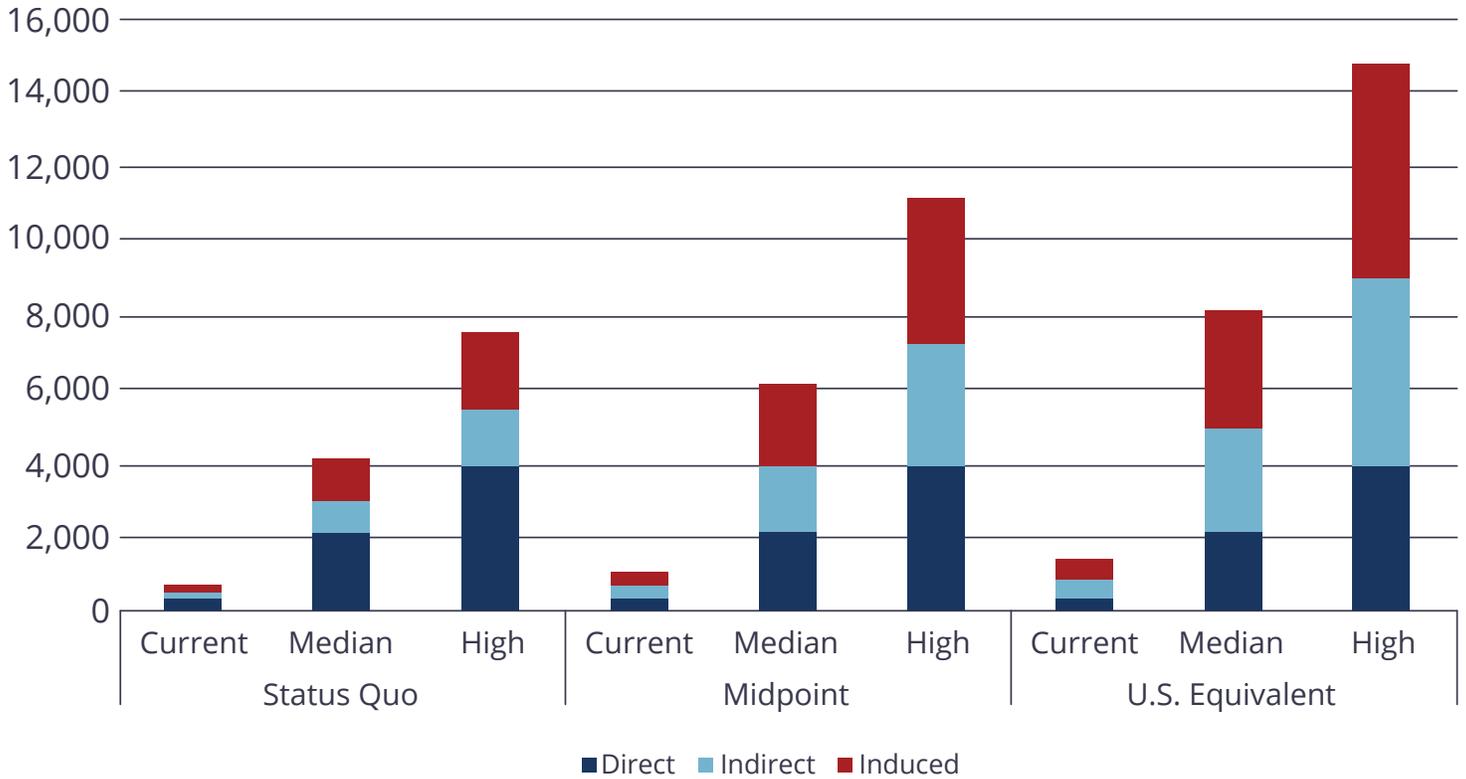
To estimate jobs potential for the West Virginia industrial energy efficiency sector, we combine existing tools, analyses, and projections from several reputable sources. Rather than provide a specific estimate, we examine multiple industry growth scenarios that show the average number of jobs that the in-state manufacturing industry could support annually from 2017 through 2030, a fourteen-year timeframe. To generate these estimates, the industrial energy efficiency analysis utilized IMPLAN, a highly respected regional economic analysis model maintained by the Minnesota IMPLAN Group. IMPLAN models inter-industry interactions and the resulting regional economic impacts, including employment. We present scenarios across two dimensions: supply chain concentration and national market penetration. The Appendix provides a more detailed description of our modeling approach and resources used.

Over 6,100 Average Annual Jobs Supported

As global demand for industrial energy efficiency technology increases, West Virginia's industrial energy efficiency cluster could grow to serve a larger portion of national demand than it does currently. By fostering industry growth, West Virginia could reasonably support over 6,100 direct, indirect, and induced manufacturing and supply chain jobs, on average, annually from 2017 through 2030. These projections do not include any installation, operations, or maintenance jobs.

Our projections for jobs potential in the industrial energy efficiency industry come from global estimates of future demand, current estimated national market penetration for West Virginia's industrial energy efficiency cluster businesses, and industry benchmarks for wages and profits. We utilized these inputs to create a variety of scenarios based on two variables. For one measure, we estimated the number of jobs supported based on varying levels of West Virginia's market penetration. For the second measure, we estimated the number of jobs supported by varying levels of supply chain concentration.

West Virginia Industrial Energy Efficiency Technology Average Annual Jobs Potential by Market Share and Supply Chain Concentration 2017 - 2030



Market Penetration

Market penetration refers to the amount of sales of a product as a percentage of the total sales volume for that product. For each technology, we created jobs estimates based on an estimate of West Virginia’s current market penetration for industrial energy efficiency products. We then created two additional scenarios in which West Virginia expands its market penetration to a quarter of the difference between its current market share and the current state market leader the region, and half the difference between its current market share and the current state leader in the region. A table of these targets is available in the Appendix.



Supply Chain Concentration

Supply chain concentration refers to the level at which West Virginia is able to fill its supply chain needs from in-state companies. The "Status Quo" scenario is based on the existing West Virginia supply chain. The "Midpoint" scenario represents the mid-point between the Status Quo and U.S. Equivalent scenarios. The "U.S. Equivalent" scenario is based on the supply chain concentration that is equivalent to what is currently available in the U.S. economy per IMPLAN's model.

We suggest that the Median market penetration and the Mid-point supply chain concentrations are realistic goals for West Virginia. If West Virginia is able to grow its market share and build a supply chain to these levels, the industry could support an annual average of over 6,100 direct, indirect, and induced jobs from 2017 through 2030. Thus, West Virginia's industrial energy efficiency industry could serve as a major vehicle for future state economic diversification and growth, while creating quality jobs for West Virginians.

Policy Recommendations

Strategically Expanding West Virginia's Industrial Energy Efficiency Sector and Supply Chain Companies

Partner with Industry Associations to Create an Energy Efficiency Industry Working Group

West Virginia's nascent energy efficiency industry employs more than 20,000 people, yet it does not have an organized industry group. An industry can flourish when there is a framework in place to bring public and private stakeholders together to engage in innovation, advocacy, and education on behalf of the industry. Moreover, businesses with a high visibility and a positive public image often have an easier time recruiting skilled workers to fill open jobs. Students are more likely to choose to gain skills in industries that they view as growing. To foster collaboration and increase the visibility of energy efficiency companies within West Virginia, industry leaders could collaborate to form an energy efficiency working group that enables cooperation and collaboration across the value chain in areas such as knowledge sharing, asset growth, policy advocacy, and cluster development. The working group could focus specifically on industrial energy efficiency, in addition to broad energy efficiency issues. Several states have carved out a competitive advantage in advanced energy industries by establishing industry-based associations or alliances.

Texas Renewable Energy Industries Alliance

In Texas, industry, academia, and government leaders have come together to form a nonprofit dedicated to promoting and advancing renewable energy in the state. Members of the Texas Renewable Energy Industries Alliance include stakeholders from a variety of technologies, including solar, wind, biofuels, energy efficiency, and geothermal. The organization focuses on creating jobs in the industry and growing the local economy.

Colorado Cleantech Industries Association

The Colorado Cleantech Industries Association (CCIA) is an industry-led organization that engages in advocacy and education. The organization focuses on conducting outreach, lobbying, and attracting capital. The CCIA also runs the Energy Fellows Institute, an intense week-long program to transition experienced executives into advanced energy industries, such as building efficiency and energy storage.

A West Virginia energy efficiency working group could conduct a variety of activities to support its participants and grow the industry, including:

- Maintaining a public supply chain database
- Conducting outreach campaigns to promote investment in energy efficiency
- Organizing knowledge-sharing and networking events
- Organizing and/or hosting hackathons to solve broad industry challenges
- Supporting the development of a STEM curriculum and industry-specific training programs
- Advocating for policies that increase demand for efficiency technologies and services that support business development

West Virginia's Leading Industry Associations

- West Virginia's Polymer Alliance Zone (PAZ) and Chemical Alliance Zone (CAZ) are two critical, member-based organizations that advocate on behalf of the polymer and chemical industries, respectively. PAZ and CAZ both leverage the collective efforts of their members to grow their industries and related service companies in West Virginia.
- West Virginia Manufacturers Association (WVMA) represents and advocates for manufacturers across the state. WVMA members receive benefits that include networking opportunities with other manufacturers and input on lobbying efforts relevant to their industry.



Chemical Industry Collaboration on Energy Efficiency Technologies

In 1996, chemical industry leaders from across the country partnered with the U.S. Office of Industrial Technologies for its Industries of the Future (IOF) program. The partnership:

- Developed a portfolio of energy-efficient technologies that would enhance the global competitiveness of the U.S. chemical industry through 2020
- Established long-term goals for industry, market, and technology growth
- Created technology research priorities for five targeted areas, including materials technologies like insulation
- Established dozens of chemical R&D projects to be driven by collaborative partnerships across the country

Afterward, West Virginia established the first state-level IOF program, in which stakeholders from across the state came together and identified five key industries to grow, including chemicals.

West Virginia could look to the chemical and polymer industry associations in the state to lead the formation of an energy efficiency working group. Industry members of these associations engage in the energy efficiency supply chain, so there is a wealth of relevant knowledge in the member base. Additionally, several associations have collaborated on energy efficiency developments in the past. For example, PAZ, along with two polymer manufacturers and West Virginia University, collaborated to develop a strategy to recycle end-of-life electronics, a project intended to prepare the in-state chemical industry for future market opportunities. PAZ could bring similar stakeholders together today to create an innovative strategy for helping chemical companies capitalize on the valuable energy efficiency end-use market.

Establishing a collaborative energy efficiency working group that brings together chemical industry leaders, energy efficiency manufacturers, and other stakeholders in residential, commercial, and industrial energy efficiency could spark innovative R&D, optimize supply chain management, and grow the energy efficiency industry overall.

Strengthen and Expand West Virginia's Foreign Direct Investment Strategy

Foreign direct investment (FDI) is a common strategy to fill business gaps and inject jobs and capital into the state economy. The Department of Commerce's International Development Division currently leads West Virginia's FDI efforts. As of 2016, West Virginia-based subsidiaries of global companies employ 29,000 workers in the state, with 50 percent of those jobs in the manufacturing sector. However, West Virginia ranks among the lowest states in the nation in per capita jobs at U.S. subsidiaries. In order to expand employment opportunities for West Virginians while strengthening the state's emerging industrial energy efficiency cluster, West Virginia could evaluate key supply chain gaps that could be filled via FDI efforts. Through more strategic stakeholder engagement, state and local leaders could further identify supply chain barriers and conduct targeted missions to attract investment from foreign companies. West Virginia could look to national best practices and resources to enhance its FDI initiative.

Best Practices for FDI and Export Programs

The U.S. Department of Commerce commissioned an extensive study of the most successful FDI and exporting programs around the country and found that state leaders of these programs share several key practices. The report found that they:

- Engage universities in making international connections and economic development
- Foster strong relationships with economic development resources engaged in FDI
- Collect good data about companies in the cluster
- Develop contact points at companies overseas
- Embrace and adapt to cultural differences, e.g., language-specific business cards and marketing materials
- Commit to long-term involvement in FDI efforts

Connect with Economic Development Resources to Put West Virginia's Emerging Industrial Energy Efficiency Cluster on the Map

There are many platforms that serve as gateways for connecting U.S. and international companies, and West Virginia could leverage these resources to highlight its emerging industrial energy efficiency cluster and attract foreign manufacturers. Some of these resources are detailed below:

SelectUSA offers advocacy, marketing assistance, and information to help state economic developers compete for global investment. Many companies looking to invest in the United States approach SelectUSA as a first step. SelectUSA often turns to Manufacturing USA centers when looking to connect foreign companies with U.S. locations. West Virginia University is a research partner for two Manufacturing USA institutes: the Clean Energy Smart Manufacturing Innovation Institute and the Rapid Advancement in Process Intensification Deployment institute, both of which have subject matter focus areas related to industrial energy efficiency.

The U.S. Cluster Mapping Project offers information about clusters across the United States and is directed by the Harvard Business School in partnership with the U.S. Economic Development Administration.

The European Cluster Collaboration Platform serves as a platform to facilitate cluster-based networking and collaboration, including identifying European partnerships. One platform initiative, the Centre for Energy Technologies Cluster – Free

What is Foreign Direct Investment?

Foreign direct investment (FDI) occurs when a company based in another country makes an investment in the United States by establishing operations or acquiring business assets. FDI increases capital in the economy, encourages transfer of technology and expertise, creates job opportunities for the local workforce, and fills gaps in the local supply chain. Strategies for state leaders include conducting FDI missions to foreign countries, inviting industry leaders to in-state conferences and tours, and providing business incentives.



Enterprise Association, connects dozens of collaborators to support new technology development in the energy sector, including energy efficiency.

West Virginia could also enhance its presence abroad by establishing more overseas trade and investment offices. The state currently has two overseas trade offices, in Japan and Switzerland, compared to Pennsylvania's seventeen offices and Florida's fourteen offices. State and local leaders could engage with international economic development offices to create more gateways for investment into the state.

Identify Target Companies to Enhance State-Driven FDI Efforts

To enhance its international initiatives, West Virginia could also actively identify and engage with companies that may be interested in locating operations in the state. In addition to the economic development resources mentioned above, West Virginia could actively seek assistance from lead generation consultants like WAVTEQ and OCO Global, regional industrial energy efficiency consortiums, and local universities to assess potential FDI opportunities. This strong network of partners could help bolster FDI in West Virginia.

The Massachusetts–Israel Innovation Partnership offers an innovative model on how to facilitate global connections. Launched in 2011 following the governor's trade mission to Israel, the partnership grew from an industry research collaborative to a joint FDI partnership. Major Israeli companies have expanded operations to the state and Massachusetts companies have invested in Israeli intellectual property and R&D operations. As of 2015, more than 200 Israeli-founded companies have made a home in Massachusetts. These businesses accounted for \$9 billion in direct revenue, \$18 billion in total economic impact, and 4 percent of the state GDP, as well as 9,000 direct jobs and 27,000 indirect and induced jobs.

West Virginia could specifically target companies around the world that manufacture industrial energy-efficient products to leverage the state's knowledge and resources in this area. The following table provides a snapshot of potential FDI target companies.

Company	Country	Description
2G Energy	Germany	Manufacturer of cogeneration systems that cater to small- and mid-sized energy needs.
MTU On-Site Energy	Germany	Manufacturer of cogeneration units that run on natural gas and cater to industrial energy needs.
Veolia	France	Operator and developer of efficient energy systems, including CHP in North America.
BASF	Germany	Chemical company that manufactures high-performance plastics, including polyurethane insulation.
Kingspan Insulation	Sweden	Manufacturer of industrial insulation products, including pipe insulation products and systems.

The Governor, mayors, business leaders, and universities could take the lead on putting West Virginia’s emerging industrial energy efficiency cluster on the map and on the global radar. A coordinated and widespread effort is necessary to attract anchor companies, cultivate new expertise, and support local jobs for West Virginians.

Create an Anchor Company Tax Credit

West Virginia is home to a number of large chemical anchor companies, such as Dow Chemical in South Charleston and Covestro in South Charleston and New Martinsville. The chemical industry—a keystone of U.S. manufacturing—provides many of the building blocks for industrial energy efficiency products. Polyurethane spray foam, for example, gains its insulating properties when two chemicals, both of which are manufactured in West Virginia, are mixed together. With a limited number of in-state energy efficiency manufacturers, the state has yet to fully tap into this valuable chemical end-use market. West Virginia could leverage strategic tax incentives to bolster the energy efficiency supply chain by offering an Anchor Company Tax Credit to in-state businesses that attract a supplier or a customer company to the state.



West Virginia could look to Rhode Island as a model for this type of incentive. In 2015, Rhode Island created an Anchor Institution Tax Credit to bolster its in-state industries. Under this policy, an existing, in-state company receives a tax credit if it is responsible for a job-creating supplier or customer company locating in Rhode Island. For example, if a Rhode Island-based wind developer lures a tower manufacturer into the state, then the wind developer would receive a tax credit. The law requires that an in-state business complete both a preliminary application identifying a business that could relocate to the state and a final application demonstrating its substantial role in the decision to relocate. The relocating business must create at least ten new full-time jobs in the state before 2019 or twenty-five new full-time jobs before 2021. The tax credit can be awarded for up to five years and the amount is based on several factors, including the extent of job creation, whether the jobs are in a state-targeted industry, whether the relocation provides benefits to a disadvantaged area, and the amount of economic return to the state.

To effectively strengthen its energy efficiency base, West Virginia could establish a tax incentive similar to Rhode Island's that would leverage the anchor companies in its strong chemical manufacturing base. West Virginia's current tax incentives for encouraging job creation and attracting companies, such as the General Economic Opportunity Tax Credit and the Corporate Headquarters Relocation Tax Credit, require beneficiaries to make significant capital investments in order to earn the credits. In contrast, an Anchor Company Tax Credit rewards the non-financial investment of time and effort that a company contributes to recruiting new companies to the state. West Virginia can leverage the strength of its anchor companies and their relationships by incentivizing these companies to recruit new businesses to the state. A stronger in-state energy efficiency supply chain means greater economic opportunities for West Virginia's chemical companies and energy efficiency manufacturers alike. By supporting supply chain growth, West Virginia could fortify its competitive advantage in the energy efficiency industry and ensure good-paying jobs for West Virginians.

Fostering a Strong Innovation Ecosystem

Leverage Philanthropic Funding Via a Foundation Liaison

West Virginia is currently facing deep budget cuts to remedy a \$500 million deficit, making new state-funded investments in innovation ecosystem assets challenging. As the state pursues new innovation initiatives, it could consider tapping into third-party resources to ease or remove the financial burden on taxpayers. West Virginia is home to many charitable organizations that can work together to provide an alternative funding pathway for research and business development programs. In fact, in 2014, 298 West Virginia-based foundations with nearly \$1.4 billion in assets gave over \$67 million in grants.

West Virginia's leading philanthropic organizations—which include the Claude Worthington Benedum Foundation, Hazel Ruby McQuain Charitable Trust, the Greater Kanawha Valley Foundation, and the BrickStreet Foundation, among others—share the goals of supporting youth education and serving the needs of communities. By working together with national foundations, these organizations could substantially improve West Virginia's innovation ecosystem. The state government could appoint a foundation liaison to connect with and facilitate support from foundations. West Virginia could look to Michigan as a model for this initiative.

Michigan Governor's Office of Foundation Liaison

As the first of its kind in the nation, the Michigan Governor's Office of Foundation Liaison (OFL) builds funding partnerships and strategic collaborations between the state government and the philanthropic community to support programs that improve education and health for all Michigan residents. The Foundation Liaison and OFL staff come to the state on loan from participating foundations. Foundations are actively engaged throughout OFL activities, with contributing funders and nonprofits partly comprising the OFL Advisory Committee. Since 2003, OFL has brokered investments from seventeen foundations, totaling more than \$150 million.

Regional Foundation Supports Local Business

The Claude Worthington Benedum Foundation provides funding through the West Virginia Capital Access Program (WVCAP) Operating Assistance Fund to help West Virginians successfully apply to the WVCAP or to improve their business competitiveness. The funding applies to a range of technical and operational assistance from business plan development and financial modeling to market research and marketing strategy.



West Virginia's foundation liaison could build relationships and disseminate information regarding the opportunities for philanthropy and investment in West Virginia. State leaders could reach out to the leading foundations in the state to assist with appointing a foundation liaison, whether by contributing a portion of the liaison's salary or lending a staff member to lead the effort. To maximize the impact, the foundation liaison could also engage national foundations with potential interests in West Virginia, such as those wanting to support rural development across the country. By using a foundation liaison, West Virginia and the foundation community could leverage one another's investments and efforts, working together to promote innovation and jobs.

Use the Foundation Liaison to Secure Funding for Innovation Ecosystem Assets

Among Appalachian states, West Virginia ranks comparatively low in terms of both innovation and small business development. Despite some well-established universities and a well-developed industrial sector, West Virginia does not experience the same rates of R&D and technology commercialization as other similar states. The foundation liaison could focus efforts on securing financial support for innovation ecosystem assets working to advance industrial energy efficiency technology. These priority areas could include advanced energy incubators and university programs focused on industrial energy efficiency innovation.

Funding Advanced Energy Incubators

Due to the technological and regulatory complexity of advanced energy, startup enterprises can require more specialized resources than generic incubators and business development programs can provide. Unfortunately, West Virginia lacks the resources necessary for energy-specific support. This leaves energy entrepreneurs struggling to obtain the mentorship, guidance, and financial support they need from a limited pool of general resources.

West Virginia's foundation liaison could look to obtain additional funding for incubators with an advanced energy focus, such as TechConnect West Virginia (TechConnect), to provide critical, industry-specific resources to early-stage advanced energy companies. In order to buttress the emerging industrial energy efficiency cluster in the state, the foundation liaison could encourage earmarking some funds for entrepreneurs in the industry.

Funding Industrial Energy Efficiency Programs at State Universities

University programs like TransTech are cornerstones of the state's innovation ecosystem in industrial energy efficiency. Funding expansion of these programs, providing scholarships or fellowships to recruit top students, and sponsoring hackathons could elevate the profile of West Virginia's emerging industrial energy efficiency cluster.

Securing additional funding for existing advanced energy incubators and university programs in industrial energy efficiency can help entrepreneurs overcome barriers and increase innovation and commercialization of industrial energy efficiency products in West Virginia.

Co-Sponsor a Hackathon to Ignite West Virginia's Entrepreneurial Culture

Despite its long history as an industrial center, West Virginia ranks among the least innovative states in the nation. The state's low R&D intensity, limited patent activity, and relatively modest base of STEM-educated professionals suggest that innovation is a significant challenge for businesses in West Virginia compared to those in other states. Likewise, the state suffers from a dearth of independent entrepreneurs and small business owners. An innovative culture is important for growing new ideas and fostering collaboration. It is particularly critical for industries like energy efficiency, where the complex nature of electricity distribution, the extensive amount of energy data, and the large number of stakeholders invested in the industry present complex challenges to industry development. In recent years, TechConnect and TransTech have made an effort to boost innovation across West Virginia through events like Innovation & Entrepreneurship Day and competitions such as the Collegiate Business Plan Competition. However, there is a shortage of events that address the unique and complex technological challenges experienced by the industry. West Virginia could consider sponsoring an industry-specific hackathon to foster collaboration and elevate the profile of the state as a national thought leader in industrial energy efficiency.

What is a Hackathon?

A hackathon is an event where people gather to collaborate on a problem or project with the objective of developing new, usable solutions. Hackathon participants are presented with a challenge and must devise a creative solution to that issue in a pre-determined time-frame, often within twenty-four to forty-eight hours. While traditional hackathons tackle software and technology challenges, hackathons have increasingly focused on larger industry and social issues as well.



Innovation & Entrepreneurship Day at the State Capitol

TechConnect partners with TransTech to host an annual Innovation & Entrepreneurship Day at the State Capitol. The event, which draws high-level state officials including the governor, industry leaders, innovators, entrepreneurs, and researchers alike to network, is part of a statewide effort by the West Virginia Legislature to strengthen the innovation community.

Carnegie Mellon's Hack the Grid

Carnegie Mellon University in Pennsylvania hosted Hack the Grid, a hackathon that challenged participants to deconstruct and analyze an extensive energy database to produce useful, actionable intelligence. The hackathon was co-sponsored by EnerNOC, an energy intelligence and performance company. The two-day event was only open to students and challenged participants to develop creative uses for energy data, which is important in the industrial energy efficiency sector.

SunCode Hackathon

Hosted by Powerhouse, a California-based energy incubator, and open to anyone interested in energy problem solving, SunCode is an annual solar-focused hackathon that challenges participants to tackle big industry problems. In a past SunCode hackathon, Powerhouse presented teams with a home energy management challenge.

West Virginia could sponsor a university-based hackathon to address challenges in the industrial energy efficiency sector. WVU or Marshall University could host the event in partnership with industry leaders to encourage experts and students alike to innovate around a particular issue relevant to industrial energy efficiency. With a relatively low-risk, low-capital investment in this event, the state could begin to develop a reputation as a regional innovation hub. The state could leverage existing programs, such as TransTech, to capitalize on existing resources and sponsor networks to generate interest in the event. By bringing students, researchers, and entrepreneurs together to innovate in an exciting and outcome-oriented environment, West Virginia could fuel the innovation culture in the state.

Encourage Commercialization of Cutting-Edge Research

With the pace of innovation moving faster than ever before, slow-moving technology transfer offices can drive away promising researchers, and hinder the ability of campus researchers and entrepreneurs to bring their ideas to the marketplace. In April 2017, West Virginia University ranked 166th out of 225 on the Milken Institute's Technology Transfer and Commercialization Index: Universities & Research Institutions. Many universities around the nation are revamping their technology transfer offices in order to help technologies developed in-state commercialize as rapidly as possible. To encourage this transition in West Virginia, policymakers could challenge WVU to streamline

and enhance its technology transfer practices. One way to achieve this is by using standardized licensing agreements, which would allow inventors to bring new technologies to the market as quickly as possible and attract researchers and businesses to the state.

The University of Michigan

The University of Michigan, ranked sixteenth on Milken's index, created a standardized licensing and revenue-sharing agreement, allocating earnings to inventors, the inventor's department (and school or college), and the central campus administration based on revenue tiers. In 2014 alone, the university's Technology Transfer Office generated 148 license/option agreements, issued 132 patents, launched fourteen startups, and generated \$18.5 million in revenue. Since 2001, the office has brought approximately \$230 million in revenue and helped create more than 2,000 jobs.

In addition to standardized licensing agreements, WVU could bolster efforts to provide business support services to the university's researchers and entrepreneurs looking to commercialize technology. Those services can include, but are not limited to:

- Accounting and legal assistance
- Small business and entrepreneur pitch training
- Access to testing facilities and technical expertise
- Assistance in applying for funding

The university could engage with various university departments to provide these services, utilizing the vast expertise of its faculty and engaging students from across campus in commercialization efforts. The university could also partner with organizations such as MATRIC and the INNOVA Commercialization Group, which both work to facilitate higher rates of commercialization in West Virginia. Removing barriers to commercialization will send a signal to businesses and researchers that the state is committed to commercializing cutting-edge research that can create jobs.



Leveraging Local Assets to Increase Access to Capital for Growing Companies

Develop Relationships with Foundations Engaging in Program-Related Investment

Program-Related Investments

Program-related investments (PRIs) are a means through which philanthropic foundations can make impact investments in nonprofit and for-profit organizations, and ultimately earn a return on those investments. PRIs can take the form of low-interest loans, guarantees, or equity investments, and can be made either directly or indirectly through an intermediary investment vehicle. Because philanthropic foundations can tolerate a higher level of risk than commercial investors, PRIs provide an opportunity for higher-risk enterprises to pursue funding for which they may otherwise be ineligible.

West Virginia's small businesses and entrepreneurs face a number of barriers when trying to access the necessary capital to start or grow their business, from credit worthiness to eligibility. Large, national foundations have substantial resources to invest across the country, and many are looking to spur economic development in regions with persistent poverty, such as West Virginia. Foundation investments, however, typically take the form of grants to nonprofit entities, leaving struggling for-profit entities behind. To align foundation spending with the needs of capital-strapped West Virginian companies, West Virginia can direct a foundation liaison to develop relationships with program-related investment (PRI) vehicles established by foundations to direct that spending into West Virginia. A PRI is a tool that allows philanthropic foundations to make atypical investments that would otherwise be subject to a tax penalty.

Major philanthropic organizations such as the Rockefeller Foundation, the MacArthur Foundation, and the F.B. Heron Foundation now frequently incorporate formal PRI programs into their broader philanthropic strategies. In some instances, foundations provide PRI funding to independent investment vehicles which re-invest those resources into early-stage companies. West Virginia could look to establish relationships with these foundations and intermediary investment vehicles to help invest in local advanced energy companies.

PRI Opportunities for West Virginia

PRIME Coalition is a national nonprofit organization that serves as an intermediary investment vehicle for PRIs in the advanced energy space. PRIME solicits investments from major philanthropic organizations and re-invests that capital in early-stage energy technology companies.

To solidify its commitment to supporting the advanced energy sector, West Virginia could call upon foundations to target their investments toward the advanced energy industry. PRIs are underutilized in the advanced energy industry. Of the 5,064 PRI transactions that occurred between 1968 and 2013, only seventy-five supported energy-related enterprises.

By liaising with interested foundations and soliciting PRIs, West Virginia could reduce barriers to access to capital for small, early-stage companies. The foundation liaison could oversee this network of PRI organizations. Additionally, by serving as a specialized screen for applicant companies, the liaison could reduce investor concerns by ensuring that funding recipients are viable and that they will promote their funders' social goals. By increasing PRI investments, West Virginia could help early-stage advanced energy companies raise capital and create jobs at minimal cost to the state.

Create Tax Incentives for Investment in Startups

West Virginia's tax rate for capital gains is 6.5 percent, the fifteenth highest in the country and higher than neighboring states. High capital gains taxes create barriers for investors by reducing potential profits. Investors are often reluctant to invest in early-stage companies because of the high level of risk involved; incentives, not barriers, are needed to encourage investment. A statewide policy that reduces or eliminates capital gains taxes for investments in West Virginia's industrial energy efficiency companies could encourage investment and spur economic growth.

Capital Gains Tax

A capital gains tax is applied to the sale of an asset that was purchased at a lower cost than it was sold. For example, if an individual purchases stock in a company and then sells that stock at a later date when the company is worth more, the profits made on this sale—the capital gains—are taxed. Nine states have no capital gains tax, including neighboring Tennessee.

Virginia's Success with Capital Gains Tax Exemptions

Virginia's Capital Gains Exemption for Technology Businesses allows individual and corporate investors to subtract long-term capital gains from their state tax burden. This exemption applies to investments in early-stage technology, biotechnology, and energy companies with revenues of less than \$3 million and operations principally in Virginia. Originally covering investments from April 2010 to 2015, the program has been renewed until 2020. The venture capital climate for seed-stage companies has significantly improved since 2011, the first year that the exemption could be claimed. Annual investment increased from \$49 million in 2012 to \$205 million in 2016, while the number of deals also increased.



The United Kingdom's Investment Incentives

The United Kingdom's Enterprise Investment Scheme (EIS) was started in 1994 with the aim to help small, high-risk companies build capital by offering tax relief to investors. In 2012, the government established the complementary Seed Enterprise Investment Scheme (SEIS), which offers tax incentives at a higher rate for early-stage investment. Both programs reduce capital gains taxes to zero after a three-year investment period. Approximately 22,900 companies have benefited from the EIS, raising over £12.2 billion in funds since the program began in 1994. From 2013 to 2014, SEIS spurred a total of £164 million of investment in 2,000 companies.

Establishing tax exemptions for investments in targeted early-stage West Virginia companies could spur investment in local companies. The state could require a three-year minimum investment before qualifying for the exemption and extend the exemption for up to ten years to provide tech companies with the patient capital they need. Access to patient capital provides early-stage companies with more certainty and helps them overcome the "valleys of death" during technology development and commercialization. Knowing that investors have an incentive to make longer-term investments in West Virginia's advanced energy sector could attract and grow startups and create jobs across the state.

Coach Businesses on How to Solicit Capital

When small businesses and entrepreneurs pitch their business idea to venture capital funds and other investors, it is critical that they know how to create and deliver a compelling pitch. Too often, businesses do not have the knowledge or skills necessary to construct a pitch that successfully attracts investment. Business development centers, incubators, and other support institutions across West Virginia could work with entrepreneurs and small business owners to ensure that their executives are fully prepared for success. To do so, West Virginia could help fund these institutions to provide proper training on how to best prepare small businesses for pitch success. West Virginia could model the training program after Pittsburgh's Innovation Works or Tennessee's Energy Mentor Network.

Innovation Works

Innovation Works, based in Pittsburgh, Pennsylvania, is part of the Ben Franklin Technology Partners network, a statewide collection of the best and brightest business minds, working together to stimulate growth and prosperity in Pennsylvania. Innovation Works focuses on supporting entrepreneurship and innovation as drivers of growth by providing funding and business expertise to early-stage technology companies. The Business Assistance program at Innovation Works connects new companies with experienced CEOs, entrepreneurs, and investors to ensure that they are prepared for success, including offering assistance in developing an effective pitch.

Energy Mentor Network

The Tennessee Advanced Energy Business Council, in partnership with Launch Tennessee, offers the Energy Mentor Network. The program aims to develop quality startups by pairing entrepreneurs with seasoned mentors and providing a structured program of mentoring and presentations. Graduates of the program will have the tools they need to successfully raise capital: a quality pitch deck, business model, and blueprint for growth.

Funding for a pitch training program could come from the state, industry associations that would benefit from the program, foundations via the foundation liaison, or a combination of these through matching funds. The program could focus on the key aspects of a business pitch: essential details, a business plan, suitable presentation format, etiquette, and timing.

In order to establish West Virginia as a hub for innovation and product development, the business community must be equipped with the skills necessary to compete for and attract capital. Strengthening the presentation skills of small businesses looking for investment capital will help drive economic growth for the state.



Establish a State Fund of Funds to Stimulate the Investment Environment

What is a Fund of Funds?

A fund of funds is a fund that invests in other investment funds as opposed to investing directly in stocks, bonds, or other securities. Because a fund of funds has a diverse portfolio, investors are better protected from high-risk investments and exposed to more ventures. Thus, a fund of funds not only fosters the state's investment community but also increases access to capital for in-state businesses.

Patient Capital

Patient capital refers to funds invested in a company for the long term. Patient capital is important for advanced energy startups because advanced energy technologies can take decades to fully develop. Venture capital firms typically have a fund horizon of three to five years, a model unsuitable for advanced energy firms.

Early-stage companies and small businesses typically have limited financial capital for growth and development. These companies tend to lack physical assets that can be leveraged for bank loans. This issue is particularly acute for new energy-efficient technologies that may be costly to develop and exhibit longer commercialization periods. For these technologies, patient capital is necessary to grow their technologies into valuable investments. West Virginia has several programs aimed at assisting businesses and fostering economic development, including a venture capital fund. However, while these programs support West Virginian companies, funding is limited and there is no sector-focused fund. The state government could establish a fund of funds and encourage top investors to devote their capital to cutting-edge energy efficiency technologies in West Virginia, thereby increasing access to capital for in-state businesses and growing an economic cluster in the state.

A fund of funds that focuses on providing patient capital ensures companies have long-term certainty and helps avoid the “valleys of death” during technology development and commercialization. In order to achieve the state's goals of providing patient capital to energy efficiency companies, it can set managing criteria to govern how the funds are invested. The fund's managing criteria could be: (1) invest in West Virginia companies, (2) provide industry returns, (3) hold investments in excess of five years, and (4) invest in advanced technologies. This strategy differs from the state's current venture capital funds, which are less targeted in their investments and make investments directly rather than use an experienced management firm.

Success with Illinois' Fund of Funds

Illinois first began investing in venture funds in 2002, using funds from the \$13 billion invested by the state treasurer. The fund invests no more than 15 percent in any given venture or private-equity fund, which then in turn invests in high-potential startups. The state gets a financial return for its investments, with past rates of return around 6 percent. Moreover, these investments have led to the creation of thousands of Illinois-based jobs.

Since 2005, Illinois has channeled \$66 million of state funds into eighteen private investment funds. Moreover, these investments have supported about 6,300 new Illinois-based jobs. In 2016, Illinois refinanced its fund of funds with \$222 million, which is expected to create over 18,000 jobs.

Success with Utah's Fund of Funds

Utah's \$300 million economic development program is managed by a nonprofit, quasi-governmental organization (the Utah Capital Investment Corporation) rather than a third-party firm. This structure allows for greater capacity to directly engage with entrepreneurs, businesses, venture capital, and private equity funds. Utah also invests in a diverse set of nation-wide partner funds to encourage outside investments in Utah companies. As of February 2016, Utah's twenty-eight partner funds have invested \$723 million in sixty-seven Utah companies, supporting over 2,700 new jobs and \$35 million in new tax revenue.

West Virginia could engage its insurance companies to raise money for the fund of funds by selling insurance premium tax credits. Insurers could contribute to the state fund of funds in exchange for a credit against the premium tax liability that can be used in a later year. The West Virginia Legislature introduced a similar tax incentive for insurance companies in 2017, with bipartisan support, but it did not pass the House Finance Committee. A future iteration could be improved if it also required that returns on investments were deposited into the general fund to recover the initial loss of tax revenue by the state. West Virginia has over 2,000 insurance entities doing business in the state, contributing \$116 million to the state GDP. Engaging those firms could generate significant revenue for the fund and for the state.

While this type of mechanism has been used in many states, it has seen recent success in Maryland and Pennsylvania, where tax credits were auctioned off to insurers and then distributed to designated investment partners.



InvestMaryland

Established in 2011, the InvestMaryland program is jointly managed by the Department of Business and Economic Development and the Maryland Venture Fund Authority, a nine-member group of business and investment experts. Maryland employs a hybrid model in which two-thirds of the funds go to selected private venture firms, about one-third filters into the state-run Maryland Venture Fund, and a small portion is directed to the Maryland Small Business Development Financing Authority. InvestMaryland raised \$84 million in the auction, exceeding its goal of \$70 million. These funds were distributed to about seven venture firms and have since supported three iterations of the InvestMaryland Challenge, an international business competition. Although attributable to multiple factors, the state experienced a 33 percent growth in venture capital from \$470 million (fifty-seven deals) in 2012 to \$623 million (sixty-two deals) in 2013, over the time of InvestMaryland's initial funding.

Innovate in PA

Similar to Maryland, Pennsylvania created the Innovate in PA program in 2013 and auctioned \$100 million in deferred insurance premium tax credits. Innovate in PA is projected to create at least 1,850 technology jobs, about 3,500 indirect jobs, and a return of \$2.37 for every dollar invested.

A dedicated effort to provide early-stage and growth financing support could help West Virginian advanced energy companies move through the “valleys of death” and expand their businesses. Investing in advanced energy efficiency technology companies will help bring the state's best ideas to the market and build thriving businesses in West Virginia.

Aligning Training Programs to Meet the Needs of Industry and Serve Students

Support Career-Connected Learning

In 2016, corporate leaders ranked the availability of skilled labor as the most important factor when deciding where to site a new facility. Unfortunately, West Virginia's workforce ranked fortieth in the nation. Having a pool of skilled workers is especially important to attract industrial energy efficiency manufacturers. As technology has improved, energy efficiency manufacturing has become innovative, fast-paced, and technologically advanced. Today, the majority of manufacturing jobs require more than a high school diploma but less than a college degree. Manufacturing also supports good-paying, middle-class jobs; the average manufacturing worker in West Virginia earns over \$65,650.

Unfortunately, West Virginia's high school students are often unaware that these good-paying jobs exist and fail to obtain the education to win these jobs. To expand awareness and put students on track to gain high-demand skills, West Virginia could open the doors to these middle-class careers in high school. By allowing high school students to engage in career-connected learning, West Virginia could increase the competitiveness of its workforce and attract international industrial energy efficiency manufacturers to the state.

Ohio's Work-Based Learning in Early Colleges

Early college programs are an innovative way to engage students in the classroom and better prepare them for the jobs of the twenty-first century. Through partnerships between high schools and local colleges, students can earn their high school diploma and an associate degree concurrently in a four- to five-year period. Students enrolled in early college programs are more likely to graduate from high school (90 percent versus 78 percent nationally). This is especially impressive because the majority of early college students are from low-income families and will be the first person in their families to attend college. Ohio has improved the early college model by embedding work-based learning in the curriculum. Ohio has provided a \$14.4 million grant to fifteen school districts in Central Ohio to develop six career pathways, including advanced manufacturing. In the 2014–2015 school year, the first year of the pilot program, nearly 25 percent of all eligible students elected to enroll in the program—over 5,400 students.

STEAM Academy

To encourage fifth to eighth grade students to begin thinking about careers in science, technology, engineering, arts, and mathematics (STEAM), BridgeValley offers summer camps at the Advanced Technology Center. The program is so popular that it often fills up and families join a waiting list.

Early College Success

Evaluations of early college programs in North Carolina found that participating students reported higher levels of academic engagement, were more likely to be on track to graduate high school, and were less likely to be suspended than students in comparative schools.



Youth Apprenticeships in Wisconsin

Wisconsin's Youth Apprenticeship Program links apprenticeship hours to high school credits. This work-based learning is applied toward high school graduation requirements, industry skill certificates, and credit within the Wisconsin Technical College System and University of Wisconsin system. From 1994 to 2012, 1,200 employers and 230 high schools helped nearly 16,000 youth apprentices earn certificates.

Boeing Core Plus Curriculum

In Washington, the state education department worked with industry partners to develop a high school curriculum that better prepares students to enter the workforce. In 2014, the first Core Plus curriculum was launched with the help of Boeing. The new curriculum allows high schools to meet industry needs and satisfy education standards. Students in the Boeing program gain manufacturing skills while earning high school credits in core subjects, including science and math. Boeing has hired 160 Core Plus students directly from high school.

To better prepare students for industrial energy efficiency manufacturing jobs, the West Virginia Legislature could establish an industry-specific early college pilot program that addresses existing skills gaps in the industrial energy efficiency sector. The state could also create a youth apprenticeship program that would allow students to earn credits toward a high school diploma and community college or university degree. Additionally, the schools could work with industry partners to develop new curriculums that bring industry applications into the classroom. By increasing career-connected learning, West Virginia can reinvigorate high school education and increase the number of skilled graduates available to support the state's advanced energy industry.

Encourage High School Partnerships with Community and Technical Colleges

By 2020, two out of three U.S. jobs will require a college degree or credential. Of the 3.4 million manufacturing job openings expected in the next decade, 2 million jobs are projected to go unfilled due a lack of skilled workers. With the majority of manufacturing jobs requiring more than a high school diploma but less than a college degree, West Virginia will need to increase the number of skilled workers in the state to be able to compete for and win good-paying industrial energy efficiency manufacturing jobs. Unfortunately, as of 2014, fewer than one out of three West Virginians held postsecondary credentials, including degrees, certificates, and certifications.

To prepare West Virginians for advanced energy manufacturing jobs, the state will need to make a concerted effort to increase the number of high school graduates continuing their education. With community and technical colleges offering a variety of credential and degree programs, high school students will need additional guidance to navigate their postsecondary options. By looking to a model in Arizona, West Virginia could increase the number of students enrolling in community and technical colleges, providing a larger pool of skilled workers to attract industrial energy efficiency manufacturers to the state.

College Connections in Arizona

In Arizona, Mesa Community College (MCC) has partnered with Mesa Public Schools to help students navigate their postsecondary options and successfully transition from high school to community college. Six Mesa high schools will host a full-time MCC advisor. Advisors will work with staff to help students take advantage of early college programs, complete college applications and enrollment forms, apply for financial aid, and develop career plans.

To increase the pool of skilled workers available for industrial energy efficiency manufacturers, West Virginia's policymakers could consider funding a partnership between the West Virginia Community and Technical College System and high schools. By offering advisors who specialize in the offerings of the community and technical colleges, the partnership could focus on recruiting students who otherwise would not enroll in any postsecondary education. Locating the advisors on high school campuses, especially those in areas of high unemployment, could allow them to encourage students at risk of dropping out to consider technical education.

Services provided by the advisors could include:

- Assisting students with community college and financial aid applications
- Educating high school staff about career paths and requirements
- Informing parents about postsecondary options and career opportunities
- Providing tours of community college campuses and facilities
- Helping students with enrollment and tips for a successful transition

STEMersion

For one week each year, BridgeValley Community and Technical College, the West Virginia Manufacturers Association, Dow Chemical, Toyota, Appalachian Power, and other partners give twenty-five middle and high school science, technology, and math teachers an introduction to local STEM businesses. The teachers tour local companies and see first-hand good-paying careers available to students who gain STEM training. Additionally, the teachers gain an understanding of how classroom concepts translate into real-world applications.



By encouraging high schools to partner with their local community or technical college, West Virginia can increase the number of students enrolling in postsecondary education and equip the next generation with the needed skills to attract good-paying, skilled industrial energy efficiency jobs.

Align Community College Efforts with Private Sector Needs

To prepare a skilled workforce to compete for industrial energy efficiency manufacturing jobs, community colleges must be able to quickly adapt to changing industry needs. In the industrial energy efficiency sector, innovation occurs rapidly and employees need to have access to continued training. For example, the increasing deployment of smart technologies in high-performance buildings means that traditional HVAC, facility management, and energy assessment skills need to be updated. Strong partnerships among local community colleges, energy efficiency installers, and energy efficiency manufacturers are essential.

Training for Maintenance and Operations

A workforce advisory board or program could also work with industry to determine workforce needs related to managing and maintaining industrial energy efficiency projects, such as energy auditing training programs and energy management certifications. Community colleges could establish programs similar to the Industrial Assessment Center at WVU, where students get hands-on experience in conducting energy audits and analyses for industrial clients.

WorkSmart in Maryland

In November 2016, the Maryland Association of Community Colleges partnered with the Department of Commerce to create the Maryland WorkSmart program, a one-stop shop for businesses and workforce stakeholders. The program will enable community colleges to strategically partner with industry to assess instruction needs and tailor training programs. If an employer needs training that does not exist, Maryland WorkSmart will reach out to national leaders to create new training modules. Each community college will have a WorkSmart Center, making it easier for industry to approach colleges about training.

Washington's Centers of Excellence

Washington's community and technical colleges are home to ten industry-specific Centers of Excellence. Each Center is housed at one of the community and technical colleges and focused on workforce and economic development for a single industry. For example, Washington has Centers focused on clean energy, construction, and aerospace manufacturing. With an advisory board that includes members from the targeted industry, education, and labor, each Center leverages strong industry ties to ensure that the state's community and technical colleges are strategically meeting the local needs for a skilled workforce.

Creating similar programs in West Virginia could not only provide a singular access point for the industrial energy efficiency industry, but also facilitate the alignment of skillsets needed by the industry. By collaborating on training needs and working more effectively with industry, West Virginia's community colleges can increase the number of skilled workers available and give the state a competitive advantage in attracting industrial energy efficiency businesses and creating good-paying jobs.

Creating Demand for Industrial Energy Efficiency Technology by Increasing Deployment

By enacting smart, forward-looking policies that encourage in-state demand, West Virginia can send a market signal to the industrial energy efficiency sector and attract companies from around the globe. Having robust local demand near industry headquarters can create synergies that drive innovation and retain talent in the state. Additionally, stimulating in-state demand can make local companies competing for capital more attractive to out-of-state investors. The following recommendations are intended to stimulate local demand for industrial energy efficiency products. State leaders can implement each of these recommendations individually or jointly, depending on state goals.

Offer Industrial Energy Efficiency Tax Incentives to Manufacturers

Energy efficiency investments can save businesses and manufacturing plants money on their electricity bills, making their products and services more cost competitive. However, high costs for energy-efficient systems and equipment are often cited as a barrier to investing in energy efficiency technology. West Virginia can reduce the overall cost of energy efficiency investments through tax incentives.

Energy efficiency incentives are habitually underutilized by state governments to meet energy and environmental targets. Although West Virginia offers tax credits to manufacturers that create jobs, such as the General Economic Opportunity Tax Credit, the state does not have any public purpose-funded energy efficiency programs. West Virginia could consider expanding its tax incentives and financial support to include companies that adopt energy-efficient upgrades, similar to programs in Virginia and Kansas.



Public Purpose-Funded Energy Efficiency Programs

Virginia allows counties, cities, or towns to offer a property tax exemption to businesses, residents, and industry that meet or exceed designated building standards for energy efficiency. Additionally, Virginia allows property tax exemptions for business or industrial facilities that utilize cogeneration equipment, such as CHP.

Kansas allows taxpayers to take a deduction of 55 percent of the amortizable costs of the system for the first year and 5 percent for the following nine years. Kansas also has a state-run revenue bond program for companies installing waste heat recovery systems. Waste heat recovery includes facilities and equipment that capture waste heat from electricity generation and use that heat for other processes rather than letting the heat escape. The Kansas Development Finance Authority issues revenue bonds for financing the construction, purchase, and installation of waste heat recovery systems.

West Virginia could expand on its existing industrial tax incentive programs by providing tax incentives for specific energy efficiency systems, as is done for building efficiency systems in Virginia and waste heat recovery systems in Kansas. The state could also enhance finance options for manufacturers installing energy-efficient products. Providing incentives for installing industrial energy efficiency equipment would remove cost barriers, increase demand, and grow the industry.

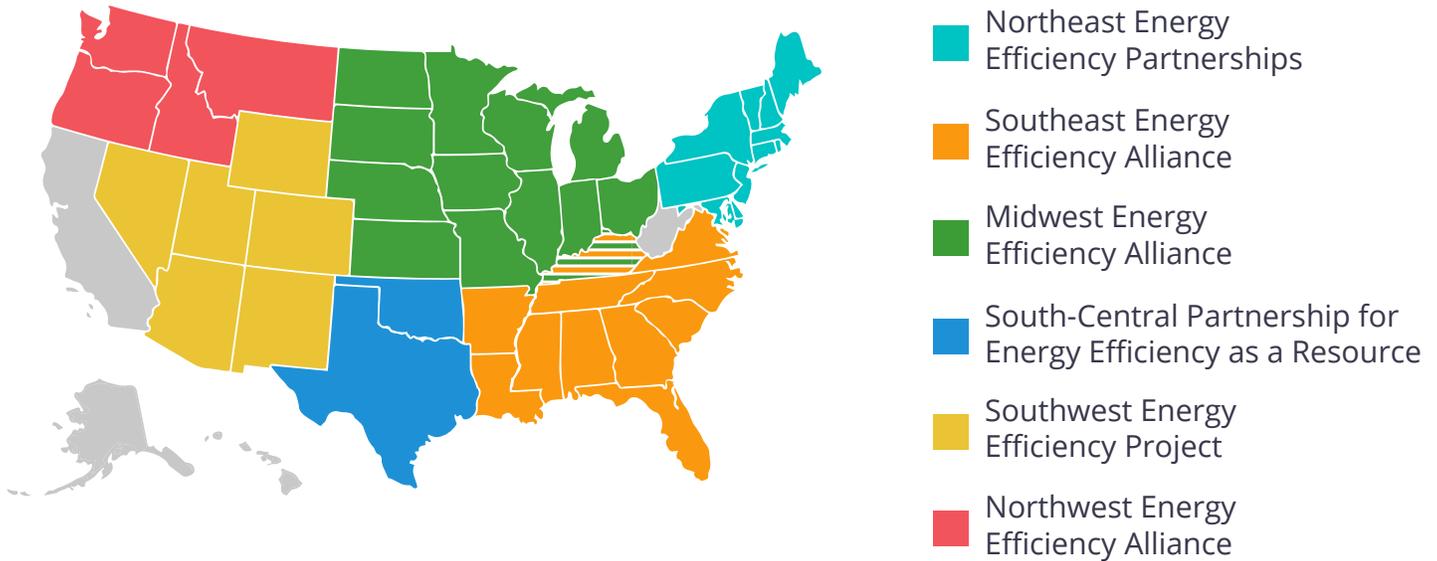
Participate in a Regional Energy Efficiency Organization

Regional energy efficiency organizations (REEOs) are network-based organizations working to advance energy efficiency in forty-six states across the country. Six regional organizations help states implement energy efficiency policies and create initiatives and programs to promote energy efficiency in their member states. West Virginia is one of the four states that are not members of a REEO. This means that West Virginian energy providers, the state energy office, the state workforce development office, and industry participants are not engaging in initiatives that could help grow the industrial energy efficiency industry in the state.

To encourage collaboration among in-state industrial energy efficiency stakeholders and grow the industry, West Virginia could join one of the existing REEOs. Support from a REEO could increase deployment of industrial energy efficiency technology in West Virginia. For example, the Northwest Energy Efficiency

Alliance (NEEA) is working to support the market for industrial energy-efficient products. Part of NEEA's industrial energy efficiency efforts is the Strategic Energy Management Hub, which allows companies to easily connect to best practice case studies, access a resource library, and attend networking events.

Map of the Six Regional Energy Efficiency Organizations



Additionally, the Midwest Energy Efficiency Alliance (MEEA) administers the Midwest Industrial Initiative (MII), a regional network that advocates on behalf of industrial energy efficiency manufacturers and related businesses. MII also supplies members with best practice strategies to make informed decisions about energy efficiency. Additionally, MEEA participates and hosts conferences and events for its members to connect them with state officials, local industry leaders, and utility program operators involved in the industrial energy efficiency sector.

West Virginia state offices and/or businesses could join either MEEA or the Southeast Energy Efficiency Alliance (SEEA), or, similar to Kentucky, the state can join both groups. Joining a REEO would give industry players and policymakers in West Virginia access to counterparts in other states that are implementing energy efficiency policies and procedures. Having a regional network and technical support would help West Virginians explore energy efficiency best practices, like decoupling. To join, West Virginia's state energy office and Department of Commerce could contact the membership office of a REEO and encourage companies in West Virginia to participate as well. Joining a REEO could mean greater industry growth and therefore more good-paying jobs for West Virginians.



Incentivize Industrial Energy Performance Using Energy Performance Indicators

West Virginia's investor-owned utilities offer nonresidential customers rebates for qualified energy-efficient equipment upgrades. Some of the qualified equipment has industrial energy efficiency applications; however, industrial customers invest in energy efficiency upgrades at a lower rate than residential customers because of the high upfront costs associated with industrial upgrades. These large energy consumers need additional incentives beyond equipment rebates to invest in new technology. Financial incentives based on energy performance indicators can provide the additional support needed to spur manufacturers to invest in energy efficiency equipment.

New Jersey and Massachusetts have used energy performance-based incentives to aid industrial energy efficiency upgrades. To establish performance-based incentives, utilities must first collect comprehensive data regarding industrial energy usage through performance indicators. With that data, utilities can set energy targets, verify when targets are met, and establish energy-savings incentives. Industrial customers who achieve certain levels of energy savings by implementing energy efficiency measures receive rebates.

Establish Energy Performance Indicators

Industrial energy performance data can help companies and policymakers better understand what levels of energy savings industrial facilities can achieve. Energy performance indicators, such as adjustable tracking and reporting tools, and metering capabilities allow utilities to accurately track customer energy usage and adjust for variation throughout the day or year.

Unfortunately, these data are limited in West Virginia. Without a baseline understanding of energy consumption, it is difficult for utilities to set performance-based targets and verify that they have been met. For this reason, utilities could benefit from using energy performance indicators. With this data, utilities can offer industrial customers savings-based financial incentives, which can motivate manufacturers to reduce energy use more effectively than equipment rebates.

Good models the state can use to help industrial facilities meet energy-savings qualifications are the ENERGY STAR Energy Performance Indicators and the Superior Energy Performance (SEP) program (based on ISO 50001 industrial energy standards). The ENERGY STAR Energy Performance Indicators can assist industrial plants in benchmarking their energy performance and comparing them to similar plants in other states. SEP-certified facilities saw energy performance improvements of up

Performance-Based Incentives

Performance-based incentives reward utility ratepayers with financial rebates when they meet specified energy-savings targets after investing in energy efficiency equipment or adopting efficient building practices.

to 30 percent over three years. West Virginia can utilize existing programs to make it easy for plants to qualify for incentives.

Use Energy Data to Establish Incentives

Once the utilities have established a system for tracking energy data among their customers, they can set cost-effective energy-savings targets. Facilities could track energy savings through energy performance indicators like those developed by ENERGY STAR. When customers meet the pre-determined targets and verify savings through benchmarking and performance measurements, they receive a certificate from the utility and rebates that apply to the energy efficiency installations or equipment. Combining financial incentives with these existing assessment and performance programs would help West Virginian manufacturers turn potential efficiency upgrades into a reality.

New Jersey's Pay for Performance Incentive Program

New Jersey offers a Pay for Performance incentive program to all commercial and industrial buildings for energy efficiency improvements. Pay for Performance participants receive financial incentives through an approved third-party program partner that works directly with the participant to recommend and install energy efficiency building equipment. Under this program, the Bayer Corporation invested \$4.2 million in energy efficiency upgrades and received \$1.1 million in financial incentives. The project resulted in annual cost savings of \$526,876 for the chemical giant, leading to a payback period of six years on the investment.

West Virginia could adopt performance-based energy efficiency incentives to target large, energy-consuming industrial plants, and use existing certificate programs, such as ENERGY STAR, to help execute the incentive program. Adopting these incentives would help reduce waste and improve industrial competitiveness in West Virginia.

Implement a Utility Energy Efficiency Resource Standard

Although West Virginia has some of the lowest retail electricity rates in the nation, low per-unit costs are offset by high rates of consumption. Despite paying 78 percent of the national average per kWh, West Virginia is the fifth-largest, per-capita consumer of electricity nationwide. As a result, residents' average monthly energy bills are higher than those in twenty-five other states and the District of Columbia. To reduce monthly energy bills while maintaining low rates, West Virginia could consider adopting



Energy Efficiency Resource Standard

An Energy Efficiency Resource Standard (EERS) is a statute that requires load-serving entities (LSEs) to reduce a certain percentage of their electrical loads by a specified date. Program designs vary, but they traditionally rely on cost-effective energy efficiency measures and demand response to achieve energy savings. Twenty-six states—including three of West Virginia's neighbors—had active EERS programs as of January 2017 and nineteen of those states have provisions and goals for CHP.

an Energy Efficiency Resource Standard (EERS) similar to those adopted by Pennsylvania and Maryland.

Pennsylvania debuted its EERS—known as Act 129—in late 2008. Act 129 required the state's LSEs to develop plans to: (1) reduce peak demand by 4.5 percent by 2013 and (2) reduce total electrical consumption by 3 percent by 2013, with an intermediate goal of 1 percent by 2011. Under the supervision of the state Public Utility Commission (PUC), Pennsylvania LSEs achieved 2,073 GWh of load reduction in the program's first two years. This initial reduction alone is projected to save ratepayers \$2.3 billion over the efficiency measures' lifespan. Based on the early success of this program, the Pennsylvania PUC has continued to set energy-savings targets for LSEs.

Maryland's 2008 EmPOWER Maryland Energy Efficiency Act similarly required LSEs to reduce total per-capita consumption to 90 percent of 2007 levels by 2015, using a combination of energy efficiency and demand response programs. It also required incremental reductions in peak demand, culminating in a 15 percent reduction by 2015. After state utilities and energy cooperatives achieved these energy and demand reduction goals, the Maryland Public Service Commission (PSC) extended the program through 2020. LSEs must now achieve staged reductions building up to an eventual incremental savings of 2 percent per year.

At present, West Virginia's energy efficiency and demand response mandates are comparatively small and the state has no provisions for waste heat recovery. The state's major utilities offer a limited selection of PSC-approved energy efficiency incentives and demand response options, but the load reduction mandates are far below the same scale as those targeted by neighboring states' EERS programs. West Virginia is therefore well positioned to benefit from an EERS program that imposes more ambitious load reduction goals on the state's LSEs and includes goals for CHP in industrial facilities.

West Virginia's legislature considered a bill in 2013 to establish an EERS for the state, HB 2210, which did not move forward. Nevertheless, it may provide a good starting point for establishing a new EERS that better fits the state's needs. Much like Maryland's EERS, HB 2210 required a 15 percent reduction in both electricity sales and peak demand by 2025 compared to a 2010 baseline. Under this bill, utilities would be required to establish energy efficiency and demand response programs in order to meet these targets. The PSC oversight would verify compliance and ensure the programs remain cost effective for ratepayers. By adopting

this type of mandatory energy efficiency standard for utilities, the state could reduce the financial burden on ratepayers while maintaining low electricity rates.

Adopting an EERS can help LSEs stay on track to meet their load reductions. Reducing LSE energy loads through energy efficiency measures is a cost-effective way to lower reliance on more expensive energy sources and thus provide cost savings to ratepayers.

Enable Local Energy and Efficiency Partnership Programs for Commercial and Industrial Energy Efficiency

For industrial property owners, the upfront cost of energy efficiency improvements can present an insurmountable barrier. Energy financing programs, such as the Local Energy and Efficiency Partnership (LEEP), were developed to help building owners overcome that cost barrier. LEEP is nearly identical to Property-Assessed Clean Energy (PACE), except PACE offers financing for clean energy programs in addition to energy efficiency. PACE-enabling legislation has been introduced in each legislative session since 2014, but has yet to pass through the legislature. The bill would have authorized local governments to adopt PACE programs and allowed districts to finance or refinance energy projects on property owned by the borrower. By permitting the implementation of LEEP programs, West Virginians could create loan programs in the state, allowing property owners to make deep, comprehensive retrofits and overcome upfront cost barriers to energy efficiency improvements.

LEEP for commercial and industrial properties enables low-cost, long-term financing for energy efficiency improvements made at plants and commercial buildings. Twenty-one states and the District of Columbia have proposed or have existing commercial PACE programs and projects, which offer similar benefits to LEEP.

Local Energy and Efficiency Partnership (LEEP)

The LEEP program allows property owners to finance investments in energy efficiency with a loan that is repaid through their property tax bill. Borrowers benefit from the loan because it spreads expensive upfront costs to more affordable installments over a fixed timeframe. Lenders are willing to offer attractive interest rates because their loan is secured by a tax lien on the property.



LEEP Program Design

When designing a LEEP program, the following features can maximize beneficial impacts:

- Voluntary involvement
- One hundred percent financing of hard and soft energy efficiency costs
- Finance terms of up to twenty years
- Option to combine LEEP with utility, local, and federal incentive programs
- Allow energy projects to be permanently affixed to a property
- Coordinate with the local municipality to file LEEP assessments as a lien on the property

Adopting LEEP-enabling legislation allows states to implement industrial energy efficiency financing programs, such as the program employed by Cambridge Engineering to install energy efficiency upgrades at its headquarters in Chesterfield, Missouri. Cambridge Engineering is a manufacturer of energy-efficient, heating and ventilation technology. The company used a PACE mechanism to upgrade its headquarters by improving the lighting, replacing the roof, upgrading the air conditioning, and installing new air volume distribution systems. The upgrades improved energy efficiency and reduced energy bills at the headquarters.

Allowing LEEP programs in the state would help West Virginian businesses make energy efficiency improvements and follow recommendations made by the state Industrial Assessment Center. Implementing these cost-saving improvements would help make the state's industries more competitive in the regional market and drive demand for industrial energy efficiency products.

Call to Action

West Virginia's emerging industrial energy efficiency cluster is a foundation upon which the state can grow its economy, create jobs, and become a leader in the production and deployment of advanced energy technology. The policies recommended in this report are complementary and intended to help West Virginia manufacture products within the state, foster entrepreneurship for technological advances, fund innovation with accessible capital, equip workers with needed skills, and grow demand for energy efficiency technology. The industrial energy efficiency cluster could serve a significant portion of national demand, especially considering West Virginia's abundance of natural resources, strong industrial base, and legacy as an energy-innovating state.

West Virginia has the opportunity to support an annual average of over 6,100 direct, indirect, and induced jobs in the industrial energy efficiency sector from 2017–2030.

To fully realize West Virginia's potential in the energy efficiency sector and position the state for continued growth, policymakers will need to make a concerted effort to seize the opportunity presented by increasing global demand. Strong leadership plays an important role in promoting West Virginia's competitive advantage in the industry and creating quality jobs for residents. State and local economic development depends on the collective work of many partners across government, universities, industry, and other stakeholders. This report recommends actions that each group can take to support the energy efficiency sector. Continued collaboration is necessary to address barriers to cluster growth and demonstrate that the state is ripe for investment.

West Virginia's leaders can draw from among dozens of innovative strategies that city, county, and state governments across the country and abroad have implemented to create job opportunities in the advanced energy sector. Examples of these best practices and a fully cited version of this report can be found on the American Jobs Project website at <http://americanjobsproject.us/>. Furthermore, the American Jobs Project can continue to serve as a partner to West Virginia by organizing working groups and conducting deeper analyses, such as identifying supply chain gaps, exploring policy strategies, and evaluating the state's comparative advantage in other advanced industries.

When a state succeeds in building an economic cluster, the benefits are felt throughout the state: a more resilient state economy, a skilled twenty-first century workforce that is trained for the jobs of tomorrow, a firm base of young people optimistic about job opportunities close to home, and a rich hub for innovation and collaboration.



West Virginia State Capitol



Growing the Industrial Energy Efficiency Cluster, Growing Jobs

- Partner with Industry Associations to Create an Energy Efficiency Industry Working Group
- Strengthen and Expand West Virginia's Foreign Direct Investment Strategy
- Create an Anchor Company Tax Credit
- Leverage Philanthropic Funding Via a Foundation Liaison
- Co-Sponsor a Hackathon to Ignite West Virginia's Entrepreneurial Culture
- Encourage Commercialization of Cutting-Edge Research
- Develop Relationships with Foundations Engaging in Program-Related Investment
- Create Tax Incentives for Investment in Startups
- Coach Businesses on How to Solicit Capital
- Establish a State Fund of Funds to Stimulate the Investment Environment
- Support Career-Connected Learning
- Encourage High School Partnerships with Community and Technical Colleges
- Align Community College Efforts with Private Sector Needs
- Offer Industrial Energy Efficiency Tax Incentives to Manufacturers
- Participate in a Regional Energy Efficiency Organization
- Incentivize Industrial Energy Performance Using Energy Performance Indicators
- Implement a Utility Energy Efficiency Resource Standard
- Enable Local Energy and Efficiency Partnership Programs for Commercial and Industrial Energy Efficiency

Appendix: Economic Impact Methodology

Modeling Approach

The American Jobs Project combines existing tools, analyses, and projections from several reputable sources to estimate job potential. Rather than providing a specific estimate, we show jobs potential across a range of possible outcomes. All jobs are shown as the average annual jobs that could exist during the analysis timeline (2017–2030). The actual number of jobs in any given year could vary significantly from the average, and the annual average is intended to be a target over the analysis timeline.

We believe the key to job creation lies in local action. Our estimates are intended to start a conversation about how local stakeholders can work together to set their goals and utilize the same tools and data that we have used to estimate potential impacts.

Specifically, the industrial energy efficiency analysis utilized IMPLAN, a proprietary model maintained by the Minnesota IMPLAN Group. Additionally, industry growth estimates and benchmarks from IBISWorld and BCC Research were used to generate impacts across different levels of U.S. market penetration. Industrial energy efficiency includes products and services from many different industries, and therefore does not have a specific designation in the North American Industry Classification System, the basis for most macroeconomic analysis and reporting. To estimate the economic impacts of industrial energy efficiency, we looked at several technologies: motors and variable frequency drives; air compressors, CHP, or cogeneration systems; air sealing and insulation for building shells, machinery, and equipment; industrial “Internet of Things” sensors; lighting fixtures; and HVAC.

Several supply chain scenarios are presented to identify the impacts of growing the West Virginia supply chain. The lowest scenario uses the current West Virginia economy as the model to represent the impacts of targeting direct industrial energy efficiency jobs and not developing the industrial energy efficiency supply chain. The highest scenario uses the entire U.S. economy as the model to represent the impacts of West Virginia having as complete of an industrial energy efficiency supply chain as the entire United States. A “midpoint” scenario gives the midpoint between the upper and lower bounds presented by the other scenarios, and is used as West Virginia’s target jobs potential in this report.

It is important to note that we do not include any impacts associated with the construction of new facilities that may result from an increased number of industrial energy efficiency firms locating in the West Virginia economy during the analysis timeline, nor do we include the construction and installation jobs associated with energy efficiency improvements.

Introduction to IMPLAN

IMPLAN is a proprietary regional economic analysis model, maintained by the Minnesota IMPLAN Group. It uses average expenditure data to estimate how industry spending cascades throughout the economy to suppliers and consumer-facing industries. IMPLAN tracks multiple rounds of indirect and induced spending impacts, until that spending “leaks” out of the selected regional economy. A region is defined by the user, and can be as small as a county or as large as the entire U.S. economy. For this analysis, both the state of West Virginia and the entire United States were used.

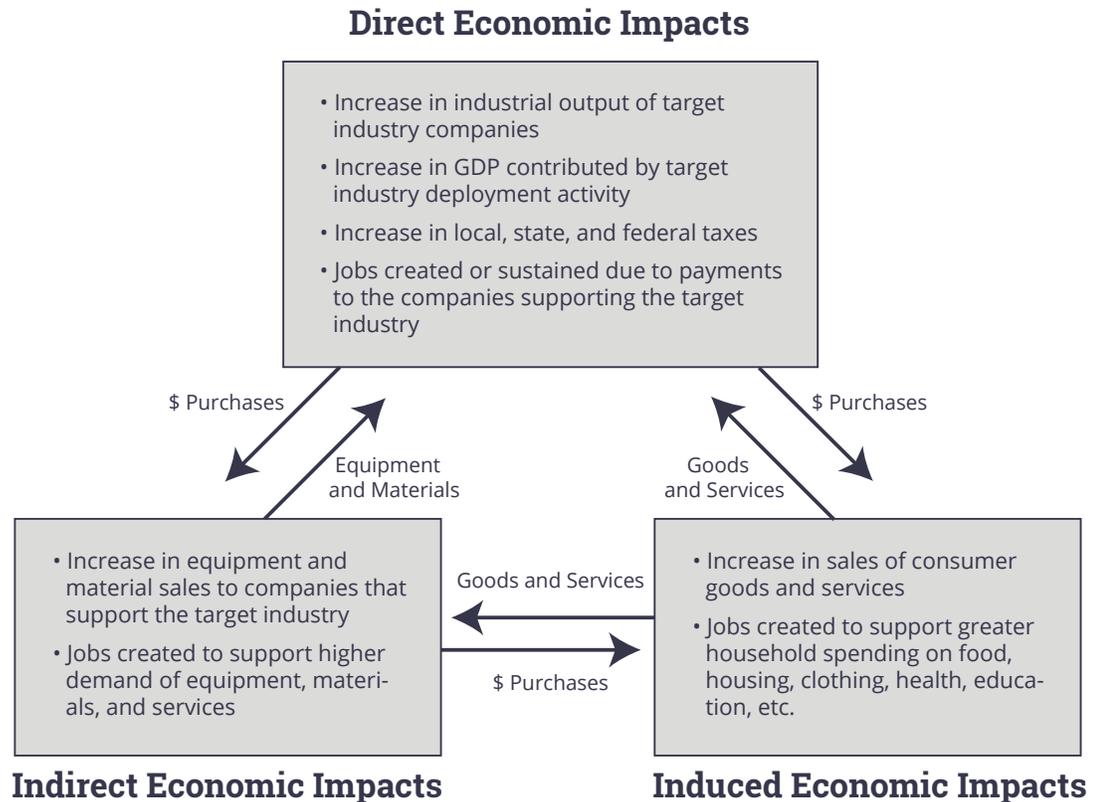
When a change of spending occurs in an economy, such as increased income for the industrial energy efficiency industry, spending also increases for supplying industries and the workforce. This cascading spending, or multiplier effect, can generate an economic impact that is often larger than the initial spending. This multiplier effect is created through multiple rounds of spending by industries paying their suppliers and employees. The supplier industries and employees, in turn, spend their money on other products or services in the economy. As the rounds of spending continue, money “leaks” out of the economy for purchasing products and services that are not available in the region. These leakages are determined by local purchasing coefficients, which are built in to IMPLAN’s models. For example, an industry that relies heavily on imported commodity products or foreign labor will have a lower impact on the economy than an industry that can purchase nearly all of its supplies in the regional economy.

The resulting impacts from the spending, including tax revenues, are summed and presented across three impact categories:

- **Direct** – Increased payments to target industries that support employees of those industries and generate the expenditures that begin to cascade through the economy
- **Indirect** – Impacts created by industry-to-industry spending, such as supply chain purchases, that are first created by direct spending from the target industry and then through increased spending by suppliers to their supply chain
- **Induced** – Employees of the target industry and their suppliers consume products and services, as a result of being supported



by direct and indirect spending (e.g., workers buy homes, cars, haircuts, and coffee). In turn, the consumer-facing industries can support their employees and those employees spend more of their income on products and services in the economy.



* From U.S. Department of Energy, "Economic Impact of Recovery Act Investments in the Smart Grid," April 2013

AJP used the most recent version of IMPLAN for this analysis, which includes 2013 data and improved modeling for regional imports and exports. The IMPLAN model utilizes input-output data from U.S. National Income and Product Accounts at the Bureau of Economic Analysis. The model includes 526 economic sectors that are tied to the North American Industry Classification System codes. Region-specific multipliers follow the flow of spending from where it originates, as it cascades throughout supplier industries and employee spending, and eventually "leaks" out of the regional economy. The sum of the direct and multiple rounds of secondary spending show the total impacts, including jobs created or sustained, tax revenues, proprietor income, and economic output.

Limitations of IMPLAN

It is important to note the limitations of these modeling methods. As mentioned, the estimates shown are only average annual jobs created or sustained and we base this off of the total job-years, or one full-time equivalent job sustained for one year, that exist within the timeframe of our analysis. This does not mean that every year will have the same number of jobs over the timeline. Any given year could be above or below the average we present. Job losses in industries that compete with those in our analysis are also not evaluated. Models do not perfectly predict behavior, so indirect and induced job estimates could vary greatly based on the reality of what is actually purchased locally. Also, foreign and domestic competition can play a significant role in limiting the potential for job creation. The estimates presented in this report are highly dependent on sustained local action towards developing and maintaining these industries.

Model Inputs

The first step to conducting the economic impact modeling was to identify how to characterize the industrial energy efficiency industry. As previously mentioned, there are a wide range of technologies in the industrial energy efficiency industry: motors and variable frequency drives; air compressors, CHP, or cogeneration systems; air sealing and insulation for building shells, machinery, and equipment; industrial “Internet of Things” sensors; lighting fixtures; and HVAC.

Second, a model for estimating the future demand for industrial energy efficiency technologies was needed. Estimates of market demand for industrial energy efficiency technologies were taken from BCC Research and IBISWorld reports for specific industrial energy efficiency technologies. Annual demand through 2030 was derived from the current market demand estimates and compound annual growth rates through 2030. We assume, for this analysis, that the rates stay constant through 2030, if they did not project that far into the future.

Third, a model for estimating wages and owner income was needed. Estimates of average wages were taken from IBISWorld. Owner income was also derived from IBISWorld, wherever possible.

Finally, the current market penetration of West Virginia’s industrial energy efficiency industry was estimated as a function of current estimated firm concentration in the target industries. IBISWorld’s ratio for employment per unit of revenue and the current concentration of firms in West Virginia were applied to BCC’s market demand totals to estimate current employment and revenues. Scenarios were developed by exploring modest



increases in the estimated market share, with the upper bound set as halfway between West Virginia and the current regional market leader for each technology. Impacts from improving supply chain concentration utilized the current West Virginia economy, an equivalent to the current U.S. economy, and the midpoint between these two bounds. Using West Virginia's current economy for the first supply chain scenario would indicate that West Virginia maintains the status quo and attracts no new businesses to supply their industrial energy efficiency industry. Using the U.S. economy as an "U.S. Equivalent" scenario would indicate that West Virginia attracts suppliers that could meet the same demand as the current U.S. economy. The "Status Quo" scenario is a lower bound and the "U.S. Equivalent" scenario is an upper bound. The "Midpoint" scenario is used to identify a reasonable target number of jobs for West Virginia.

Technology	Current WV Market Share	Median Scenario	High Scenario	Regional Market Leader Share	Regional Market Leader
Boilers, Heat Recovery Steam Generators, Cogeneration, and Trigeneration	0.7%	2.8%	4.9%	9.1%	NY
HVAC	0.1%	1.48%	2.85%	5.6%	PA
Motors and Transformers	0.8%	2.03%	3.25%	5.7%	OH
Pumps and Compressors	0.5%	1.63%	2.75%	5.0%	OH
Variable Frequency Drives	0.2%	1.88%	3.55%	6.9%	PA
Sensors	0.2%	1.65%	3.1%	5.7%	MA
Sealants	0.6%	2.48%	4.35%	8.1%	OH
Lighting Fixtures	0.1%	1.4%	2.7%	5.3%	IL
Insulation	0.5%	1.7%	2.9%	5.3%	PA

Model Outputs

Once the data were prepared for input into IMPLAN, we ran the model for each scenario and generated the outputs. Outputs were reported for direct, indirect, and induced impacts under each scenario in terms of employment, labor income, GDP, total economic output, and state/local and federal tax revenue. Only employment is presented in the report, and we represent this output as the average annual employment during the analysis period. The additional output data is available by request.

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