



# The Washington Jobs Project

A Guide to Creating Jobs in Grid Modernization



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# 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

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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.

## University of Washington, Clean Energy Institute

The Clean Energy Institute (CEI) at the University of Washington was founded in 2013 with funds from the state of Washington. Its mission is to accelerate the adoption of a scalable clean energy future that will improve the health and economy of our state, nation, and world. To accomplish this mission, CEI supports the advancement of next-generation solar energy and battery materials and devices, as well as their integration with systems and the grid. The institute creates the ideas and forms the people needed to generate these innovations, while facilitating the pathways to bring them to market.

## Western Washington University, Institute for Energy Studies

The Institute for Energy Studies (IES) at Western Washington University (WWU) is a multi-college collaboration that offers interdisciplinary undergraduate degrees that address the science, technology, policy, business, and economics of energy systems. The growing WWU energy curriculum includes about two dozen courses and four-year degrees in electric energy engineering, energy policy and management, and business and sustainable energy, as well as minors in energy policy and energy science and a self-designed major in energy and environment. IES also supports graduate students who conduct energy technology and policy research to complete MA and MS degrees in WWU's Huxley College of the Environment.



Dozens of hands were involved in the process of researching, writing, designing, and reviewing the report. Kate Ringness was the lead editor. Jackie Kimble, Laura Hobbs, Tiffany Wong, Andrew Miller, Rob Purviance, Connor J. Clark, and Wes Adrianson were supporting researchers and authors. Henry Love was the lead analyst, and Amariah Baker was the graphic designer.

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Jimmy Jia, *Distributed Energy Management*

Tshanda Kalombo, *U.S. Department of Commerce*

Tom Karier, *Northwest Power and Conservation Council*

Michael Kintner-Meyer, *Pacific Northwest National Laboratory*

Daniel Kirschen, *University of Washington*

Loren Lyon, *Impact Washington*

Daniel Malarkey, *Doosan GridTech*

Colleen McAleer, *Washington Business Alliance*

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Beth Mills, *Washington State Department of Revenue*

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Ahlmahz Negash, *Tacoma Power*

Anne Nelson, *Washington State Department of Commerce*

Lee Newgent, *Washington State Building and Construction Trades Council*

Troy Nutter, *Puget Sound Energy*



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Emmit Owens, *Research Triangle Cleantech Cluster*

Eleni Papadakis, *Workforce Training and Education Coordinating Board*

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Jaime Rossman, *Washington State Department of Commerce*

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Tony Usibelli, *Washington State Department of Commerce*

Joe Wallin, *Carney Badley Spellman*

Deloit Wolfe, *Impact Washington*

Roger Woodworth, *dba Mindset Matters, Retired Avista Corp. Chief Strategy Officer and President of Avista Development*

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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 sixty interviews with stakeholders and experts in Washington have identified grid modernization as showing particular promise in the state. Demand for grid modernization technologies is increasing globally, thereby creating an opportunity for Washington manufacturers to create middle-income jobs for Washingtonians and elevating Washington's companies in the marketplace.

Washington is well positioned to benefit from rising global demand for grid modernization technologies given its strong anchor companies, established competitive advantage in the Internet of Things, and robust innovation ecosystem. Opportunities to leverage this momentum to further serve growing regional, national, and global markets offer real benefits for the state economy and Washington residents.

However, there are several barriers hindering Washington's grid modernization industry and preventing its existing companies from reaching their full potential. These barriers to growth range from lack of access to capital for small- and medium-sized companies and entrepreneurs, a need for more technical training of early-career and mid-level workers, and a dearth of facilities that provide open-access services for companies and researchers to validate, test, and demonstrate new hardware or software products and services. Washington must address these roadblocks to enhance its competitiveness as a hub for grid modernization.

To take full advantage of these opportunities, state leaders can pursue strategies to create a strong foundation for industry growth and to help Washington businesses grow, innovate, and outcompete regional, national, and global competitors. With forward-thinking policies, Washington's grid modernization sector can support an average of 13,800 direct, indirect, and induced jobs annually through 2030. These direct jobs will spark

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job growth and economic development across the state as employees spend their earnings in the local economy.

## Summary of Recommendations

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

### Strategically Expanding Washington's Grid Modernization Sector and Supply Chain Companies

**Facilitate Formalization of a Grid Modernization Public-Private Partnership:** Leveraging existing organizations and relationships to help local businesses steer the growth of the state's grid modernization industry.

**Strengthen and Expand the State's Foreign Direct Investment Strategy:** Leveraging national and regional economic development resources, and strong international corporate and university brands, to attract international grid modernization investment.

**Provide Tax Incentives to Attract and Grow New Grid Modernization Businesses and Fill Supply Chain Gaps:** Developing incentives for grid modernization companies to conduct research and development (R&D), locate in Washington, and inject capital into local communities.

### Leveraging Local Assets to Increase Access to Capital for Growing Companies

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

**Improve Washington's Equity Crowdfunding Law:** Streamlining equity crowdfunding and creating an online hub to increase program uptake.



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## Fostering a Strong Innovation Ecosystem

**Support Access to University and National Lab Resources for Businesses:** Facilitating small- and medium-sized business access to state-of-the-art laboratory resources and expertise.

**Promote the Growth of Specialized Advanced Energy Incubators and Accelerators:** Improving startups' access to mentors and talent with specialized knowledge of the advanced energy industry.

**Leverage Philanthropic Funding Via a Foundation Liaison:** Strengthening Washington's resources through collaboration with charitable foundations.

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

**Promote Private-Sector Training:** Incentivizing businesses to invest in workforce development programs.

**Expand Career-Connected Learning:** Engaging students early to improve graduation rates and build transferrable skills.

**Encourage High School Partnerships with Community and Technical Colleges:** Guiding students through the transition to postsecondary education.

## Creating Opportunities for Deployment of Grid Modernization Technologies

**Educate and Inform Policymakers on the Benefits of Grid Modernization:** Creating a market for grid modernization products through outreach and education on the economic benefits to utility customers of grid modernization.

**Encourage Utility Innovation:** Promoting industry R&D through novel incentive packages.

**Explore Novel Funding Mechanisms for Demonstration and Infrastructure Projects:** Moving beyond taxpayer funding for demonstration projects.

**Create and Adopt Industry Standards:** Easing integration challenges by creating common standards for grid modernization technology and encourage Washington-based companies to adopt the standards.

**Define Utilities' Outcome-Based Objectives for Grid Modernization:** Establishing goals to guide future investment in grid modernization technologies.



# 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 Washington and designed recommendations specifically tailored to the state. These recommendations are informed by extensive research and over sixty 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 seek to capitalize 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.

## 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 emission 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 employees and 32 percent to 102,000 employees, 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 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.

## 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



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.

## Key Cluster Elements

Economic clusters require several critical assets coordinated 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 businesses—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. Local abundance of raw materials and natural resources can also help grow a local manufacturing cluster. For example, a state with a high solar energy potential or abundance of silicon can be a natural home for a thriving solar manufacturing cluster. However, if local adoption of solar technology is slow, the state can tap into larger regional, national, and global markets to drive cluster development.

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## 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, nation, or world, 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 and maintenance. These earnings are spent and re-spent in the local economy creating and maintaining additional jobs in grocery stores, restaurants, medical providers, and other sectors. The result is a multiplier effect where a dollar of earning in a cluster circulates throughout local businesses and their employees and creates an impact greater than the initial injection. Therefore, promoting an economic cluster by recruiting manufacturers and their suppliers can result in an economic impact greater than the direct earnings impact.

## Report Structure

*The Washington Jobs Project: A Guide to Creating Jobs in Grid Modernization* begins by highlighting Washington's economic opportunity to build a globally competitive grid modernization cluster; the strengths, weaknesses, opportunities, and threats of a grid modernization cluster in the state; and the global market opportunity in grid modernization. Washington's grid modernization cluster development assets are then detailed. The next sections provide a snapshot of job opportunities in the sector and potential job growth from cluster development. The analysis culminates in policy recommendations to grow the cluster that are tailored to Washington. A fully cited version of this report is available on the American Jobs Project website at <http://americanjobsproject.us/>.





Pacific Northwest National Laboratory (PNNL)



# Washington's Economic Opportunity in Grid Modernization

## What is Grid Modernization?

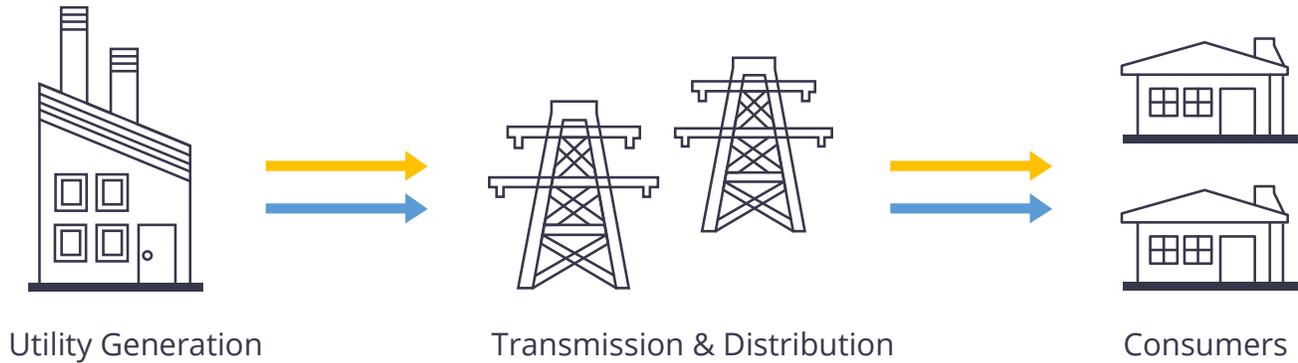
The legacy power grid is the centerpiece of the U.S. energy economy, delivering critical electricity from generators to consumers. However, new challenges and priorities are driving major changes to the current electricity system. There is increasing stress on the grid due to rising deployment of renewable energy and distributed generation, increased customer participation in electricity markets, environmental and greenhouse gas reduction goals, the need for resilience to weather events and natural disasters, aging infrastructure, and mounting concerns around vulnerability to cyber and physical attacks. These trends signal changing economic, environmental, security, and consumer priorities, and, consequently, an urgent need for grid modernization.

The nation's legacy grid, managed historically with very little real-time data, was built with strategies to keep power flowing safely: overcapacity through intermediate and peaking plants, large reserve fossil power generators, one-way flow of electricity, and human operator decision-making. Some of these key characteristics of the legacy grid will need to evolve. Large-scale fossil fuel generation is not compatible with long-term greenhouse gas reduction goals. Distribution systems are now seeing unprecedented two-way flow due to new technologies designed to manage end uses, and operational control and analysis will need to be adapted to this bidirectional flow. Furthermore, human operator decision-making will need to be accelerated and further supported to manage load and numerous capacity assets, such as renewables.

To rapidly modernize the grid to meet today's pressing needs, innovation, collaboration, and leadership are required to accelerate technological, regulatory, market, and business model transformations. These grid modernization efforts are built upon a vision for the future that presents a reliable, resilient, secure, sustainable, and adaptive grid that remains affordable for consumers.

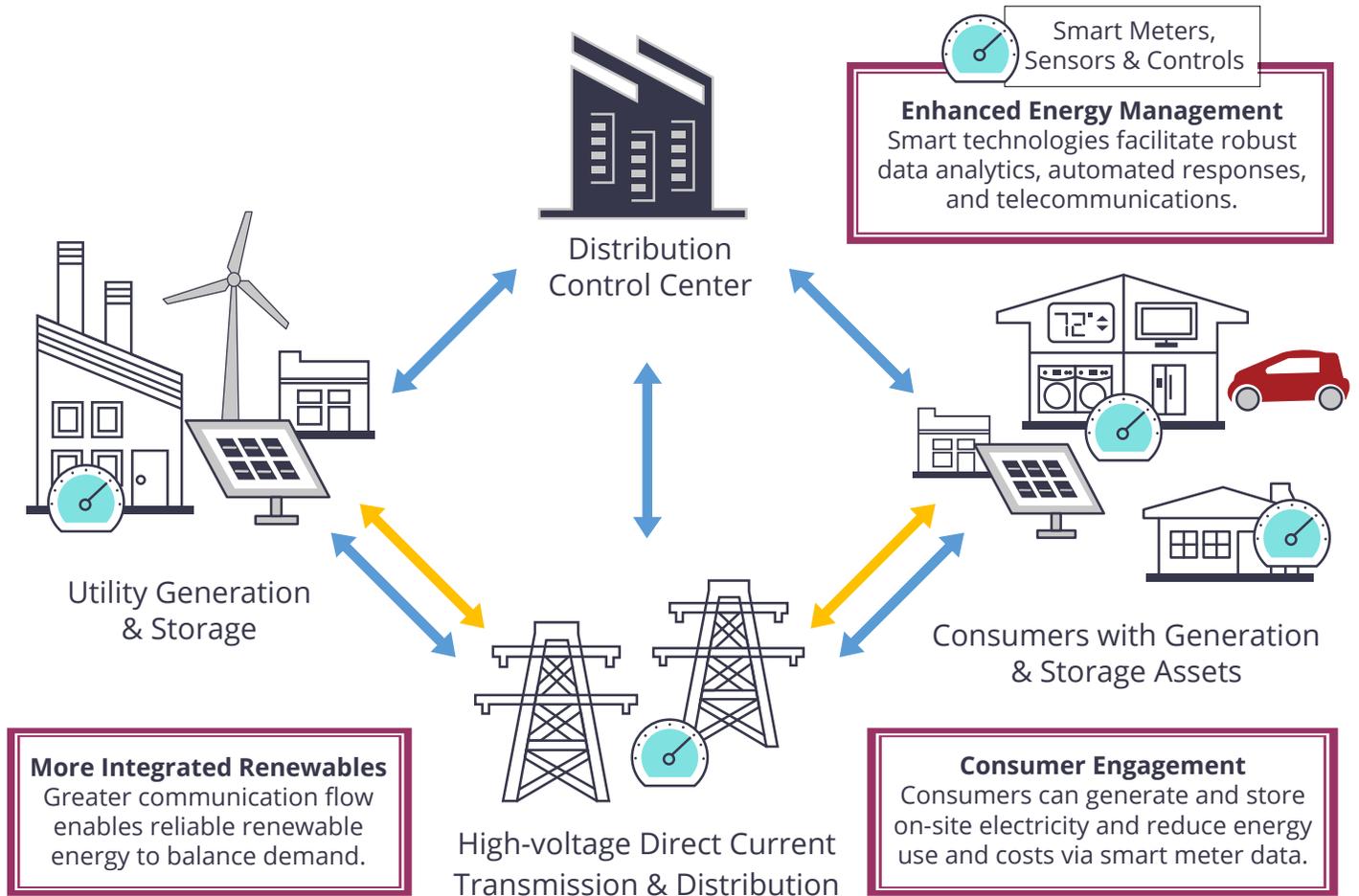
# THE GRID BEFORE MODERNIZATION...

*One-way **power flow** and **communication network***



# THE GRID AFTER MODERNIZATION...

*Two-way **power flow** and **communication network** enabled by distributed generation and smart technologies*



### Grid Modernization vs. The Smart Grid

The terms grid modernization and the smart grid are often used interchangeably to describe efforts to create the 21st century grid. The smart grid, however, is a major feature under the umbrella of grid modernization. Grid modernization encompasses a large toolkit for creating the grid of the future, including regulatory reform, market trends, business model transformations, infrastructure repair and maintenance, and technological innovation. The smart grid refers to digital technology that enables two-way communication between a utility and its customer as well as sensors along transmission and distribution (T&D) lines. Smart grid technologies are key enabling technologies for grid modernization, leveraging the power of information and digital communication to better utilize, enhance, and secure the grid.

Grid modernization employs numerous technologies, on both the utility- and consumer-side, to achieve these outcomes. For example, renewable energy, battery storage, energy efficiency technologies, and integrated resources, such as building energy management systems and microgrids, are transforming the traditional generation, transmission, and distribution network with distributed generation and flexible and reliable energy supply. Sweeping advances in price-to-performance have occurred over the past decade in many individual technology areas, thanks to unrelenting progress in advanced materials, advanced manufacturing, and information technology.

There is also an emerging, dynamic layer to the power grid: The Internet of Things (IoT). The IoT is a wireless, internet-enabled network of sensors, devices, and software that can facilitate robust data collection and analytics, digital control and automation, and telecommunications. These “smart” technologies include advanced metering infrastructure, phasor measurement units, voltage regulation equipment, power flow controllers, and equipment health sensors. Physical generation, transmission, and distribution assets are also embedded in the IoT, including feeder switches, substations, and transformers. Because of two-way digital communication, information gathered by IoT assets can flow in multiple directions to empower both grid system operators and consumers. Enhanced communications through seamless interoperability of IoT components—allowing not only the exchange of information but also its use—can create active and reactive systems that quickly adapt to grid conditions.



The Power Grid

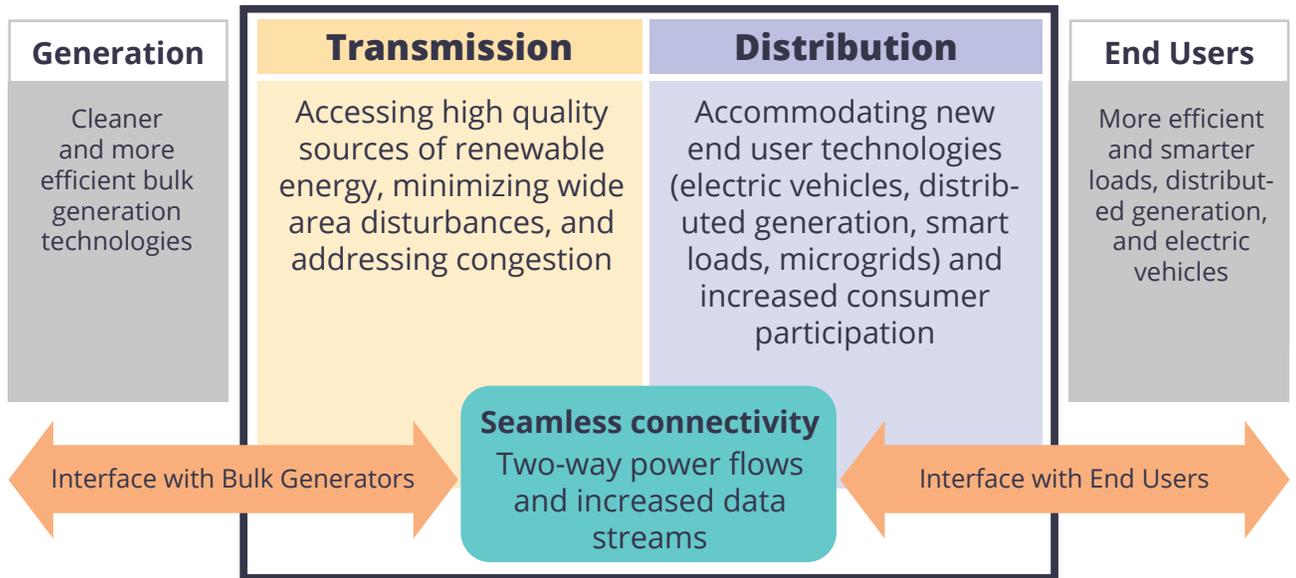
## Examples of Grid Modernization Technologies

	Types of Products	Expected Benefits
 <p><b>Transmission</b></p>	<ul style="list-style-type: none"> <li>• Synchrophasors / Phasor measurement units (PMUs)</li> <li>• High-voltage direct current (HVDC) transmission systems</li> <li>• Flexible alternating current transmission systems (FACTS)</li> <li>• Distribution transformers</li> </ul>	<ul style="list-style-type: none"> <li>• Real-time voltage and frequency data</li> <li>• Efficient power transmission</li> </ul>
 <p><b>Distribution</b></p>	<ul style="list-style-type: none"> <li>• Volt/VAR control devices</li> <li>• Automated switches</li> <li>• Automated capacitors</li> <li>• Distribution transformers</li> <li>• Fault indicators</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced outages</li> <li>• Improved reliability</li> <li>• Volt/VAR control</li> </ul>
 <p><b>Advanced Metering Infrastructure (AMI)</b></p>	<ul style="list-style-type: none"> <li>• Smart meters</li> </ul>	<ul style="list-style-type: none"> <li>• Operational savings</li> <li>• Automated readings</li> <li>• Reduced outages</li> </ul>
 <p><b>Information &amp; Communications Technology (ICT)</b></p>	<ul style="list-style-type: none"> <li>• Remote terminal units (RTUs)</li> <li>• Software to connect devices to communications network</li> <li>• IoT platforms for grid/energy management</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to monitor and control units across the system</li> </ul>
 <p><b>Utility-scale Energy Storage</b></p>	<ul style="list-style-type: none"> <li>• Batteries</li> <li>• Pumped Hydro</li> <li>• Capacitors</li> </ul>	<ul style="list-style-type: none"> <li>• Frequency regulation</li> <li>• Voltage control</li> <li>• Demand response</li> </ul>



For the purposes of this report, we will focus on the transmission and distribution (T&D) aspects of grid modernization, such as high-voltage direct current (HVDC) transmission lines, remote thermal units (RTUs), synchrophasors, dynamic volt/volt-ampere reactive (volt/VAR) voltage regulation systems, flexible alternating current transmission systems (FACTS), transformers, smart meters, IoT platforms for grid/energy management, and utility-scale energy storage.

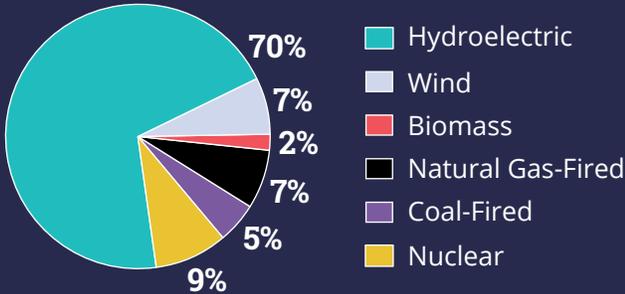
### Report Focus Areas Within The Grid Modernization Framework: Transmission and Distribution





## Washington's Electricity Infrastructure

### Net Electricity Generation by Source, November 2016



**#1** *Producer of electricity* from hydroelectric sources, accounting for **30%** of utility-scale net hydroelectricity generation in the U.S.

### Ranks 9th

in the U.S. for electricity generated from non-hydroelectric renewable sources.

Wind accounts for **65%** of non-hydro renewable energy generation.

In-state coal-fired power generation will be **phased out by 2025.**

### Washington is served by both public and private utilities.

#### Public Utilities

including PUDs, cooperatives, and municipal utilities make up **55%** of WA retail electricity service

#### 3 Investor Owned Utilities

make up **45%** of WA retail electricity service

### Washington's Electricity Grid

#### GRID INFRASTRUCTURE

- Washington is part of the Western Interconnection (WI) power grid that operates in the western United States and parts of Mexico and Canada.
- Bonneville Power Administration (BPA) owns, operates, and maintains about 75% of the transmission network in its Pacific Northwest service territory.

#### GRID RELIABILITY

- Western Electric Coordinating Council (WECC) and Peak Reliability ensure reliable operation of the WI by coordinating its members' planning and operation activities.
- Reliability standards are mandatory with financial penalties for non-compliance.

#### POWER PLAYER

- BPA dominates power generation in Washington and the Pacific Northwest, providing about 28% of the electric power used.
- BPA markets and transmits at-cost federal electricity, most of which is hydro-electric.

#### ELECTRICITY MARKETS

- There is no regional ISO or RTO in the Northwest, like MISO in the Midwest and PJM on the East Coast.
- Some utilities in Washington are looking at alternative forms of grid management with real-time access to electricity from other utilities.
- The Western Energy Imbalance Market (EIM), established in 2014 as the first real-time wholesale energy market in the Western U.S., enhances grid reliability and generates utility cost-savings for participants. While EIM is still an emerging market, some Washington utilities are participants and others are considering operational agreements.



## Washington's Energy Economy

### CLEAN ENERGY JOBS

In 2016, there were an estimated **61,889** Washington workers in the energy efficiency industry alone.



WA's clean tech industry currently employs nearly **90,000** workers.

**33%** of green jobs require only a high school diploma  
**38%** require an apprenticeship or certificate



### WASHINGTON CLEAN TECH SECTOR



400+ companies  
195 patents

#### 2015 Clean Technology Total Gross Business Income

**\$ 17.4 billion**

Washington's clean tech industry is backed by **over \$1 billion** in venture capital.



Total wages for WA clean tech businesses in 2015 were almost **\$4 billion**.

### The electricity sector leads clean tech jobs in WA:

**11.5%** of those jobs are in electric distribution

**3.1%** are in electric transmission and control

**2.8%** are in hydroelectric power generation



### Key State Actions:

#### Energy Independence Act

Established a renewable portfolio standard that requires certain utilities to meet **15%** of customer load with non-hydro renewables by 2020



#### Clean Energy Fund

Allocates a total **\$76 million** to clean energy research and deployment statewide.



### Results Washington

Established goals for sustainable energy and a clean environment, including targets for greenhouse gas emissions, wildlife preservation, clean air and water, contaminated site restoration, habitat protection, farmland and outdoor recreation.



# What Does Grid Modernization Mean for Washington State?

## Opportunity to Create a More Responsive and Resilient Grid

Washington can benefit by deploying grid modernization technology throughout the state. By transforming its power grid, Washington could better integrate its immense renewable electricity capacity and ensure efficient intrastate and interstate transmission of this generation. A modernized grid could also provide the state with more flexibility with its generation assets, allowing the state to accommodate changes in priorities with respect to air and water quality and conservation efforts. Additionally, better instrumentation and control equipment, such as smart inverters, across the distribution network can allow grid operators to efficiently match variable output and load, while demand response and integrated storage can help to smooth and balance supply and demand. Upgrading T&D systems with greater automation and other grid modernization strategies will increase resilience to storms, natural disasters, and cyber attacks; support further renewables integration; and ensure power reliability.

### A More Resilient Washington

Washington's susceptibility to earthquakes increases the risk that the state's grid could fail on a large scale, leaving thousands without power during a natural disaster. The 2016 Cascadia Rising mega-earthquake exercise demonstrated the vulnerability of the electricity grid and underscored the need to significantly improve its resiliency. In 2017, Governor Inslee created a Resilient Washington Sub-cabinet that includes a specific focus on energy and electricity resiliency. Grid modernization advocates can make a targeted effort to demonstrate how grid modernization products can help the state reach its goals.

### Lack of Resiliency = Economic Loss

Power outages and interruptions can impart significant costs to the economy; research shows that the average annual cost to the U.S. economy of storm-related power outages is estimated to be between \$20 to \$55 billion. In 2015, Washington State ranked sixth in the United States for weather-related outages. Also in that year, nearly 20,000 Spokane electricity customers lost power for a week as a result of a massive windstorm, earning it a spot on the list of Top 10 Most Significant U.S. Blackouts of 2015.



Smart meter installation



### Results Washington Tracks Industrial Sector Performance

Results Washington's Public Dashboard publishes tracking data related to gross business revenue and employment growth for key industrial sectors. Thus far, Department of Commerce efforts to grow key industrial sectors have had positive results; growth targets have been met and raised over the last two evaluation periods.

## Opportunity to Support Thousands of Jobs Statewide

Washington has experienced varied impacts from the Great Recession. The information and communications technology sector, led by industry leaders such as Amazon and Microsoft, remained stable during the recession and has grown steadily since. Mostly located in and around Seattle, the sector has grown to 14,000 firms, employing nearly 200,000 people. At the county level, Seattle-region Snohomish and King counties stand out as leaders in the state with strong economic growth and low unemployment.

Unfortunately, throughout the recent recovery period, economic growth has not been consistent across the state's economic sectors or regions. Like many of the more rural parts of the state, Ferry, Yakima, and Grant counties saw already-stagnant economies decline during the Great Recession and have been slow to recover fully. Unemployment is generally higher in these counties (9 to 11 percent) than in the more urban Seattle area (3 to 4 percent). Yakima County's average annual wage is 37 percent below the state average. In Ferry County, declining resource extraction and an older workforce have contributed to persistently low economic growth. Making matters worse, the closure of a neighboring county's gold mine in 2017 is anticipated to result in the direct, indirect, and induced loss of 10 percent of the jobs in Ferry County.

Supporting a grid modernization cluster fits in with the state's plans to address these inequities and expand job opportunities for Washingtonians. As part of the state's economic development program, the Washington State Department of Commerce has identified several sectors, including cleantech, aerospace, and defense, as having the best potential to spur growth and create jobs. Department leaders work to strengthen these industries by supporting small businesses, training workers, and promoting public-private partnerships.

Perhaps more than with other sectors, grid modernization jobs can be distributed throughout the state, addressing the needs of those located further from urban areas. While most cleantech startups are likely to be near thriving urban areas, many installation, operations, and maintenance jobs related to grid modernization are likely to be distributed more evenly across suburban and rural areas. Washington can spur economic development across the state and create good-paying jobs for hard-working residents by growing its emerging grid modernization cluster.

## Capitalizing on Global and National Demand for Grid Modernization Products

In addition to reaping the economic benefits of transforming the state power grid, Washington could capitalize on growing global and national demand by becoming a major exporter of grid modernization technologies. Additionally, falling costs will enable greater deployment of grid modernization technologies in the state and facilitate growth in the broader market.

### Rising Demand

The U.S. export market for grid modernization products is valued at \$30 billion annually, which could grow with rising global demand. Between 2014 and 2015, global annual smart grid investments grew by 12 percent. Future annual growth projections range from 8 to 18 percent up to 2020.

Grid modernization information technology (IT) represents a significant portion of potential market growth globally. The smart grid IT and analytics market is projected to pass \$21.4 billion in 2026. Managed services, or software as a service, will be the fastest-growing segment at a 16 percent annual rate. One bullish market valuation predicts the global grid modernization software market will grow from \$19.8 billion in 2016 to \$65.4 billion in 2021, an annual rate of 27 percent. North America will continue to capture the largest market share but growth will slow with the winding down of projects funded by the American Recovery and Reinvestment Act (ARRA).

The T&D equipment market is expected to grow annually by 16.2 percent and achieve a \$24.6 billion value by 2020. Advanced T&D products include high-voltage direct current (HVDC), synchrophasors, remote terminal units, and voltage optimization devices, with HVDC accounting for about 79 percent of the market. However, interoperability and interface standard issues remain major technical barriers to market growth.

In the United States alone, there are high estimates of grid investments needed to adequately support future conditions. In 2014, the International Energy Agency estimated U.S. power grid investments would total \$2.1 trillion by 2035, or \$100 billion each year. Other reports projected an average annual investment of \$17 to \$24 billion is needed to bolster the grid over the next twenty years. When compared to an estimated twenty-year total of \$1.3 to \$2 trillion in economic benefits, however, grid modernization presents a benefit-to-cost ratio range of 2.8 to 6.0.

### Falling Technology Costs Can Also Fuel Demand

Falling technology costs can incentivize deployment. For example, experts estimate that the cost of battery storage technologies will drop by 70 percent by 2030. This will support or accelerate growth in the U.S. energy storage market, which is projected to increase ninefold to 2,045 MW by 2021. Technology costs may decrease steadily with advances in manufacturing and materials, network innovations, economies of scale, and increased competition.



Sustained interest and investment will be supported by policies and incentive programs, falling technology costs, regulations curbing carbon emissions, aging physical infrastructure, and a need for better centralized grid management and control due to rising energy demand and increased generation and storage capacity. Washington is ideally positioned to seize the opportunity to supply the growing U.S. demand for grid modernization technologies.

## **Washington's Competitive Advantage in Grid Modernization**

Washington is well positioned to become a leader in grid modernization technology manufacturing and systems development. Washington has a clear competitive advantage over most other U.S. states in technology and systems related to the Internet of Things (IoT), a key component of grid modernization. Washington is home to world-class research institutions dedicated to researching the grid: University of Washington (UW), Washington State University (WSU), and Pacific Northwest National Laboratory (PNNL). Added to this are a number of strong anchor companies—Itron, Schweitzer Engineering Labs, and S&C Electric Company—forming the foundation of the cluster. Also supporting the cluster is Redmond-based Grid Solutions, a joint venture between General Electric and Alstom and a global leader in grid management software. Moreover, market-leading companies based in Washington—Amazon, Boeing, Costco, Microsoft, Starbucks, REI, and others—are committed to sustainability. Amazon Web Services, for example, has completed a series of power purchase agreements that bring them about halfway to fulfilling a pledge to run on 100 percent renewable energy. The combination of technology innovators and committed market makers is a powerful force for the emerging Washington cluster. Likewise, Starbucks, Target, and REI just signed up for the new Green Direct program offered by Puget Sound Energy. Approved by the Washington Utilities and Transportation Commission, the groundbreaking Green Direct program gives large customers an ability to tailor their energy portfolio while ensuring other utility customers are unaffected.

Washington has already taken the lead in deploying grid modernization products by participating in the Pacific Northwest Smart Grid Demonstration Project, the largest ARRA-funded smart grid project in the United States, and investing \$26.9 million in local grid modernization grants through the state's Clean Energy Fund. The Fund broadly promotes clean energy research, development, demonstration, and deployment by providing grants to nonprofit lenders, electric utilities, and research organizations. For example, Seattle City Light will create

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an emergency microgrid system to ensure critical power for fire stations, shelters, and communication lines. Snohomish County Public Utility District also recently installed the largest capacity containerized vanadium flow battery system in the world.

Washington could grow its emerging grid modernization cluster and create a competitive advantage over other grid modernization or smart grid clusters by analyzing specific components within the supply chain and targeting areas for growth. With an innovative, robust set of local and state policies to build upon the cluster's already strong foundation and impressive track record of demonstration projects, Washington could become a national and global leader in manufacturing grid modernization products.

## **Smart Manufacturing Washington's Emerging Opportunity**

In addition to investing in grid modernization, Washington should consider developing its smart manufacturing sector. Sometimes referred to as the “fourth industrial revolution,” smart manufacturing capitalizes on real-time sensing, control, and modeling to improve safety, optimize plant performance, and increase energy and resource efficiency. Because smart manufacturing depends on the same types of data-driven feedback networks that comprise the modern electrical grid, many smart manufacturing technologies overlap with grid modernization technologies and can be produced by the same companies. With its entrenched software industry, its established base of network hardware companies, and its existing smart manufacturing innovation centers at WSU, UW, and PNNL, Washington is well positioned to capitalize on market opportunities related to smart manufacturing. Global markets are set to grow with business investment jumping from \$215 billion in 2015 to \$832 billion in 2020, and total investment reaching nearly \$1.6 trillion in 2020. Thus, the Industrial Internet of Things (IIoT) and smart manufacturing technologies present a significant opportunity for Washington's businesses. See Appendix 1 for more information on Washington's competitive advantage, market growth potential, cluster assets, and policy recommendations for smart manufacturing.



## Washington's Strengths, Weaknesses, Opportunities, and Threats in the Grid Modernization Sector

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> <li>• Strong anchor companies in smart grid hardware and software manufacturing, including legacy information technology industry</li> <li>• Strategic export location for electricity products and goods to neighboring states and Asian markets</li> <li>• Top-notch institutions engaged in clean energy R&amp;D, commercialization, and industry partnerships (UW, WSU, PNNL)</li> <li>• Skilled workforce with higher education levels than national average</li> <li>• High quality of life attracts and keeps talented workers</li> <li>• State leaders' commitment to increasing clean energy</li> <li>• Industry access to university-based resources for technology innovation and commercialization via Clean Energy Testbeds</li> <li>• Participation in Pacific Northwest Smart Grid Demonstration Project</li> <li>• Established training programs supported by the Center of Excellence for Clean Energy</li> <li>• Corporate commitments to renewable energy and sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Low electricity rates impede local market growth for products</li> <li>• Lack of patient capital for clean energy startups</li> <li>• Only three major incubator/accelerator programs tailored to cleantech businesses</li> <li>• Lack of a major facility that is a visible, regional hub of activity</li> <li>• Lack of corporate engagement in state and university endeavors</li> <li>• No personal state income tax, which limits state revenue and requires more output at business level</li> <li>• Only 35 percent of young adults enrolled in postsecondary education</li> <li>• Inadequate funding for K-12 education</li> <li>• Cascade Mountain range divides the state creating a sense of isolation in some regions</li> <li>• Perception of low critical mass to support cluster growth: no "buzz" around the industry</li> </ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> <li>• Large U.S. market potential: U.S. power grid investments poised to total \$2.1 trillion by 2035</li> <li>• Access to project financing via \$76 million Clean Energy Fund</li> <li>• Growing renewable energy demand in neighboring states</li> <li>• Momentum from state strategic plan to grow cleantech sector</li> <li>• Employment potential and opportunity to diversify industries in Eastern Washington</li> <li>• Global smart grid clusters that could be targeted for foreign direct investment</li> <li>• Successful regulatory and financial models in other states and abroad for encouraging utility participation in grid modernization</li> <li>• Public research institutions conduct cutting-edge research that can create local spin-off companies</li> </ul>	<ul style="list-style-type: none"> <li>• Competition from Asian companies for market share</li> <li>• Competition from other states with well-established smart grid clusters and supportive state policies (e.g., New York's REV initiative, mandates and tax credits for energy storage)</li> <li>• Long sales horizon for largest customers of grid modernization products</li> <li>• Utilities are reluctant to implement pilot programs</li> <li>• Aging workforce and lack of pipeline for young workers</li> </ul>



# State Assets to Support Grid Modernization Cluster Development

Having a strong economic foundation is essential to sustaining and growing clusters. Reinforcing the state's strengths in its innovation ecosystem, access to capital, and workforce development could support the expansion of existing grid modernization companies and attract new businesses to the state. Washington has a solid foundation of these resources upon which it could build a world-class grid modernization manufacturing cluster.

## Innovation Ecosystem

### Innovation Ecosystem

- Promotes research and development
- Facilitates movement of new technologies to market
- Incubates early-stage businesses
- Supports a “liquid” talent pool

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 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.

Washington's innovation ecosystem is well situated to promote the growth of local grid modernization and smart manufacturing companies. The Pacific Northwest National Laboratory (PNNL) and the state's two major research universities—Washington State University (WSU) and the University of Washington (UW)—each lead robust advanced energy R&D programs, often working in collaboration with local industry partners. Access to a community of investors and the state's network of 119 incubators, accelerators, coworking spaces, and makerspaces provides entrepreneurs a path from concept to commercialization.

It is important to note that fostering innovation and startup successes in the energy sector is different than other sectors. The ability of firms to test, validate, and demonstrate their technologies is the most cited barrier to success by small companies in the clean energy sector. Access to patient capital is the second-most cited barrier; a recent MIT study shows that traditional venture funding is a poor model for cleantech innovation and advocates for a more patient type of capital.

State investment in resources to research, develop, and deploy advanced energy technology has been focused and impactful on technological and business development; Washington ranks among the most innovative and entrepreneurial states in the nation. Together with targeted cleantech investment—such as the \$76 million Washington State Clean Energy Fund—these resources position the state to be a potential leader in the development of new advanced energy and grid modernization businesses.

## Research Universities

UW provides comprehensive support for students, post-doctorates, and faculty at each step in the innovation process. The school's state-funded Clean Energy Institute (CEI) leverages a substantial portfolio of federal and private research support to bring together researchers from across disciplines to advance next-generation solar energy and battery materials and devices, as well as their integration with systems and the grid. In February 2017, CEI opened the Washington Clean Energy Testbeds to facilitate commercialization of clean energy technologies. CEI has also proposed a new Center for Advanced Materials and Clean Energy Technologies to promote interdisciplinary energy education and research while catalyzing partnerships between academic researchers, industry actors, and government.

### Clean Energy Testbeds

In February 2017, UW's Clean Energy Institute (CEI) debuted the Washington Clean Energy Testbeds, a new \$8 million R&D facility designed to accelerate prototyping for startups and big businesses alike. The Testbeds provide easy access to expertise and equipment, enabling researchers and entrepreneurs to rapidly turn ideas into marketable products. Unlike other similar facilities around the country, the Washington Clean Energy Testbeds do not require researchers to undergo a lengthy vetting process; instead, CEI maintains intentionally low barriers to entry in order to better facilitate innovation.

Technology transfer at UW is the purview of CoMotion (formerly the UW Center for Commercialization). In addition to standard intellectual property support, CoMotion provides UW entrepreneurs with incubation resources (via CoMotion Labs), gap funding (via the CoMotion Innovation Fund), and mentorship. CoMotion also connects student entrepreneurs to unaffiliated funding sources, including USEED@UW crowdfunding and state and federal financing resources.

### CoMotion Innovation Fund

- Capable of funding \$1 million of applied research annually
- Up to \$40,000 available per project with an additional \$10,000 reserved for customer development activities
- Award recipients receive support from a team of small business, intellectual property, finance, and regulatory experts



### UW Entrepreneurship Competitions

The Business Plan Competition is an annual competition hosted by the Buerk Center for Entrepreneurship at UW's Foster School of Business. It is open to any student actively enrolled in a degree program in Washington and has funded eighty-seven companies to date.

The Alaska Airlines Environmental Innovation Challenge is an annual competition co-hosted by the Buerk Center, the College of Engineering, and the College of the Environment. CEI and CoMotion partly sponsor the Challenge, which charges interdisciplinary teams to develop innovative products that address complex environmental problems.

### Urbanova

Urbanova connects industry, public, and academic partners, including Avista Utilities, the City of Spokane, Itron, McKinstry, the University District Development Association, and WSU, to create and test smart city technologies as well as to gather data to provide insights and present novel solutions to urban challenges. The centerpiece of the program is developing a living laboratory in Spokane's 770-acre University District area. Project partners develop and utilize the campus's robust data collection and sensing capabilities to test data-driven smart city concepts. Current projects include connected streetlights, a shared energy economy, and urban energy and human-scale air quality measurements.

WSU provides resources and support for affiliated entrepreneurs. The university's Clean Technology program brings together researchers from across campus to address challenges in smart grid, advanced materials, and related topics. The program supports the Energy Systems Innovation Center, which connects researchers with industry and government partners to encourage collaborative and interdisciplinary advanced energy R&D. Additionally, the program serves as a clearinghouse for clean energy initiatives around campus, such as the Voiland College of Engineering and Architecture's Smart Power Networks initiative.

Entrepreneurs at WSU have access to a full menu of commercialization tools. The Office of Commercialization liaises with industry partners to promote third-party licensing of WSU technologies, and maintains a bank of startup resources for early-stage businesses. The Office of Commercialization also administers the Commercialization Gap Fund, which provides up to \$50,000 to bring innovative technologies to market. Finally, entrepreneurs and startups in need of workspace may take advantage of the incubator facilities and low-cost office space at the WSU Research and Technology Park.

### Resources for Innovation and Expansion

Washington is home to substantial innovation ecosystem assets outside of the academic R&D pipeline. PNNL in Richland is heavily involved in the research and development of grid modernization technologies, as demonstrated by the wealth of patents related to advanced energy infrastructure. PNNL also maintains a catalog of business development resources for small businesses in the Tri-Cities area.

## **PNNL Grid Modernization Projects**

PNNL has emerged as a leading research institution driving grid modernization efforts. PNNL co-leads the Department of Energy's (DOE) Grid Modernization Laboratory Consortium, a partnership among fourteen national labs to identify, plan, and execute top grid modernization priorities. PNNL is also involved in half of the eighty grid modernization projects announced as a result of the Consortium's analysis, including the Transactive Campus Demonstration partnership with UW and WSU. Research focus areas will include grid architecture, control theory, standards for grid services, and foundational analysis. The new Systems Engineering Building at PNNL, which uses high-speed data and advanced computing to allow researchers and industry partners to visualize the grid, is key to its leadership in grid modernization.

The Washington State Department of Commerce manages two programs to facilitate in-state technology commercialization. The Innovation Partnership Zone (IPZ) program encourages businesses to cluster in an appropriate geographic area according to their industry classifications. This type of clustering brings R&D facilities, workforce development programs, and private sector resources together in discrete zones in order to better facilitate business development. Three of the state's fourteen IPZs—Tri-Cities, Walla Walla, and Spokane—focus on some aspect of energy and grid technologies; the Grays Harbor IPZ specializes in sustainable advanced manufacturing.

The Startup Washington program facilitates access to business development resources, including a database of 119 in-state incubators, accelerators, makerspaces, and coworking spaces and a directory of venture capital and angel investment firms. Unlike the IPZ program, however, Startup Washington does not readily provide resources targeted to specific industries.

## **Battery500**

Battery500 is a PNNL-led consortium of national laboratories, universities (including UW), and industry players designed to accelerate R&D of lithium batteries for electric vehicles. The consortium's ultimate goal is to produce a battery with an energy density in excess of 500 watt-hours per kilogram. To that end, and recognizing the innovation potential of U.S. companies, the consortium will devote 20 percent of its \$50 million, DOE-funded budget (paid in annual increments of \$10 million over five years) to the exploration of nascent "seedling projects" from throughout the R&D community.



### **Spotlight on Innovation Ecosystem Leaders**

The Cascadia CleanTech Accelerator launched in 2016 as a partnership between the CleanTech Alliance and Oregon BEST. The program is open to early-stage cleantech companies with less than \$1 million in funding, and provides industry-specific mentorship, marketing assistance, and financing guidance. Participants are also eligible for a series of funding competitions.

The Pacific Northwest Cleantech Open is a regional extension of Cleantech Open, which is a volunteer-based, startup competition and accelerator program that has trained more than 1,200 alumni nationwide to date.

Ignite Northwest is a Spokane-based, nonprofit accelerator for advanced energy, bioscience, and aerospace companies with viable prototypes and defensible intellectual property. The twelve-week program is offered twice yearly. Training includes general business skills, go-to-market planning, and growth financing options, in addition to access to a mentoring network and an end-of-program demo day. Program graduates are also given access to the Technology Growth Fund, which offers working capital loans to companies that cannot access bank debt.

Washington State is exemplary in its dual commitment to clean energy and technological innovation. However, few of the state's small business resources are capable of providing detailed, industry-specific guidance to entrepreneurs in the advanced energy sector. Of the workspaces in the Startup Washington network, only two have programs devoted to cleantech. Even with the recent addition of the Cascadia CleanTech Accelerator, early-stage cleantech companies must compete for a relatively limited selection of industry-specific resources. Moreover, there continues to be a need to increase access to the infrastructure that can de-risk a new technology through validation, testing, and demonstration.

## Access to Capital

Access to affordable capital is essential for entrepreneurs to develop new products, grow their businesses, bring products to market, and create jobs. Having access to investors or 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.

Investors are hesitant to invest in advanced energy technologies due to high risk, long maturation periods, and long timelines for return on investments. Advanced energy companies often lose out to more traditional tech-based industries that have shorter proof-of-concept timelines, wider end-use markets, and lower capital needs. To ensure the success of as many new and small businesses as possible, Washington's lawmakers should consider creating policies to attract patient capital to the state.

## Capital Resources and Programs for Washington's Entrepreneurs

Element 8 is an angel investment organization in Washington State that focuses exclusively on cleantech investments. Seventy private, accredited investors invest in early-stage companies that improve global sustainability. Since its inception in 2006, Element 8 has invested more than \$29 million in seventy-four deals. Other private investors in cleantech are Bellingham Angel Investors, Puget Sound Venture Club, Cascadia Capital, OVP Venture Partners, and Voyager Capital. Startup Washington maintains a list of other angel and venture capital firms that operate in the state.

Washington Research Foundation Capital (WRF Capital) specializes in early-stage breakthrough innovations in life sciences, information technology, and physical sciences emerging from the state's research institutions. WRF Capital allocates its profits to the Washington Research Foundation's ongoing philanthropic activities.

Similar to WRF Capital, the W Fund invests exclusively in promising startups emanating from Washington research institutions, including UW, WSU, and PNNL. Created by UW in 2012 with a combination of business, venture capital, and federal funds, the W Fund invested \$20 million in seventeen companies in its first four years of operations, with two companies engaged in cleantech applications. The W Fund has nearly expended its available capital.

### Access to Capital

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

### Competition for Venture Capital Dollars

In 2015, over 75 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 25 percent, stifling innovation across the country and highlighting the importance of state policies for new venture capital investments. In Q4 2016, Washington ranked fifth in venture capital investments, nationally. However, relative to California's 43.3 percent share and New York's 14.5 percent share of national investment dollars, Washington's 2.8 percent share indicates room for improvement.



**Breakthrough Energy Ventures (BEV)**

BEV is the venture capital extension of the Breakthrough Energy Coalition, an association of investors committed to supporting cleantech developments around the world. Over the next twenty years, BEV is committed to investing at least \$1 billion in cleantech startups based on their perceived climate impact, technical feasibility, novelty, and ability to attract outside capital.

Two organizations help businesses that would otherwise have difficulty obtaining loans. Craft3 provides loans to businesses in underserved communities that can range from \$25,000 to \$5 million. Craft3 created the Future Energy Fund with support from the state’s Clean Energy Fund to assist Washington’s clean energy businesses in obtaining financing for innovation and growth. The Collateral Support Program for Small Businesses provides collateral support for short-term loans for businesses that would not otherwise qualify.

**Workforce Development**

Trained and skilled workers are fundamental to the success of an industrial 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 any emerging or established industry in the state. Washington’s unemployment rate was 5.1 percent in January 2017, above the national average of 4.8 percent. In the Seattle region, the employment rate was much lower than the state average at 3.4 percent. In 2016, over half of the state’s labor force growth came from companies in the Seattle region.

Washington’s population continues to grow, largely from net migration into the state. In 2016, the state estimated a 1.73 percent population increase (122,000 people), the largest single-year increase since before the Great Recession. In 2015, just under 1.1 million students attended Washington’s public elementary and secondary schools.

**Washington’s School Funding Dilemma**

The state is facing a September 2018 deadline to respond to a state Supreme Court ruling that found Washington was not adequately funding its schools. Washington has already increased spending by more than \$2 billion, but some estimate that an additional \$1.76 to \$4 billion each year is needed. Plans to comply with the court order are still being developed.

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In order to capitalize on opportunities in the advanced energy space, Washington’s policymakers can take proactive steps to address skill gaps and structural challenges in its workforce. A thoughtful sector-based workforce development approach should 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 Washington can focus efforts on regions and populations still experiencing high unemployment. The potential for grid modernization manufacturing offers the residents of Washington the opportunity for good-paying jobs.

## Workforce Strengths

Washington’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 smart grid technologies and related fields. For example, the Pacific Northwest Center of Excellence for Clean Energy, headquartered at Centralia College, works with industry and education partners to ensure that the community colleges are producing skilled workers. One such program to prepare students for jobs in the wind turbine industry is offered by Walla Walla Community College. Students enrolled in the program can earn an associate degree or a one-year certificate in wind energy technology.

Washington’s residents have higher education levels than the national average. As of 2014, an estimated 51.6 percent of residents held postsecondary credentials, including degrees, certificates, and certifications—above the national average of 45.3 percent. For Washington residents of ages twenty-five to sixty-five, nearly 12 percent held a graduate or professional degree, roughly 22 percent held a bachelor’s degree, and nearly 11 percent held an associate degree.

The Running Start program encourages students in eleventh and twelfth grades to enroll in college courses tuition-free. Students can choose to take courses at any of the state’s technical or community colleges as well as Central Washington University, Eastern Washington University, Washington State University, and Northwest Indian College. Although the state waives tuition for students in the program, students must pay community college fees. Students can use credits earned in the program toward their high school diploma as well as a college diploma.



**Interdisciplinary Learning at Western Washington University (WWU)**

WWU's Institute for Energy Studies offers interdisciplinary undergraduate degrees in electric energy engineering, energy policy and management, and business and sustainable energy; a self-designed major in energy and environment; and minors in energy policy and energy science. The interdisciplinary energy curriculum includes courses in Electric Power and Electromechanical Devices, Energy Processing and Power Electronics, Smart Grid and Renewable Power, and Economics of Electric Markets.

The Institute for Energy Studies links to WWU's entrepreneurship and innovation program to produce Energy Entrepreneurship Fellows, with the goal of preparing graduates to become both founders of new enterprises and disrupters of existing businesses in need of innovation, such as utilities.

**New Battery and Solar Training Facilities**

Recognizing the jobs potential of the advanced energy economy, Washington funded Energy Northwest to engage utility and labor leaders in the development of a battery and solar training facility.

Washington's universities have been national leaders in smart grid technology and education. In collaboration with UW and ten other partners, WSU led the modernization of curricular elements in smart grid engineering for undergraduate and graduate students with financial support from the DOE. Additionally, WSU is home to the Energy Systems Innovation Center, which fosters collaboration between faculty, industry, and government on smart grid technology and other clean energy areas.

UW's Clean Energy Institute has specific, clean energy-focused education that spans all levels of education in the State of Washington. UW feeds the clean energy talent pipeline with outreach to K-12 students and then supports newly admitted students from disadvantaged backgrounds during their freshman year. Community college students, and their instructors, can join other undergraduates working in UW laboratories during the summer in the Clean Energy Bridge to Research program funded by the National Science Foundation (NSF). At the Master and Ph.D. levels, NSF Research Traineeship Program grant funding supports fellowships to graduate students that participate in the Data Intensive Research Enabling Clean Technologies program. Finally, a Washington Research Foundation gift has funded an Innovation Fellows Program in Clean Energy for postdoctorates.

To increase options for students to enter the workforce or pursue graduate school, Washington's community and technical colleges offer applied bachelor's degree programs that build on the skills and learning of associate degree programs. The programs provide technical college graduates with the opportunity to earn a four-year degree, an opportunity often not open to students with an associate degree from a technical college. Additionally, the program gives technical college students a path to graduate school. Washington's community and technical colleges offer degrees in a variety of fields; although degrees are offered in sustainable building and sustainable practices, no other applied bachelor's degree programs exist for advanced energy.

The Center for Advanced Manufacturing Puget Sound (CAMPS) brings members together to support the manufacturing community. The membership includes nearly 180 companies, organizations, academic partners, and public-sector partners. CAMPS aims to improve the image of manufacturing and attract new talent to the industry, with a focus on youth and transitioning military service members.

While there are workforce development strengths, Washington has significant room for improvement. Low enrollment rates in postsecondary education, baby boomers aging out of the workforce, and a lack of coordination between K-12 schools and community and technical colleges make planning for the jobs of tomorrow a challenge.



# The Impact of Washington's Grid Modernization Cluster

Washington's existing assets translate into major opportunities for business growth and job creation in the grid modernization sector, laying the groundwork to catalyze economic opportunity for thousands of Washingtonians.

## Companies in Washington's Grid Modernization Supply Chain

Washington has a number of firms in the grid modernization supply chain, providing a solid base from which to grow the local industry. Itron, based in Liberty Lake, is a leading global manufacturer of smart meters. UniEnergy Technologies, located in the Seattle suburb of Mukilteo, manufactures utility-scale vanadium flow batteries that have been deployed by Washington utilities. Redmond-based Zetron is a provider of remote terminal units, which can be used for monitoring and controlling electrical transmission networks. Washington is also home to one of the leading power T&D automation companies, Pullman-based Schweitzer Engineering Laboratories, which manufactures synchrophasors, fault indicators, and automated switches.

Global leaders Siemens and ABB are the primary manufacturers of high-voltage direct current transmission systems and flexible alternating current transmission systems, and both have locations in Washington.

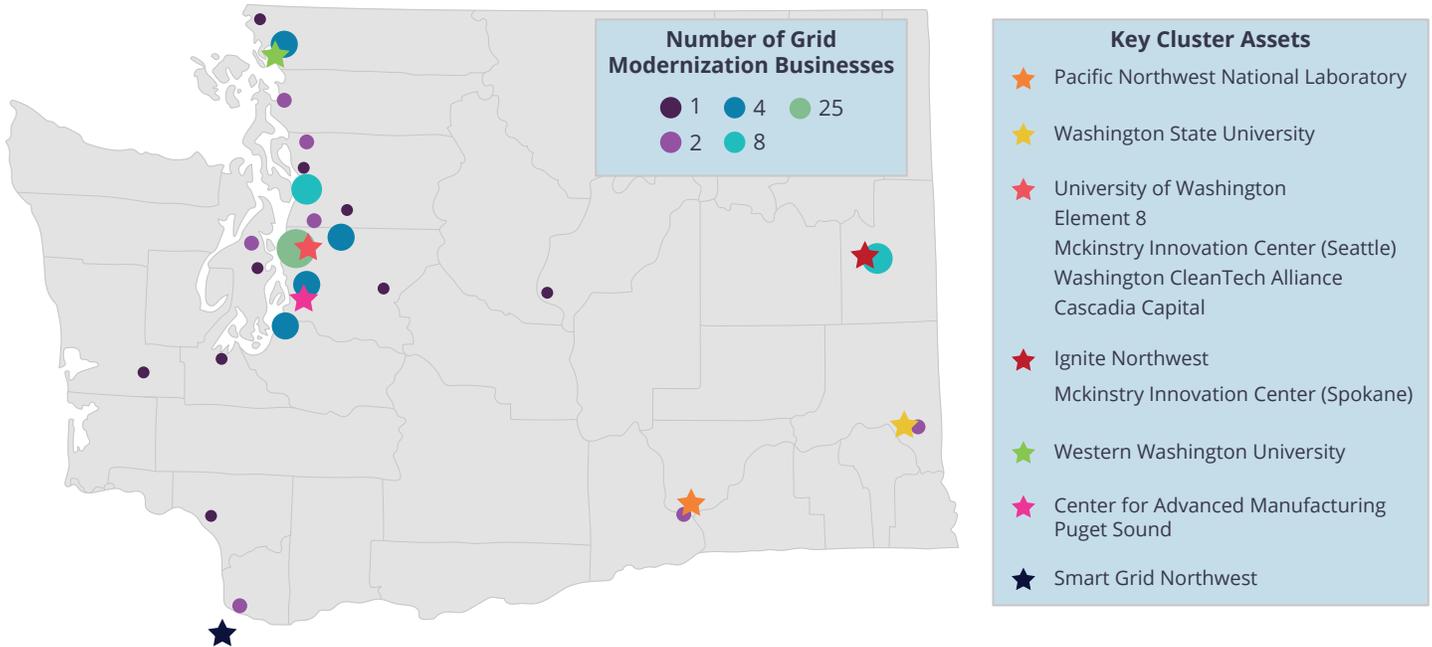
Arlington-based Outback Power manufactures grid-interactive and microgrid inverters and batteries, allowing consumers to sell residentially generated power into the grid. Anderson Electric Controls manufactures custom converters that support distributed power generators on the grid. Redmond-based Data I/O manufactures microcontrollers for IoT applications, including by major customers such as ABB and Siemens. Doosan GridTech offers a distributed energy resource management system to optimize usage of storage and distributed resources. Demand Energy, a Liberty Lake-based subsidiary of Enel Green Power, offers an energy management system to optimize distributed and behind-the-meter assets.

Software plays a major role in grid modernization. For example, Seattle-based renewable power forecasting company 3TIER

by Vaisala enables power planning on grids with appreciable renewables penetration, whereas industrial customers of demand management software products from Seattle-based Powerit Solutions are compensated for providing grid flexibility for curtailing demand when power production is out of balance with power demand. Grid Solutions, a joint venture by global leaders GE and Alstom, hosts its Worldwide Center of Excellence for Network Management Solutions in Redmond.

Expanding the knowledge of the local grid modernization supply chain through supply chain analysis could enhance foreign direct investment missions by identifying supply chain gaps that can be filled by foreign companies.

## Washington's Grid Modernization Cluster



## **Snapshot: Washington Companies**

Washington's grid modernization industry benefits from a diverse group of businesses, ranging from small supply chain businesses to large anchor companies. The following vignettes showcase four Washington companies and their impact on jobs in the state.

### **UniEnergy Technologies: 25 Employees**

- Founded in 2012 by researchers in the PNNL Grid Energy Storage Program
- Technological leader in vanadium flow batteries
- Designs and manufactures megawatt-scale energy storage products
- Customer segments include utilities, renewable power generators, and microgrid operators
- Avista Utilities and Snohomish County Public Utility District used more than \$10 million in state Clean Energy Fund grants to purchase and integrate UET vanadium redox flow batteries in 2014
- Funded by DOE grants while developing technology at PNNL
- Received more than \$25 million in venture capital funding from overseas investors
- Established projects in several U.S. states and abroad

### **Doosan GridTech: Est. 45 Employees**

- Founded as 1Energy in 2011 to create software for utilities to manage electricity flows into the grid
- Developed a distributed energy resource management system to optimize usage of energy storage and distributed energy resources
- Acquired by Doosan Heavy Industries & Construction in 2016
- Plans to leverage the 1Energy technology and Doosan Industries' scale to rapidly expand in North America
- Customers include Duke Energy, Austin Energy, and Snohomish County Public Utility District
- Plans to expand focus beyond utilities to independent power producers and commercial clients

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## **Itron: Est. 500 Employees in Washington**

- Multinational corporation involved in energy and water resource management for forty years
- Manufactures standard and smart metering devices for residential, commercial, and industrial use
- Additional product lines and offerings include networks, sensors, data collection, analytics software, and managed services
- \$2 billion in worldwide sales in 2016, including nearly \$1 billion in its electricity division
- Nearly 8,000 electricity, natural gas, and water utility customers in more than one hundred countries

## **Schweitzer Engineering Laboratories: Est. 2,400 Employees in Washington**

- Founded in 1982 based on expertise in power system reliability and safety
- World leader in designing and manufacturing protection, monitoring, control, automation, and metering products for electric power systems
- SEL intertie, synchrophasor, and metering solutions integrate distributed energy resources into the grid
- Primarily serves customers in the utility, government, and industrial sectors
- Employee-owned company named as one of Fortune's 100 Best Companies to Work For in America in 2012
- Primary manufacturing operations in Pullman will be expanded by 200,000 square feet by June 2017, adding 850 new jobs

## **Job Opportunities in Grid Modernization**

Manufacturing grid modernization products requires a variety of professions, including skilled engineers, technicians, assemblers, operations, software specialists, and sales representatives. As a result, holistic workforce development and education programs are required to ensure all positions—from manufacturers to maintenance—are filled. These are good-paying jobs that require anything from a high school diploma to an advanced degree. The following table gives a snapshot of the type of jobs available in the grid modernization sector.

Other job opportunities include wholesale and manufacturing sales representatives; financial managers; bookkeeping, accounting, and auditing clerks; marketing managers, research analysts, and specialists; construction managers and laborers; and urban and regional planners.



<b>Examples of Available Jobs</b>	
<b>Computer and Mathematical Occupations</b>	
<b>Computer systems analysts</b>	Study and address issues with an organization's computer systems
<b>Network and computer systems administrators</b>	Maintain an organization's computer networks and systems
<b>Computer network architects</b>	Create data communication networks
<b>Operations research analysts</b>	Address advanced technical issues within organizations
<b>Systems software developers</b>	Develop underlying software systems or applications
<b>Information security analysts</b>	Design security measures to protect an organization's computer networks and systems
<b>Architecture and Engineering Occupations</b>	
<b>Electrical and electronics engineers</b>	Design and develop electrical and electronic equipment
<b>Civil engineers</b>	Design, build, and manage construction projects
<b>Mechanical engineers</b>	Design and develop mechanical tools, engines, and machines
<b>Chemical engineers</b>	Design, develop, and test processes and equipment for manufacturing products that use chemicals
<b>Engineering technicians</b>	Assist head engineers with design, production, and testing
<b>Materials scientists</b>	Study materials and their interactions at microscopic levels to develop and test products
<b>Installation, Maintenance, and Repair Occupations</b>	
<b>Electrical and electronics repairers, powerhouse, substation, and relay</b>	Install and repair electrical equipment at generation sites, substations, and relays
<b>Electrical power-line installers and repairers</b>	Install and repair electrical wiring for electricity generation and distribution systems
<b>Telecommunications equipment installers and repairers</b>	Set up and maintain equipment that enable communications
<b>Electricians</b>	Install, maintain, and repair electrical systems
<b>Power Production Occupations</b>	
<b>Power distributors and dispatchers</b>	Manage the distribution of electricity or steam
<b>Power plant operators</b>	Control and maintain electricity generation equipment
<b>Manufacturing Production Occupations</b>	
<b>Electrical and electronic equipment assemblers</b>	Assemble parts into finished electrical and electronic products
<b>Industrial production managers</b>	Oversee daily operations of manufacturing

# Grid Modernization Jobs Snapshot

## Systems Software Developer

Develops underlying software systems or applications



*Wage:* \$51.04

*Training:* Bachelor's degree

## Engineering Technician

Assists head engineers with design, production, and testing



*Wage:* \$27.89

*Training:* Associate degree (in specific branch of engineering)

## Electrician

Installs, maintains, and repairs electrical systems



*Wage:* \$28.27

*Training:* High school diploma or equivalent, apprenticeship

## Power distributor and dispatcher

Manages the distribution of electricity or steam



*Wage:* \$41.49

*Training:* High school diploma or equivalent, long-term on-the-job training

## Industrial production manager

Oversees daily operations of manufacturing



*Wage:* \$50.31

*Training:* Bachelor's degree



### Direct, Indirect, and Induced Jobs

To estimate the potential economic impact of Washington's grid modernization supply chain, we distinguish direct, indirect, and induced jobs.

- **Direct jobs:** reflect jobs resulting from initial changes in demand in Washington's grid modernization industry.
- **Indirect jobs:** reflect jobs resulting from changes in transactions between industries as supplying industries respond to increased demand from Washington's grid modernization industry.
- **Induced jobs:** reflect jobs resulting from changes in local spending as a result of increased demand in Washington's grid modernization and indirect industries.

## Potential Job Growth from Grid Modernization Cluster Development

To estimate jobs potential for the Washington grid modernization industry, 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 number of jobs that the in-state manufacturing industry could support annually, on average, each year from 2017 through 2030, a fourteen-year timeframe. To generate these estimates, the grid modernization 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. Appendix 2 provides a more detailed description of our modeling approach and resources used.

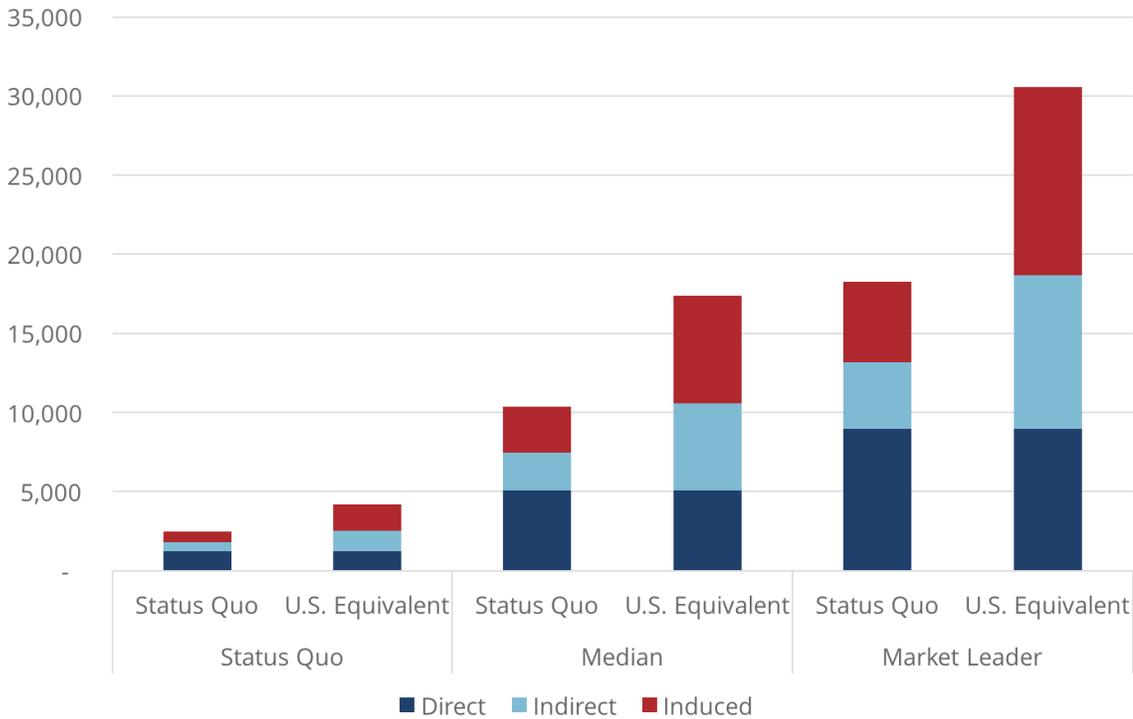
### 13,800 Average Annual Jobs Supported

As global demand for grid modernization increases, Washington's grid modernization cluster could grow to serve a larger portion of national demand than it does currently. By fostering industry growth, Washington could reasonably support over 13,800 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.

### Additional Jobs Opportunity: Construction, Operations, Maintenance, and Management Services

By building the grid modernization industry, Washington would also generate numerous service jobs from new facility construction and technology deployment, such as operations, maintenance, and management services. This jobs analysis does not account for these associated jobs, meaning that Washington can benefit from an even greater economic impact than estimated.

Washington Grid Modernization Average Annual Jobs by Market Penetration and Supply Chain Concentration 2017-2030



Our projections for jobs potential in the grid modernization industry come from global estimates of future demand, the current estimated national market penetration rate for Washington’s grid modernization 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 Washington’s market penetration. For the second measure, we estimated the number of jobs supported by varying levels of supply chain concentration.

### 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 Washington’s current estimate of existing market penetration for grid modernization products. We then created two additional scenarios in which Washington matches the market penetration of the current state market leader and a median between Washington and the market leader.

### Technologies Included in Analysis

The range of technologies included in our analysis includes: smart meters, advanced grid-scale energy storage, high-voltage direct current (HVDC) transmission lines, remote terminal units (RTUs), synchrophasors, dynamic volt/volt-ampere reactive (volt/VAR) voltage regulation systems, flexible alternating current transmission systems (FACTS), other smart grid T&D technology (reclosers, fault indicators, automated switches), and IoT platforms for smart buildings, infrastructure, and grid management.



## Supply Chain Concentration

Supply chain concentration refers to the level at which Washington is able to fill its supply chain needs from in-state companies. The "Status Quo" scenario is based on the existing Washington supply chain. The "Midpoint" scenario represents the midpoint 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 Midpoint supply chain concentrations are realistic goals for Washington. If Washington is able to grow its market share and builds a supply chain to these levels, the industry could support an annual average of over 13,800 direct, indirect, and induced jobs from 2017 through 2030. Thus, Washington's grid modernization industry could serve as a major vehicle for future state economic growth, while creating quality jobs for Washingtonians.



Prepping a Microgrid



# Policy Recommendations

Washington has tremendous potential to expand the grid modernization cluster and position itself as a national and global leader. State leaders can fortify the grid modernization sector by improving workforce training and increasing access to technical and financial resources for businesses. The state can also implement innovative strategies that remove barriers to growth and increase demand for locally made products. Whether taken as a whole or as piecemeal solutions, the following policy recommendations can attract private investment, stimulate the state's economy, and create good-paying jobs for Washingtonians.

## **Strategically Expanding Washington's Grid Modernization Sector and Supply Chain Companies**

### **Facilitate Formalization of a Grid Modernization Public-Private Partnership**

In late 2016, the Washington State Department of Commerce set out a strategic plan to grow the state's cleantech sector by engaging relevant industry associations, research organizations, lenders, and investors. Washington is home to a number of relevant industry associations—including CleanTech Alliance and Smart Grid Northwest—that are working to advance the interests of cleantech companies in the state. These organizations already partner with the Washington State Department of Commerce on several initiatives, but not specifically on grid modernization. Building on this important foundation, Washington's grid modernization businesses could benefit from the expansion of this partnership into a more formal public-private partnership specific to grid modernization, wherein industry players partner with existing industry associations and government leaders to engage with stakeholders and grow Washington's grid modernization sector. The partnership could take the lead on enabling cooperation and collaboration across the value chain in areas such as knowledge sharing, asset growth, policy advocacy, and cluster development. Washington could look to states such as North Carolina and Colorado, which have both successfully established public-private partnership schemes to grow their cleantech clusters in a specific technology area.

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### **North Carolina’s Cleantech Cluster**

North Carolina’s Research Triangle Regional Partnership—an association of economic development agencies in the state’s Research Triangle region—founded the Research Triangle Cleantech Cluster (RTCC) as a way to strategically engage industry leaders in the regional development of the cleantech sector. Notably, while RTCC’s Advisory Council bridges the public-private divide by drawing from industry, academia, and government, the Board of Directors that steers the cluster is composed exclusively of business leaders. This organizational structure positions industry players to contribute valuable insight and to substantially influence the industry’s regional growth strategy. RTCC strategically targeted the smart grid industry for growth, engaged local anchor companies to spearhead efforts to build the cluster, and focused the bulk of its efforts on developing the state’s impressive smart grid cluster.

### **Colorado’s Clean Energy Cluster**

By contrast, the Colorado Clean Energy Cluster (CCEC) puts industry, universities, and government on relatively equal footing within its Board of Directors. CCEC relies on a “triple helix” model—referring to the cluster’s reliance on all three stakeholder groups—to develop public-private partnerships that address clean energy problems. The model in turn generates programs like FortZED, which brings together local businesses, the City of Fort Collins, and Colorado State University to catalyze and promote advanced energy solutions.

An active public-private partnership could draw on the resources, expertise, and networks of each entity to maximize its reach and impact. Through its members and partners, the partnership would have a unique understanding of cluster assets and areas for improvement in regulatory and legislative policy, access to capital, R&D, project finance, and workforce development. Once formed, a partnership could serve multiple purposes, including stakeholder and regulator education, legislative advocacy, business development, and business outreach. Regardless of whether a partnership follows the North Carolina or Colorado models, it could give Washington businesses increased authority and control over the direction of the cluster.



### **Broad Approach to Cluster Development**

Washington's grid modernization partnership could be a key driver of cluster development, convening stakeholders and resources to engage in strategic initiatives. Industry leaders and economic developers could determine the best approach for cluster development in the state, with one potential approach outlined below.

- **Initial Engagement:** Identify and engage with key stakeholders in industry, government, academia, and other relevant fields.
- **Cluster Analysis:** Map company base and evaluate intercompany linkages, externalities, and synergies. Define and evaluate industry assets in workforce development, access to capital, and the innovation ecosystem as well as supply- and demand-side policies and programs. Conduct market trend and competitive position analyses.
- **Strategy Formation:** Develop vision and goals for the cluster based on analyses. Create strategic policy and institutional initiatives to improve cluster competitiveness and identify drivers for each initiative.
- **Strategy Implementation:** Get initiatives in motion, mobilize investment and public-private partnerships, and improve the business environment.
- **Cluster Sustainability:** Establish formal or informal organizational structure to continue cluster initiatives and investments.

Washington is home to a number of relevant industry associations—including CleanTech Alliance and Smart Grid Northwest—that are well positioned to serve as drivers for an expanded and more formalized public-private partnership scheme that focuses solely on grid modernization. The partnership could draw on the resources, expertise, and networks of these industry associations to maximize its reach and impact. Working through these organizations, a partnership could also leverage existing connections with the Department of Commerce and the Governor's Office to achieve key political and regulatory ends. Working together could bolster the state's chances of securing funding from the federal government or other national organizations. The state government can continue to support the efforts of the cluster by facilitating activities and providing funding for joint initiatives.

### **Best Practice Partnership Activities**

A grid modernization partnership could conduct a variety of inward and outward activities to support its participants and grow the industry. Activities could include:

- Maintaining a public supply chain database
- Conducting outreach campaigns to promote investment in grid modernization
- Organizing knowledge-sharing and networking events
- Developing research projects and hackathons to solve broad industry challenges
- Identifying regional and federal contract opportunities
- Supporting the development of a STEM curriculum and industry-specific training programs
- Advocating for policies that increase demand for grid modernization technologies and services and support business development

### **Acquiring First Customers for Startups**

Advanced energy startups often have difficulty contracting their first customer due to their lack of established relationships with utilities and understanding of utility purchasing procedures. A grid modernization partnership could leverage its relationships with utilities and other end users to help startups develop an initial customer base.

Both Smart Grid Northwest and CleanTech Alliance represent substantial member constituencies, but neither organization alone currently provides the full spectrum of services that a purpose-driven, public-private partnership designed specifically for the grid modernization industry could offer. Since each organization brings a unique set of assets to the table, CleanTech Alliance and Smart Grid Northwest could consider forming a more formalized partnership with the support of the Department of Commerce. By engaging in this way, each organization could extend the benefits of the program to its constituent members without requiring them to double down on membership fees. The state government could support the efforts of the cluster by facilitating activities and providing funding for joint initiatives. A grid modernization network could provide enormous value for Washington businesses and the state by facilitating exchange, strengthening cluster assets, and presenting a unified voice on policies that impact their businesses. A purpose-driven grid modernization partnership would signal Washington's commitment to cultivating the cluster in the state and create the "buzz" that the state's industry needs to attract investment.



### 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 in foreign countries, inviting industry leaders to in-state conferences and tours, and providing business incentives.

## Strengthen and Expand the State'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 Office of Economic Development and Competitiveness currently leads Washington's FDI efforts. In 2015, FDI projects increased by 42 percent while capital investments jumped by 65 percent. Washington-based subsidiaries of global companies support 101,500 workers, with 32 percent of those jobs in the manufacturing sector; however, the state ranks twentieth in the United States for local jobs supported by FDI. In order to expand employment opportunities for Washingtonians while strengthening its grid modernization cluster, Washington 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. Washington could look to national best practices and resources to enhance its FDI initiative.

### Best Practices for FDI and Exporting 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

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## ***Connect with Economic Development Resources to Put Washington's Grid Modernization Cluster on the Map***

There are many platforms that serve as gateways for connecting U.S. and international companies, and Washington could leverage these resources to highlight its advanced grid modernization cluster and attract foreign businesses. 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 like the Clean Energy Smart Manufacturing Innovation Institute when looking to connect foreign companies with U.S. locations.

**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 initiative is dedicated to management support for smart grid clusters across Poland, France, Spain, and Bulgaria.

Washington could also enhance its presence abroad by establishing more overseas trade and investment offices. The state currently only has two representatives overseas, compared to seventeen overseas trade offices for Pennsylvania and fourteen for Florida. The federal State Trade Expansion Program (STEP) provides all funding for the state's current trade representatives abroad. Impressively, the return on investment for Washington's STEP program was \$191 worth of export sales for every \$1 invested by the program, the highest out of all twenty-four states in the program by a wide margin. Given the proven success of past international trade efforts, state and local leaders could focus efforts and funding to facilitate more engagement with international economic development offices to create more gateways for investment into the state.



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***Expand Regional FDI Best Practices to Promote Local Economic Development Throughout the State***

Washington has many regional entities dedicated to FDI that could be leveraged to foster industry growth. Regional best practices for attracting FDI could be mirrored across the state to distribute economic impacts. In particular, the Greater Seattle Region Global Trade and Investment Plan stemmed from a multi-stakeholder process to create a roadmap for “going global,” with support from the Global Cities Initiative.

Launched in early 2015, the partnership has since advanced the plan by piloting “Go Global!” workshops to over 125 representatives from local small- and medium-sized businesses; collaborating on inbound and outbound trade and investment missions with support from the Washington State China Relations Council; assessing regional export potential; and leveraging the newly established UW Global Innovation Exchange with Tsinghua University (China) and Microsoft and the Eastside Innovation Triangle. These activities show the Greater Seattle region has focused on gathering regional partners, determining and leveraging its trade and investment assets, and strengthening its local industry base. The roadmap helped boost regional FDI in its first year of implementation, attracting four times more foreign real estate investment and 33 percent more foreign-owned company investment than in 2014. Other regions in the state could emulate this best practice to stimulate interest of foreign companies.

***Identify Target Companies to Enhance State-Driven FDI Efforts***

To enhance its international initiatives, Washington 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, Washington could actively seek assistance from SelectUSA, lead generation consultants like WAVTEQ and OCO Global, regional grid modernization consortiums, and local universities to assess potential FDI opportunities. This strong network of partners could help bolster FDI in Washington.

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.

Washington could specifically target companies in regions pursuing grid modernization to leverage the state's knowledge and resources in this area. The following table provides a snapshot of potential FDI companies.

<b>Potential Foreign Direct Investment Targets</b>		
<b>Company</b>	<b>Country</b>	<b>Description</b>
Ingeteam	Spain	Manufactures electrical products and control software
Landis+Gyr	Switzerland	Produces advanced energy metering products
LSIS	South Korea	Develops automated power T&D products
Stornetic	Germany	Manufactures energy storage flywheels
ZincNyx	Canada	Produces zinc flow battery technologies for energy storage
Eneida	Portugal	Provides grid asset optimization software
Leclanche	Switzerland	Provides integrated energy storage solutions with lithium-ion technologies
Yunicos	Germany	Develops energy storage projects and control software



**International Smart Grid Clusters and Associations**

Washington could also establish relationships with international smart grid clusters and their member companies and engage with global-facing associations dedicated to advancing smart grid technology. Some of these international groups are listed below.

**Foreign regional smart grid clusters:**

- Basque Energy Cluster (Spain)
- Copenhagen Cleantech Cluster (Denmark)
- Smart Grid Services Cluster (Norway)
- Smart Grids France
- Smart Technology Cluster (Lithuania)

**National associations that are members of the Global Smart Grid Federation:**

- Danish Intelligent Energy Alliance
- EDSO for Smart Grids (European Union)
- India Smart Grid Forum
- Industrial Technology Research Institute (Taiwan)
- Israeli Smart Energy Association
- Japan Smart Community Alliance
- Korea Smart Grid Association
- Norwegian Smartgrid Centre
- Smart Grid Australia
- Smart Grid Canada
- Smart Grids Flanders (Belgium)
- Smart Grid Ireland
- SmartGrid Great Britain
- Think Smartgrids (France)

The governor, mayors, business leaders, and universities could take the lead on putting Washington's grid modernization cluster on the map. A coordinated and widespread effort is necessary to attract anchor companies, cultivate new expertise, and support local jobs for Washingtonians.

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## Provide Tax Incentives to Attract and Grow New Grid Modernization Businesses and Fill Supply Chain Gaps

Washington has the potential to significantly mark its leadership in the grid modernization sector by expanding its industry scope. Attracting companies to Washington could bring new expertise to the in-state industry, inject more capital into local communities, and create numerous job opportunities for Washingtonians, especially in areas of the state where economic recovery has not been as robust. There are currently no targeted incentives in Washington designed to attract grid modernization companies to the state. Targeted incentives signal to industry and investors that the state is motivated to create a critical mass of businesses in a given sector and can serve to attract those investors. Washington could establish strategic tax incentives to help existing grid modernization companies remain competitive and attract new businesses by (1) reinstating the high technology tax credits for R&D spending by grid modernization companies, (2) offering an anchor company tax credit that leverages support from in-state businesses, and/or (3) developing a uniform, tiered tax incentive package.

### ***High Technology Tax Credits for R&D Spending***

In order to stay competitive in a continually evolving industry, grid modernization companies must devote resources to R&D and innovation. Industry leaders indicate that grid modernization companies would benefit from tax preferences designed to encourage investments in innovation. In 2017, the Washington State Legislature is considering a measure that aims to reinstate tax preferences for certain industries engaging in R&D. The bill offers business and occupation (B&O) tax credits for R&D and sales and use tax deferral for construction for companies doing R&D in specific industries. However, this legislation does not include grid modernization companies. In order to capitalize on Washington's competitive advantage in grid modernization and become a national and global leader in the space, state leaders should consider adding grid modernization companies to those eligible for the tax preferences.

### ***Anchor Company Tax Credit***

Washington could also encourage in-state grid modernization companies to fill supply chain gaps by offering an anchor company tax credit. Washington 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 industry. 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, the wind developer would receive a tax credit. This credit requires an in-state business to complete a preliminary application identifying a business that could relocate to Rhode Island and a final application demonstrating its substantial role in that company's decision to relocate. The relocating business must create at least ten new full-time jobs by 2019 or twenty-five new full-time jobs by 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 benefits a disadvantaged area, and economic return to the state. To effectively leverage its existing grid modernization company base, Washington could establish a B&O tax credit, modeled after Rhode Island's tax credit.

### ***Tiered Incentive Package***

Washington could create a uniform, tiered incentive package for grid modernization companies interested in expanding or locating operations in the state. This incentive package could include tax exemptions, deductions, or credits as well as job training and infrastructure investments. To be eligible for this incentive, Washington could require that an interested company commit to creating a minimum of new jobs in the state. As a company's total investment and number of new employees increases, the length and percentage of certain tax incentives could improve. The Nebraska Advantage Package offers an example of this incentive structure. Nebraska's program provides six tiers of benefits to interested businesses based on their expected investment and employment. Potential provisions include sales tax refunds, investment credits, and wage credits. Between 2006 and 2015, seventy-eight companies received a benefit under this program. While creating tax incentive packages on a case-by-case basis may work well with large companies negotiating among several states, a uniform and tiered incentive for grid modernization companies could attract businesses of all sizes and signal Washington's commitment to the industry. While Washington's tax structure differs from that of Nebraska, the tax credits could apply to Washington's B&O or public utility taxes.

Washington could consider at least one of these strategic tax incentives. By supporting supply chain growth, Washington could fortify its competitive advantage in the grid modernization industry and ensure quality jobs for Washingtonians.

# Leveraging Local Assets to Increase Access to Capital for Growing Companies

## Establish a State Fund of Funds to Stimulate the Investment Environment

Early-stage companies and small businesses typically have limited financial capital for growth and development and need patient capital to grow. Grid modernization technologies are often high-risk ventures that come with costly and long commercialization periods, yet they can lead to enhanced technologies and disruptive innovations. Stakeholders in Washington report that one of the most significant barriers to grid modernization sector growth is the lack of available patient capital. One strategy to attract top investors into a state and to the cleantech sector is to establish a state-focused cleantech fund of funds, which invests in venture capital and investment funds, rather than directly into companies. A state fund of funds could focus on providing patient capital to clean energy businesses, offering long-term financial security and bridging the valley of death during technology development and commercialization.

In order to ensure that Washington clean energy companies have access to patient capital, the state can set management criteria for the fund of funds. The state could require investment managers that receive funds to (1) invest in Washington companies, (2) hold investments in excess of five years, (3) provide industry returns, and (4) invest in clean energy companies. By attracting investments from the nation's premier venture capitalists and private equity investors, Washington will also gain their knowledge, discipline, and expertise.

### 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.

### Patient Capital

Patient capital refers to dilutive 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.



Access to capital



**Significant Returns from State Fund of Funds**

Similar funds of funds in Illinois and Utah have demonstrated success. Since 2005, Illinois has channeled \$66 million of state funds into eighteen private investment funds. The state has had rates of return around 6 percent. 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. In Utah, a non-profit, quasi-governmental organization manages the state's \$300 million economic development program. Utah invests in a diverse portfolio, including out-of-state funds. This encourages outside investments in Utah companies and in-person mentoring of the in-state businesses. 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.

Washington could launch its own initiative aimed at bringing investments to local startup companies from the top investment firms in the country. A regionally- or state-focused fund of funds that emphasizes positive returns and engages the business community is a market-driven model for creating jobs and boosting economic growth.

In order to avoid triggering possible constitutional challenges over investing state funds in private entities, Washington could consider using tax credits to encourage private investments in the fund of funds in two ways. First, the state could offer B&O tax credits to companies that contribute directly into the fund. Second, the state could use an auction of insurance premium tax credits to incentivize fund contributions. Specifically, the state could require those insurance companies that win the tax credit auctions to contribute money directly into the fund established by the state. Insurance companies could use the tax credits they purchased against their premium tax liabilities in a later year. With more than 2,250 insurance firms accounting for nearly 1.5 percent of state GDP, tens of millions of dollars could be raised this way. While this type of insurance tax credit mechanism has been used in many states, it has seen recent success in Maryland and Pennsylvania.

## **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 capital 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.

Patient capital provides companies long-term certainty and helps avoid the valley of death during technology development and commercialization. By requiring the fund's investment managers to invest in Washington clean energy companies and hold investments for over five years, the state can ensure that there is a supply of patient capital available to its advanced energy startup companies. A dedicated effort to provide early-stage and growth financing support could help startup companies move through the valley of death, expand their businesses, and advance the state's economic development goals for small business growth and job creation.



### Equity Crowdfunding and Enabling Legislation

Equity crowdfunding is a mechanism for early-stage companies to raise money from a large group of investors by issuing ownership shares. By virtue of securities exemption laws, these unlisted companies are not required to register the shares with federal or state securities regulators, reducing the cost and time associated with typical securities offerings. The purpose is to spur innovation, economic activity, and small business growth by easing the regulatory burden faced by entrepreneurs when raising public funds.

### Types of Investors

- Equity crowdfunders are usually non-accredited investors with restrictions on how much they can invest in companies.
- Accredited investors are individuals whose incomes exceed \$200,000 (\$300,000 if married) for three consecutive years, or who have a net worth of more than \$1 million dollars, not including home values.

## Improve Washington's Equity Crowdfunding Law

Equity crowdfunding is a mechanism utilized to attract private funding for startups. Over the past four years, twenty-five states and the District of Columbia have enacted intrastate securities exemptions that allow equity crowdfunding from non-accredited investors. These exemptions align with updates to the federal exemption for equity crowdfunding under Title III of the JOBS Act.

Washington State authorized equity crowdfunding in 2014, but only two companies have applied to take advantage of the new funding mechanism. Business leaders cite an onerous application process, low funding limits, unnecessary reporting and escrow requirements, limits on the type of permissible instrument, and a lack of access to potential investors as barriers to taking advantage of the crowdfunding benefits. Washington can look to other states around the country for examples of how to successfully improve uptake of this important funding mechanism.

### Invest Georgia Equity Crowdfunding Exemption

The Invest Georgia Equity Crowdfunding Exemption allows non-accredited Georgia investors to invest up to \$10,000 in any company based in the state. Georgia also allows companies based in the state to raise up to \$5 million per year via equity crowdfunding, one of the highest limits in the United States. State investment limits can and often do exceed those allowed under federal rules for interstate offerings, allowing states to compete with each other to become the most attractive place to start a business.

### Oregon Interstate Offering Exemption

The Oregon Interstate Offering Exemption allows non-accredited Oregon investors to invest up to \$2,500 in any Oregon business. These investments can be in the form of equity, notes, or debentures, giving businesses and investors greater flexibility in determining their capital structure. There are no escrow or portal requirements, reducing costs for small businesses. Since its inception in January 2015, twelve companies have accessed equity crowdfunding via the exemption.

Washington State can look to exemption laws in other states and at the federal level for inspiration on how to craft a more effective and competitive crowdfunding law. For example, the state could:

- Remove escrow and pre-approval requirements for smaller offerings
- Permit “testing the waters”: allow an issuer to solicit the general public to determine interest levels in the offering before going to the expense of preparing formal offering documents
- Allow aggregate annual equity crowdfunding investments up to \$5 million
- Allow sales to business entities as well as individuals
- Simplify rules for advertising
- Increase investment limits for accredited investors
- Relax or repeal the minimum requirements for offerings of preferred stock

Additionally, online equity crowdfunding hubs allow entrepreneurs to advertise their business ideas and gather small investments from many investors via a website. By creating a single location for investors to fund new businesses, equity crowdfunding hubs can dramatically improve access to capital.

Washington’s leaders could create an equity crowdfunding hub to showcase Washington companies looking for startup capital. The online portal could be hosted on the Startup Washington website to leverage existing web traffic and improve its visibility. The state could charge a small closing fee for each transaction to offset the cost of running the program. By creating its own equity crowdfunding hub, Washington could attract funding to spur startup growth and job creation.

### **Crowdfunding Hub in Wisconsin**

Rather than waiting for the private sector to act, several states have taken the initiative to set up a crowdfunding hub. Wisconsin, for example, offers a licensed crowdfunding hub called CraftFund where Wisconsin investors can browse specialized companies seeking investors.



## Fostering a Strong Innovation Ecosystem

### Support Access to University and National Lab Resources for Businesses

Washington is home to grid modernization R&D leaders: Pacific Northwest National Laboratory (PNNL), Washington State University (WSU), and the University of Washington (UW). PNNL has the distinction of being co-lead of the Grid Modernization Lab Consortium, a \$220 million, cross-cutting DOE initiative, and UW is a leading recipient of DOE Office of Science funding for basic energy research among U.S. universities. UW is also home to the state's Clean Energy Testbeds, a state-of-the-art user facility. Washington's research institutions can offer substantial capabilities and resources to support growth and innovation for companies at all scales but small- and medium-sized companies can especially benefit. Unfortunately, these companies often lack the upfront funds to utilize the facilities, are not savvy about how these facilities can help, or are unsure how to access them. Washington could strengthen its business environment, better leverage the state universities' and PNNL's resources, and ensure small companies survive the commercialization phase by funding a small business assistance program.

The DOE Small Business Voucher (SBV) program has recently begun to address the funding gap for small- and medium-sized enterprises to access the R&D capabilities of national labs, but the resources are limited. Separate and distinct state-funded schemes have improved technology assistance resources for a wider range of small businesses. New Mexico and Tennessee offer successful models for state-lab partnerships for small business assistance.



Testing Voltage Control for Variable Solar

### **New Mexico Small Business Assistance Program**

In New Mexico, small businesses can secure access to resources at Sandia National Laboratories and Los Alamos National Laboratory through the state-funded New Mexico Small Business Assistance Program (NMSBA). Through this program, businesses apply for technical support from the Labs, including testing support, design consultation, and access to special equipment or facilities. Businesses can either request an individual project or leverage a larger project with businesses sharing similar technical challenges. Under the enabling legislation, NMSBA must “establish a methodology to utilize contractors who have demonstrated the capability to provide small business assistance,” allowing the program to leverage services through universities and the state Manufacturing Extension Partnership. NMSBA has seen widespread success in the state, assisting businesses in all thirty-three counties and serving a client base that is mostly located in rural counties (65 percent). Since its inception in 2000, the program has assisted over 2,300 businesses, helped create or retain over 4,000 jobs, and provided over \$43 million in technical assistance through the two Labs.

### **RevV! Tennessee Manufacturing Innovation Program**

Based on the success of NMSBA, the State of Tennessee established the RevV! program in 2015. The pilot program is supported by a partnership between the state government, the University of Tennessee (UT), and Oak Ridge National Laboratory (ORNL), and both UT and ORNL staff review applications. Through RevV!, manufacturers can apply for vouchers to tap into ORNL’s capabilities including advanced manufacturing demonstration; advanced materials processing, characterization, and fabrication; and computational science. RevV! is supported by a \$2.5 million grant from the state, which was recently replenished. Although it is a relatively new program, RevV! currently funds thirteen projects with a total of \$1.5 million, and has seven project commitments in the pipeline.

Washington could pilot a grant-funded program that offers vouchers for small businesses to receive technical assistance from PNNL, UW, or WSU. State officials could work closely with lab staff to identify what resources to provide and determine appropriate compensation for the cost of use of the facility. Similar to New Mexico’s program, Washington could also require contract opportunities with universities and other resources to expand the capabilities available to small businesses.



### Impact Washington

As a part the NIST Manufacturing Extension Partnership program, Impact Washington provides manufacturers with consulting services in business valuation, operations, organizational development, and growth and innovation. The nonprofit organization also administers a number of federal, state, and local grants designed to keep Washington-based manufacturers competitive in global markets.

In order to inform more small- and medium-sized businesses about the capabilities of the labs, the small business assistance program could support a more formal relationship between PNNL, UW, WSU, and Impact Washington. This would leverage Impact Washington's relationships with small- and medium-sized companies to educate and apprise them of the state's impressive R&D resources and enhance uptake of the program.

### Entrepreneurs-in-Residence Assist Startup Growth

Universities are fertile ground to grow more savvy grid modernization startups. On many campuses like UW, entrepreneurs in residence with key domain expertise and a history of business success are used to enhance business development and accelerate research ideas to market. State support of an entrepreneur-in-residence network among all the state's research universities could be a vehicle to catalyze more small-business development and improve success.

### Incubatenergy Network

Incubatenergy Network is a national consortium of incubators focused on clean energy companies. Supported by a DOE grant and managed by the Electric Power Research Institute (EPRI) and the National Renewable Energy Laboratory. Incubatenergy connects the top clean energy incubators around the country to share best practices and contacts with investors, corporate partners, and first customers.

## Promote the Growth of Specialized Advanced Energy Incubators and Accelerators

Washington is one of the most innovative and entrepreneurial states in the nation; two major research universities, a DOE national laboratory, and a number of private industry researchers feed innovative technologies into the state's network of incubators, accelerators, and startup investors. Due to the technological and regulatory complexity of the cleantech sector, however, these generic small business resources may not be the most efficient commercialization tools for early-stage advanced energy companies. Washington is currently home to two major incubator and accelerator programs tailored to cleantech businesses—CleanTech Alliance and Ignite Northwest. By comparison, New York State is home to seven, and the San Francisco Bay Area alone is home to four. As a result, energy entrepreneurs must either compete for a relatively limited set of resources or forego industry-specific mentorship and guidance—a problem that has hindered past early-stage investment in Washington. Washington State's budget does not provide support to its cleantech incubators nor does it provide targeted support to promote the growth of specific industries. Washington could take inspiration from states like New York, which provide targeted programmatic assistance to qualifying clean energy incubators that establish physical facilities at key sites throughout the state.

## New York Supports Clean Energy Incubators

The New York State Energy Research and Development Authority (NYSERDA) supports six clean energy incubators, which together have created more than 1,000 jobs over the past seven years. Based on the success of this program, NYSERDA solicited proposals from new or existing clean energy incubators in need of support and financial sponsorship. To be eligible for funding, incubators must (1) have a proven track record in the clean energy industry, (2) site their principle place of business and management team in New York State, and (3) operate physical facilities within the state. Successful applicants are eligible to draw up to \$2 million from a pool of \$10 million to support up to 75 percent of their total project costs; incubators are responsible for funding the remaining 25 percent through non-NYSERDA sources.

By replicating a program similar to New York's, Washington could encourage the development of purpose-built advanced energy incubators and provide critical, industry-specific resources to early-stage grid modernization companies. Washington could provide small business incubator grants with operational funding from the general fund. These funds can also serve as a referral tool to engage early-stage companies within the Washington Clean Energy Testbeds, since they are open to both internal and external users. Additionally, these advanced energy incubators could provide the foundation for local companies to access significant capital resources, such as those offered by Breakthrough Energy Ventures.

Washington may also consider explicitly integrating a clean energy incubator program with existing innovation ecosystem assets, such as the Innovation Partnership Zone (IPZ) program, which geographically clusters assets based on industry classification. For example, the state may condition funding eligibility to encourage new clean energy incubators to site facilities in one of the three advanced energy IPZs.

Strong business development resources—such as UW's CoMotion and the Department of Commerce's Startup Washington program—emphasize the importance of mentorship at each stage of business development. By prioritizing incubators with strong mentorship resources at every step of the process—from business model development to manufacturing and marketing—Washington could provide critical resources to early-stage advanced energy companies while also helping to ease investor concerns. Incubators that employ industry professionals in residency programs may be especially valuable to IPZs, as these

## Public Incubator Example: Cyclotron Road

- Incubator at Lawrence Berkeley National Laboratory (LBNL) is funded by DOE grants
- Sited in the San Francisco Bay Area, it leverages the nation's premier innovation ecosystem
- Each cohort includes six early-stage advanced energy companies
- Each company receives approximately \$500,000 in non-dilutive funding over the course of two years
- Program includes living stipend for founders; access to LBNL lab space, scientists, and researchers; and business plan support
- The first cohort created thirty advanced energy manufacturing jobs and secured \$15 million in additional research and private funding over the two-year incubation period



### Providing an Important Next Step for Startups

WSU's I-Corps program, UW's Alaska Airlines Environmental Innovation Challenge and Business Plan Competition, and PNNL's commercialization programs all contribute to launching startups. However, each of these programs fails to provide startups with assistance for the next step in corporate growth once the programs or competitions conclude. Both Cascadia CleanTech Accelerator and Ignite Northwest are non-dilutive, early-stage accelerators that could provide follow-on support for advanced energy participants in these programs.

incubators could bring seasoned industry professionals in close geographical proximity to related R&D and commercialization programs.

Certain regional organizations, such as the Cascadia CleanTech Accelerator, are already taking steps to develop similar incubators in the Pacific Northwest. By supporting this or similar up-and-coming cleantech incubators, Washington could provide more advanced energy entrepreneurs with the industry-specific resources they need.

### Leverage Philanthropic Funding Via a Foundation Liaison

Washington State maintains a robust network of innovation ecosystem assets and programs, many of which are financed directly by the state legislature. As the state pursues new business development initiatives, it should consider tapping into third-party resources to ease the financial burden on the state. Washington is home to many charitable organizations that can join together to provide an alternative funding pathway for research and business development programs. In 2014, 1,309 Washington-based foundations with \$58 billion in assets gave a total of \$4.1 billion in grants. The state government could appoint a Foundation Liaison to connect with and broker support from these local foundations as well as national foundations. Washington could look to Michigan as a model for this initiative.

#### Michigan'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.

The Department of Commerce could reach out to the leading foundations in the state and enlist their help in appointing a Foundation Liaison and contributing a portion of the liaison's salary. Key priorities for the Foundation Liaison could include funding clean energy incubators, recruiting students, funding world-class educational facilities, and training workers. The Foundation Liaison could also look to improve access to capital for advanced energy startups in the state.

### Improving Access to Capital Via Foundation Investments

Traditional foundation investments take the form of grants to nonprofit entities, leaving struggling for-profit entities behind. However, foundations have increasingly recognized their potential to spur job growth and economic development in markets where access to traditional financing pathways is poor. Program-related investment (PRI) programs fill this gap by providing foundations the vehicle to make jeopardizing investments, atypical investments that would otherwise be subject to a tax penalty.

To maintain their nonprofit status, foundations must abide by a few key rules. First, the investment must primarily serve a charitable purpose. Second, financial gain must not be a significant purpose of the investment. Third, the foundation must not attempt to influence legislation through the investment.

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. Specific to advanced energy companies, the nonprofit PRIME Coalition was formed to solicit PRI funding and reinvest it in early-stage energy companies around the country.

**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.

Via a Foundation Liaison, Washington can establish close relationships with the PRIME Coalition, PRI programs, and other members of the foundation community to leverage one another's investment efforts to promote business, innovation, and jobs.

### Program-Related Investments

Program-related investments (PRIs) are a means by 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 can tolerate, PRIs provide an opportunity for higher-risk enterprises to pursue funding for which they may otherwise be ineligible.



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

### Community and Technical College Resources

**Tuition** – Washington State reduces tuition for registered apprentices; apprentices may receive a 50 percent tuition reduction at community and technical colleges.

**Grants** – The Job Skills Program can fund 50 percent of the cost of training programs for new and existing workers at community and technical colleges. The program targets regions with high unemployment, high levels of poverty, large-scale job loss, industries that are new and growing, or a population that lacks skills needed for employment.

**Coordination** – The Pacific Northwest Center of Excellence for Clean Energy works with industry and education partners across the state to coordinate workforce development efforts.

### Promote Private-Sector Training

In addition to preparing the next generation of workers for entry-level jobs, Washington can focus on upskilling existing workers to fill demand for mid-career job openings created as baby boomers age out of the labor force. While the median age of a U.S. worker is forty-two, the average energy industry employee is over fifty years old. In the Pacific Northwest, a 2013 survey of employers found that 60 percent of the electric utility workforce was forty-five years of age or older and that 17 percent of workers would retire by 2018. Encouraging businesses to invest in workforce training is especially important because it opens the doors to good-paying jobs for Washingtonians that might otherwise go to out-of-state job candidates. Policymakers can look at an existing program in Washington and successful programs in other states for models of how to strategically target tax credits to promote private-sector training that upskills existing workers.



Continuous training programs ensure a skilled manufacturing workforce

## Customized Training with Local Colleges

Since 2006, Washington has encouraged companies to partner with local colleges to train their employees through the Customized Training Program. Participating companies have been eligible for a B&O tax credit worth up to 50 percent of the total cost of training. The popular program was extended once, and credits must be earned before July 2017. Because employers strongly prefer policy certainty, these short-term extensions can reduce the effectiveness of the program. Extending the tax credit for a longer term or making it permanent could increase the number of companies participating.

## Internal Training

Several states have programs that offer tax credits for workforce training expenses conducted internally within a company. While Washington requires the participation of a local college for the Customized Training Program, other states do not. Rather, these states generally require just pre-approval of the training and cap the amount of eligible expenses. For example, Rhode Island offers a 50 percent tax credit, up to \$5,000 per employee over three years. Similarly, Georgia provides a tax credit of 50 percent, up to \$1,250 per employee. By only requiring pre-approval, not the participation of the local college, the tax credits can support internal training opportunities.

## Apprenticeships

South Carolina has demonstrated how a small investment in apprenticeships can have significant payoffs for workers and the state. Apprenticeships empower students to develop valuable on-the-job skills, while simultaneously earning money. South Carolina's successful apprenticeship system offers a modest \$1,000 state tax credit per apprentice per year. For every dollar that South Carolina has invested in the program, the state will collect more than \$27 in tax returns over the career of an apprentice. Overall, the estimated social benefit of a registered apprenticeship exceeds the social cost by more than \$49,000. Currently, there is a bipartisan bill stalled in Congress—the LEAP Act, S. 393—that would establish a similar tax credit at the federal level. In total, eleven states offer some form of tax credits for apprenticeships, but Washington offers none.

## Training Partnerships

With tax credits for internal training, businesses would be free to partner with other businesses and unions to develop tax credit-eligible training programs. For example, businesses could partner with the International Brotherhood of Electrical Workers (IBEW) and conduct classes at the IBEW training centers.

## Registered Apprenticeships

To qualify for state and federal benefits, apprenticeships must be registered with the Washington State Apprenticeship and Training Council. Registration ensures that programs meet minimum standards established under the federal National Apprenticeship Act.



By encouraging companies to invest in worker training, Washington can engage the private sector in workforce development and provide opportunities for entry-level workers to gain the skills they need to advance their careers. Washington could provide tired incentives, with targeted industries such as grid modernization receiving larger tax benefits. Since Washington does not have an income tax, the state could offer B&O tax credits. By promoting private-sector workforce training, the state can build upon its strong foundation in advanced energy and expand opportunities for hard-working Washingtonians.

## Expand Career-Connected Learning

A 2013 study found that 72 percent of all job openings in Washington State will require at least a postsecondary credential by 2021. In 2014, only 35 percent of eighteen- to twenty-four-year-olds in Washington were enrolled in a postsecondary program, well below the national average of 41.6 percent. While much attention and resources have gone to increasing enrollment at four-year programs, there is now a national surplus of workers with bachelor's degrees and a shortage of workers with associate degrees or credentials.

### Running Start

The Running Start program encourages students in eleventh and twelfth grades to enroll in college courses tuition-free. Students can choose to take courses at any of the state's technical or community colleges as well as Central Washington University, Eastern Washington University, Washington State University, and Northwest Indian College. Although the state waives tuition for students in the program, students must pay community college fees.

In Washington State, the Running Start program does not solve this shortage because the program is merely intended as a transition to college. Running Start students must take classes at the local college, not their high school, and are not expected to complete an associate degree or other certification during high school. To meet the rapidly growing demand for workers with more than a traditional high school diploma, Washington State should consider expanding opportunities for students to earn a degree or certification in high school and better advertise Running Start programs that support this. Additionally, the state could expand opportunities to complete an apprenticeship in high school.

### ***Establish Early Colleges with Work-Based Learning***

Early college programs are an innovative way to engage students in the classroom and better prepare them for the jobs of the 21st 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 or minority 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 of early college classes. 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 program, nearly 25 percent of all eligible students elected to enroll in the program—over 5,400 students. Washington could enhance Running Start by adding an early college program that provides students with a pathway to a credential or advanced degree by the time they finish high school.

### **Create Energy and Grid Modernization Youth Apprenticeships**

In 2016, Governor Inslee announced a new youth apprenticeship program in partnership with the Aerospace Joint Apprenticeship Committee (AJAC). The registered AJAC apprenticeship program will allow high school students to earn high school and college credits, all while earning a paycheck. The first group of fourteen AJAC youth apprentices will earn an average of \$28,000 in the program. The new program is modeled off similar, successful programs in Wisconsin, Oregon, South Carolina, and Kentucky. Wisconsin’s program has grown to serve 3,000 youth apprentices, with 75 percent expected to complete the program, graduate from high school, and earn a state certification. Washington could scale-up the youth apprenticeship program to include advanced manufacturing and grid modernization apprenticeships.

Washington’s policymakers, either through a statewide pilot or local leadership, could establish industry-specific early college programs and youth apprenticeships that address existing skills gaps in the grid modernization sector. Establishing pathways for high school students to gain postsecondary training would reinvigorate high school education and increase the number of STEM-trained graduates available to support the state’s advanced energy industry.

### **Encourage High School Partnerships with Community and Technical Colleges**

To have a competitive workforce with the skills needed for 21st century jobs, Washington has set the goal of increasing the number of adults in the state with a postsecondary credential to 70 percent by 2023. As of 2014, less than 52 percent held a postsecondary degree or certificate. With more than three out of four new manufacturing jobs requiring postsecondary education, this shortage of skilled workers could negatively impact the state’s ability to attract and retain manufacturers of grid modernization products. While Washington’s community and technical colleges are focused on increasing the number of students enrolling in postsecondary education, many high school students lack sufficient guidance to navigate their options. As of 2014, Washington’s high schools only offered one school counselor for every 502 students, more than double the recommended ratio of 1-to-250.

#### **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.



**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 to assist students' transition to college and careers. 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 number of high school students enrolling in postsecondary education, Washington's policymakers should consider funding a partnership between the state's community and technical colleges 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 could allow them to encourage students at-risk of dropping out to consider technical colleges. Advisors could be linked directly to the local community colleges or with the State Board of Community and Technical Colleges to ensure advisors are knowledgeable about offerings across the system.

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

By encouraging high schools to partner with their local community or technical colleges, Washington can increase the number of students enrolling in postsecondary education and equip the next generation with the needed skills for in-demand jobs in advanced manufacturing.

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## Creating Opportunities for Deployment of Grid Modernization Technologies

By enacting smart, forward-looking policies that encourage in-state demand, Washington can send a market signal to the grid modernization industry 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.

### Educate and Inform Policymakers on the Benefits of Grid Modernization

Deployment of grid modernization technology in Washington is hampered by the lack of full understanding of the benefits a modernized grid would provide for Washington utility customers. Without a clear picture of how grid modernization technologies can improve the economics for utility customers, it is difficult for utilities to justify investing in the technology. Grid modernization advocates can work to educate and inform policymakers on the benefits of deployment. California Energy Storage Alliance is one organization that has succeeded in making a market for energy storage in California through education, outreach, and advocacy.

#### **California Energy Storage Alliance (CESA)**

CESA represents the interests of energy storage companies in California to policymakers. As part of its mandate, CESA conducts workshops for policymakers, develops policy, organizes working groups, comments on pending legislation and regulations, and conducts research. CESA has been instrumental in the adoption of several market-making regulations in California.

Washington State's grid modernization industry members could use the framework established by the public-private partnership mentioned earlier in this report to engage in education, outreach, and research activities. The partnership can propose research to be conducted by the state's universities and PNNL, conduct working groups with industry stakeholders to address challenges facing the industry, and educate legislators, regulators, and utility leaders on the benefits of grid modernization.



The partnership could begin by educating policymakers on the benefits of a resilient grid. Storms, earthquakes, and cyber-attacks all pose threats to the resiliency of Washington's grid. Conducting research and then educating policymakers on the economic cost of power outages and the ways grid modernization can diminish these costs could help establish a market for grid modernization technology in the state.

## Encourage Utility Innovation

Grid modernization technologies like energy storage are new to the market, have high upfront costs, and require extensive testing. Utilities need to ensure technology efficiency and reliability at scale before making capital-intensive investments. With an ever-changing grid, more investment in R&D is required for demonstration projects. To encourage Washington investor-owned utilities (IOUs) to innovate, state leaders could support incentives and explore novel funding mechanisms. Countries like the United Kingdom have embedded incentives for innovation into their regulatory framework, resulting in increased expenditures on innovative activities.

### **Innovation Funding Incentive**

The United Kingdom instituted an initial Innovation Funding Incentive (IFI) in 2004, which focused on distribution system needs, earmarking up to 0.5 percent of utility revenue for research, development, and deployment projects. In the first year, 90 percent of costs are recoverable and, in the second year, only 70 percent are recoverable, encouraging early program uptake. The IFI resulted in utilities spending six times as much on innovation projects in a four-year period.

### **Low Carbon Networks Fund**

The success of IFI led to a larger 2010 initiative called the Low Carbon Networks Fund, which was funded by a charge on distribution utilities to enable them to compete for up to £500 million over five years or up to 2.3 percent of allowable revenue. The Low Carbon Networks Fund has one tier of funding that enables companies to recover costs of small projects, and another larger tier that requires cross-sector partnerships and knowledge sharing. This model continues along with a periodic allowance to fund smaller projects that will benefit local ratepayers.

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The Washington Utilities and Transportation Commission could enact similar mechanisms to encourage the state's IOUs to invest in innovative technology. Requiring the IOUs to earmark a certain percentage of revenue for grid modernization efforts will likely increase deployment of grid modernization technology in the state. The earmarked revenue could fund utilities' internal research projects, R&D at local universities or PNNL, and/or fund pilot projects. Allowing the utilities to choose the R&D projects and research venue can ensure that the utilities are able to tailor the research to their needs.

## Explore Novel Funding Mechanisms for Demonstration and Infrastructure Projects

While the Clean Energy Fund is an effective funding mechanism for grid modernization demonstration projects, there is a need within the state for additional methods of funding that do not rely on taxpayer dollars. Washington's leaders could consider novel funding mechanisms that enable utilities, particularly customer-owned utilities, to deploy new technologies.

### ***Employ a Technology-as-a-Service Model***

Municipal utilities may want to experiment with innovative technologies, but lack available capital or the appetite to engage in a lengthy infrastructure financing process. In this case, utilities can employ a "technology-as-a-service" model that allows them to upgrade their systems without owning the equipment outright.

Service models are now expanding beyond solar, as seen with Schneider Electric's "microgrid-as-a-service" model. In Montgomery County, Maryland, officials partnered with Schneider and Duke Energy on the construction of two microgrids. Instead of paying for the system upfront, Montgomery County will buy the power produced, while Schneider will maintain the microgrid and Duke will own the facility. This model allows smaller utilities or municipalities to invest in next-generation technologies without high upfront costs.

### ***Provide Access to Blended Finance for Infrastructure Projects Via a Multi-Asset Renewal Fund***

An innovative funding model that is starting to gain traction in the United States is the multi-asset renewal fund (MARF). A MARF is a highly-customizable finance mechanism classified as a hybrid alternative investment. This privately managed investment vehicle creates opportunities for public sector project finance and improves investment prospects for local companies. Its structure strategically bundles the various asset classes comprising a thematic industry cluster to attract investment, leverage public sector funds, and distribute impacts across an industry. By



### What is Blended Finance?

Blended finance is “the strategic use of development finance and philanthropic funds to mobilize private capital flows to emerging and frontier markets.” Local governments and business leaders are increasingly using blended finance mechanisms to de-risk sustainable development investments. Current global capital markets are worth upwards of \$218 trillion, presenting an opportunity for local leaders to tap into this capital pool to enhance cluster growth.

bundling different types of asset classes with different risk profiles, MARFs attract investors that would not ordinarily invest in cleantech and improve project finance opportunities. Washington could consider using this model to increase the availability of financing for grid modernization projects.

MARFs were developed by Corymbus Asset Management in partnership with the Global Cleantech Cluster Association (GCCA). When creating a MARF, Corymbus first scopes the financial network of an emerging industry by identifying the flow of capital through the local economy. Then, the various asset classes of the industry cluster are assessed for risk to find high-growth investment opportunities. The assets are then bundled and de-risked by balancing the risk profiles of the investments in the portfolio, creating a MARF. MARFs are large investments of around \$300 to \$500 million, consisting of a combination of liquid and illiquid capital commitments, including stocks, corporate bonds, private equity, futures contracts, and infrastructure finance products. MARFs are operationalized by a licensed alternative asset manager, with biannual evaluations to rebalance risk by adding or eliminating projects or companies. By having multiple asset classes bundled into one investment fund, large institutional investors (like pension funds or wealth management firms) are able to invest in an industry cluster with reduced risk and broader impacts. Creating an investment vehicle to facilitate investment in an entire cleantech cluster has several benefits for a state.

#### Potential Benefits to Creating a MARF

- **Increase financing opportunities for infrastructure:** MARFs facilitate green performance bonds, straight project finance (debt and equity), or structured finance (securitizing cash flows from bundled smaller projects) that can be used to finance large projects or cluster-related infrastructure, including grid upgrades, and leverage public financing to attract private financing.
- **Increase access to capital for cluster companies:** Later-stage private equity or leveraged debt investments are available for high-growth potential companies.
- **Develop a market for cluster products:** Infrastructure project finance documentation can contain conditions that require using products of the cluster companies, creating a market and fostering cluster growth (i.e., green procurement).
- **Increase value for securities relevant to industry clusters:** Bundling the securities of cluster companies and infrastructure cash flows can drive scale of investment in the cluster, increasing its value.

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Although MARF is a new hybrid investment model, countries such as Finland have incorporated the model in their financial approach to transitioning to a low-carbon economy. Finland's MARF assessment and investment resulted in the identification of smart grid, smart mobility, and green chemistry clusters, each comprised of small firms, growth equity companies, and publicly traded firms. Example infrastructure projects include upgrades to energy utilities to incorporate IoT and blockchain technology and urban mining (waste-to-energy and other high value by-products). Based on simulations and ten-year backtesting, MARFs can yield risk-adjusted returns of 8 to 12 percent, depending on portfolio allocations.

Washington is well positioned to develop a MARF due to its strong history of and continuing interest in cluster development. GCCA's partner, the P80 Foundation, leverages their investments from the world's eighty largest pension funds, with billions committed to cleantech investment. Washington State government, business, and finance leaders could engage with GCCA and Corymbus to determine whether developing a MARF would be a good fit for the state economy and what the next steps would be. Through this innovative finance tool, Washington could increase infrastructure investment in the grid and grow its grid modernization cluster, harnessing global capital to create local jobs.

## Create and Adopt Industry Standards

Industry standards are essential to the wide adoption and deployment of any technology. Washington's grid modernization and smart grid pilot projects experienced challenges integrating new components into existing grid structures due to a lack of standardization among technology components. Interoperability of the components was challenging; various system components (especially communication capabilities) were not interoperable due to different versions of rapidly evolving communication standards. Other barriers include diverse operational characteristics and different utility interconnection protocols. Leaders in Washington helped launch the Modular Energy Storage Architecture (MESA) Standards Alliance, which seeks to address the lack of industry-wide standards for energy storage products. State leaders could use this effort as a model to create grid modernization technology standards to increase deployment of the technology.



**Modular Energy Storage Architecture (MESA) Standards**

MESA is an “open, non-proprietary set of specifications and standards” for energy storage. MESA standards endeavor to address the challenges created by a diverse range of products in the energy storage market through greater system interoperability, safety, affordability, and scalability. It is anticipated that standardization throughout the energy storage industry will reduce costs, increase customer choice, expand markets, and encourage innovation.

Washington utilities and energy storage manufacturers were instrumental in establishing the MESA Standards Alliance to address the main barriers to growth. Washington’s leaders in the grid modernization industry can look to expand on the MESA Standards Alliance’s initial work to include more products beyond energy storage. If Washington’s grid modernization companies are part of this effort and are early adopters of the standards, they will be ideally positioned to compete in the U.S. marketplace.

**Define Utilities’ Outcome-Based Objectives for Grid Modernization**

Washington State IOUs currently earn revenue on capital investments, which incentivizes them to do capital-heavy projects. This model does not lend itself to the kind of innovation and investment needed to modernize the grid. More so than ever, utilities have increasingly complex electricity delivery systems, greater access to data, and a wider range of technologies that can enable a reliable and resilient grid. With this trend, regulators are changing the way they define success for a utility: instead of rewarding utilities with recovery of reasonable and prudently incurred costs, utilities are encouraged to achieve specific outcomes that are important to customers, regulators, and the utility. This enables utilities to incorporate right-fit technologies or make other investments to achieve pre-determined outcomes. New York has embarked on an initiative to adopt outcome-based regulations that enable them to achieve outcomes that range from wholesale and retail goals to social objectives.

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### **New York’s Reforming the Energy Vision (REV) Model**

Launched in 2014 by Governor Cuomo, New York’s REV is a policy and regulatory initiative that aims to modernize and decarbonize the state’s electric power system. By 2030, REV seeks to reduce greenhouse gas emissions by 40 percent from 1990 levels, generate 50 percent electricity from renewables, and reduce building energy consumption by 23 percent from 2012 levels. In addition to creating an active and responsive grid, REV seeks to enhance efficient, reliable power supply by restructuring the utility revenue model; utilities will be compensated for providing market or platform services as opposed to spending on capital equipment. Earning adjustment mechanisms (EAMs) are intended to help transition ratemaking by rewarding positive outcomes in five performance areas: peak load reduction, energy efficiency, customer engagement, affordability, and streamlined interconnection. The Public Service Commission defined specific metrics for each performance area. EAMs will be regularly updated and eventually removed as markets mature. Regulators noted that some performance areas are outside of the control of distribution utilities and accommodated this by linking these performance areas with financial rewards but not penalties.

Washington could use New York’s REV model as a basis for embarking on its own evaluation of shifting the utility model in the state. The first step to creating outcome-based metrics is data collection. Next steps for utilities and stakeholders include setting targets over lengths of time, developing reward/penalty schemes, seeking approval from the Utilities and Transportation Commission, and establishing regular times to revisit goals. Launching appropriate pilot projects to test assumptions that form the basis of the outcome-based metrics will be critical to developing a model that all stakeholders can support.



## Additional Ways To Bolster an In-State Market for Grid Modernization Products

Industry leaders recommend several other ways Washington's IOUs and Utilities and Transportation Commission could expand the in-state market for grid modernization products.

- **Transition from integrated resource planning to integrated system planning:** Effectively planning for grid optimization, distributed resource options, and T&D upgrades when considering utility capital spending.
- **Integration of advanced metering infrastructure:** Continuing to invest in assets that give customers more choice and better information.
- **Deeper demand-side resource engagement:** Accelerating demand response in the state.
- **Enhanced cost recovery by utilities:** Reducing risk for utilities by pre-approving investments for grid modernization and accelerating cost recovery in limited situations.
- **Flexible evaluation of capital investments by utilities:** Encouraging innovation by utilities by allowing greater leeway in evaluating the economics of capital investments.



# Call to Action

Washington's emerging grid modernization cluster is a solid 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 Washington manufacture products within the state, foster entrepreneurship for technological advances, fund innovation with accessible capital, equip workers with needed skills, and grow demand for grid modernization technology.

**Washington has the opportunity to support an annual average of over 13,800 direct, indirect, and induced jobs in the grid modernization sector from 2017 through 2030.**

The grid modernization cluster is well positioned to serve a significant portion of national demand, especially considering its proximity to the Pacific Northwest technology markets and states committed to increasing their renewable energy use.

To fully realize Washington's potential in the grid modernization 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 Washington's competitive advantage in the industry and creating quality jobs. 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 grid modernization sector. Continued collaboration is necessary to address barriers to cluster growth and demonstrate that the state is ripe for investment.

Washington'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 Washington by organizing working groups and conducting deeper analyses, such as identifying supply chain

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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 21st 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.



Washington State Capitol Legislative Building



## **Growing the Grid Modernization Cluster, Growing Jobs**

- Facilitate Formalization of a Grid Modernization Public-Private Partnership
- Strengthen and Expand the State's Foreign Direct Investment Strategy
- Provide Tax Incentives to Attract and Grow New Grid Modernization Businesses and Fill Supply Chain Gaps
- Establish a State Fund of Funds to Stimulate the Investment Environment
- Improve Washington's Equity Crowdfunding Law
- Support Access to University and National Lab Resources for Businesses
- Promote the Growth of Specialized Advanced Energy Incubators and Accelerators
- Leverage Philanthropic Funding Via a Foundation Liaison
- Promote Private-Sector Training
- Expand Career-Connected Learning
- Encourage High School Partnerships with Community and Technical Colleges
- Educate and Inform Policymakers on the Benefits of Grid Modernization
- Encourage Utility Innovation
- Explore Novel Funding Mechanisms for Demonstration and Infrastructure Projects
- Create and Adopt Industry Standards
- Define Utilities' Outcome-Based Objectives for Grid Modernization



# Appendix 1: Capitalizing on Global Growth in Smart Manufacturing

Manufacturing and energy go hand in hand. Industrial end uses account for almost 30 percent of Washington’s annual primary energy consumption, and the story is similar around the nation. The industrial sector thus provides substantial capacity for reductions in energy use and related emissions where system inefficiencies can be mitigated. As manufacturers around the world increasingly adopt smart technologies and develop an “industrial internet of things” (IIoT) to improve safety, quality control, and logistical efficiency, some of those technologies may simultaneously improve energy efficiency as well. Because many of these smart manufacturing technologies overlap with grid modernization technologies, Washington is well positioned to become a leader in the smart manufacturing sector.

## Smart Manufacturing

- Optimizes energy use, manufacturing efficiencies, and energy productivity
- Decreases costs of production by up to 20 percent
- Saves the United States \$7-15 billion per year in energy costs

# What is Smart Manufacturing?

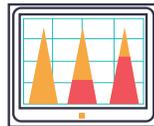
Smart manufacturing describes the next generation of data-driven manufacturing solutions. Sometimes referred to as the “fourth industrial revolution,” it capitalizes on real-time sensing, controls, and modeling to improve safety, optimize plant performance, and increase energy and resource efficiency. Because smart manufacturing depends on the same types of feedback networks that comprise the modern electrical grid, many smart manufacturing technologies overlap with grid modernization technologies, such as sensors, logic controllers, motion controllers, machine learning algorithms, and IIoT software platforms. However, the smart manufacturing sector also includes technologies like computer-aided design, advanced robotics, and additive manufacturing.

## Types of Smart Manufacturing Products



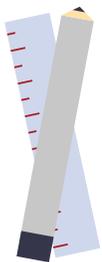
### Advanced Sensing and Instrumentation

- Smart sensors
- Pervasive sensing
- Distributed intelligent systems



### Process monitoring, control, and optimization

- Programmable logic control
- Logic, sequence, and motion controllers
- Optimization and machine learning
- Intelligent motors
- Advanced robotics for assembly
- Additive manufacturing (3D-printing)



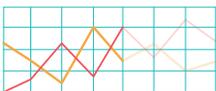
### Advanced hardware and software platforms

- IIoT software platforms
- User-friendly software for tracking, assembly, accounting
- Generative design
- Computer-aided design (CAD)



### Visualization, Informatics, & Digital Manufacturing Products

- Integrated information systems
- Manufacturing big data and analytics



### Real-time and predictive modeling and simulation technologies



## Market Demand for Smart Manufacturing Technologies

The global market for smart manufacturing technologies has experienced dramatic growth over the last decade and is forecast to experience similar growth in the next few years. PwC predicts business investments in the IIoT market will experience a compound annual growth rate of over 23 percent, growing from \$215 billion in 2015 to \$832 billion in 2020. Washington could position itself as a key player in the market for IIoT and smart manufacturing technologies in order to take advantage of this economic opportunity.

### Clean Energy Smart Manufacturing Innovation Institute (CESMII)

The Clean Energy Smart Manufacturing Innovation Institute (CESMII), part of the Manufacturing USA network, launched in early 2017 with support from the DOE, state, and local governments, leading academic institutions and industry partners. CESMII's goals include increasing energy efficiencies in manufacturing, substantially reducing the cost and risk of deploying smart manufacturing systems, and improving workforce training in smart manufacturing to grow American manufacturing competitiveness. The Institute, led by the Smart Manufacturing Leadership Coalition, will manage five regional manufacturing centers to promote the development and adoption of new smart manufacturing technologies. PNNL will operate one of these regional centers in Richland, where it will partner with UW and WSU to fast-track the development of smart manufacturing technologies.

### Global Industrial Internet of Things business investment projected to reach

**\$832 billion**  
by 2020.

## Washington's Competitive Advantage in Smart Manufacturing

Washington has already begun to establish itself as a potential leader in the smart manufacturing sector. UW and WSU both house advanced manufacturing research and innovation centers, the Collaborative Center for Advanced Manufacturing and Advanced Manufacturing Lab, respectively. PNNL is slated to lead the Northwest Regional Manufacturing Center for Manufacturing USA's Clean Energy Smart Manufacturing Innovation Institute (CESMII) with combined support from the state, DOE, and industry funders. The Center for Advanced Manufacturing Puget Sound (CAMPS) is a valuable resource for small- and medium-sized manufacturers to learn about innovative technologies, service providers, supply chain development, and workforce training. CAMPS also works to secure grant funding to explore solutions to common industry challenges.

Additionally, many of Washington's existing industries overlap to varying degrees with the advanced manufacturing sector. Major companies, including Microsoft, Adobe, and Amazon, anchor the state's growing software industry, and hardware companies like Schweitzer Engineering Laboratories have established themselves as IoT market leaders (particularly in the energy industry). Finally, aerospace and defense companies—such as Boeing, Aerojet Rocketdyne, and SpaceX—are increasingly investing in advanced manufacturing equipment and techniques.

Moreover, Washington State’s leaders and citizens have indicated a willingness to embrace energy efficiency as an important resource planning tool. The state enacted the Energy Independence Act that requires large utilities to undertake cost-effective energy conservation. Bonneville Power Administration’s Energy Smart Industrial Program and commitment to energy efficiency as a means to meeting future electricity demands bolster this existing state-wide focus on energy efficiency.

## **Washington’s Strengths, Weaknesses, Opportunities, and Threats in the Smart Manufacturing Sector**

<b>STRENGTHS</b>	<b>WEAKNESSES</b>
<ul style="list-style-type: none"> <li>Established IoT industry</li> <li>Established software industry</li> <li>Existing smart manufacturing research and innovation centers at UW and WSU</li> <li>Federal investment through PNNL</li> <li>Strong investment from aerospace industry</li> <li>State focus on energy efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Lack of an Industrial Assessment Center</li> <li>Low-cost electricity</li> <li>Limited private venture capital and angel investor funding</li> <li>Reliance on aerospace and defense industries risks a lack of market diversification in manufacturing</li> </ul>
<b>OPPORTUNITIES</b>	<b>THREATS</b>
<ul style="list-style-type: none"> <li>Growing U.S. and global market for smart manufacturing</li> <li>Aerospace industry could benefit from innovation</li> <li>Substantial job growth potential in smart manufacturing cluster</li> </ul>	<ul style="list-style-type: none"> <li>West Coast innovation in California could crowd investment</li> <li>Federal funding could be shifted by new administration</li> </ul>



### Industrial Assessment Centers (IAC)

The University of Washington operated a federally funded IAC from 2006 to 2011. The IAC assisted small- and medium-sized manufacturing operations with system engineering, helping them identify and mitigate energy and resource inefficiencies at their facilities and facilitating about \$5 million in energy savings. IACs are re-funded by the DOE in five-year cycles and no application was submitted for a new IAC after 2011. A new program, modeled after the federal IAC program and operated by either UW or Impact Washington or a combination of both, could bolster demand for smart manufacturing products and serve as a liaison between manufacturers and the smart manufacturing sector. The program could focus on training students in using smart technology and introducing small- and medium-sized enterprises to the energy savings produced by smart technology.

## Fostering a Smart Manufacturing Cluster in Washington State

The 2017 Smart Manufacturing Summit, held in Seattle and co-hosted by Boeing and co-sponsored by Microsoft, potentially elevated Washington's position as a national leader in smart manufacturing. In order to capitalize on this momentum and ensure that Washington is well positioned as a leader in smart technologies, state leaders could consider investing in targeted programs to better align existing IoT industry assets with smart manufacturing needs. Washington's leaders could bolster the emerging smart manufacturing sector in the state by:

- Sponsoring a new industrial assessment center through UW or Impact Washington
- Ensuring full engagement of industry in smart manufacturing leadership meetings
- Funding Impact Washington to perform energy audits for high energy users and market industrial energy efficiency concepts to encourage adoption of new technology
- Expanding successful CAMPS programs statewide
- Increasing the number of maker labs and maker curriculums in high schools
- Marketing small business loan programs that are available for energy efficiency upgrades
- Improving Washington's manufacturing workforce by creating standards-based portable credentials designed for specific manufacturing sectors
- Allowing companies to fully expense investment in energy efficiency technology in year one
- Funding early adoption of smart manufacturing technologies by industry through sponsored pilot projects

By promoting smart manufacturing to in-state industries and developing its sector early, Washington could position itself as a potential global leader in a rapidly growing field.



# Appendix 2: Jobs Modeling 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 grid modernization analysis utilized IMPLAN, a proprietary model maintained by the Minnesota IMPLAN Group. Additionally, industry growth estimates and benchmarks from IBISWorld, Technavio, and BCC Research were used to generate impacts across different levels of U.S. market penetration. Grid modernization is an industry of industries and 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 grid modernization, we look at several technologies: smart meters, advanced grid-scale energy storage, high-voltage direct current (HVDC), remote terminal units (RTUs), synchrophasors, dynamic volt/volt-ampere reactive (volt/VAR), flexible alternating current transmission systems (FACTS), other smart grid transmission and distribution (T&D) technology (reclosers, fault indicators, automated switches), and Internet of Things (IoT) platforms for smart grid management.

Several supply chain scenarios are presented to identify the impacts of growing the Washington supply chain. The lowest scenario uses the current Washington economy as the model to represent the impacts of targeting direct grid modernization jobs and not developing the grid modernization supply chain. The highest scenario uses the entire U.S. economy as the model to represent the impacts of Washington having as complete of a grid modernization supply chain as the entire United States. A median scenario gives the median between the upper and lower bounds presented by the other scenarios, and is used as Washington's target jobs potential in this report.

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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 grid modernization firms locating in the Washington economy during the analysis timeline, nor do we include the construction and installation jobs associated with modernizing the grid.

## 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 Washington State and the entire United States were used.

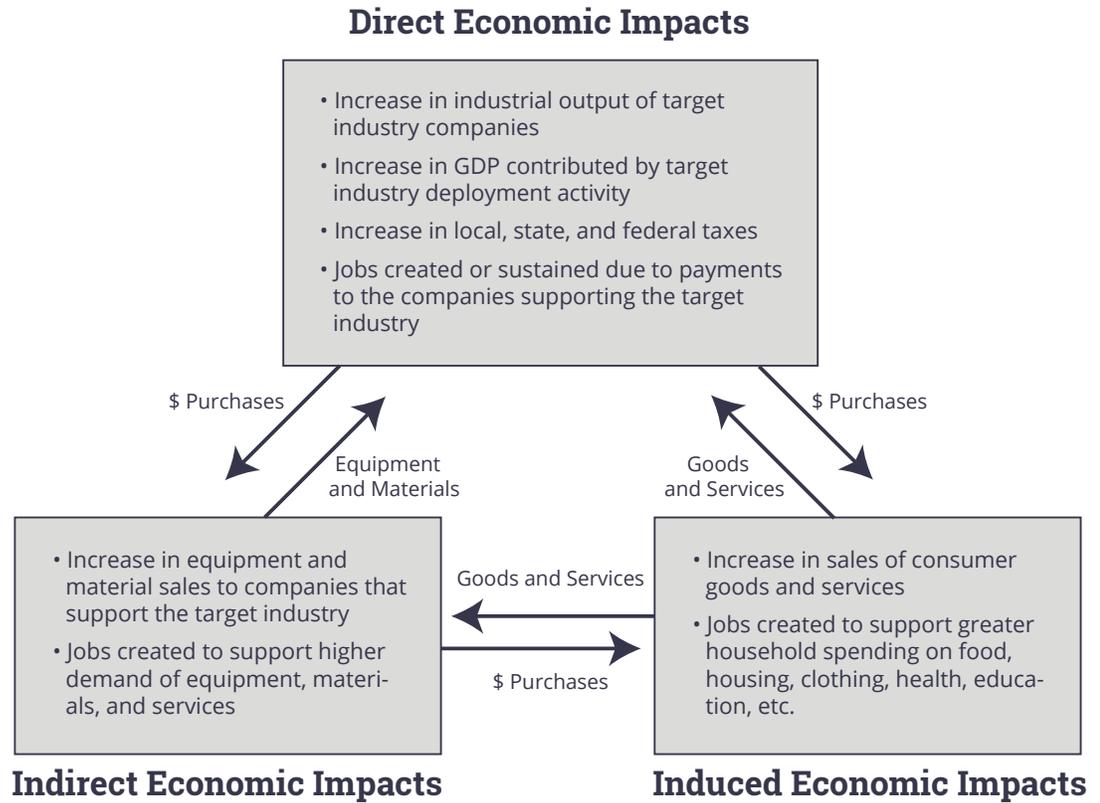
When a change of spending occurs in an economy, such as increased revenue for the grid modernization industry, spending also increases for supplying industries and the workforce. This cascading spending, or multiplier effect, can generate an economic impact that is often larger than the initial spending. 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 lattes). 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

We 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.

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## 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 grid modernization industry. As previously mentioned, there are a wide range of technologies in the grid modernization industry and our analysis specifically included smart meters, advanced grid-scale energy storage, HVDC transmission lines, RTUs, synchrophasors, dynamic volt/VAR voltage regulation systems, FACTS, other smart grid T&D technology (reclosers, fault indicators, automated switches), and IoT platforms for smart buildings, infrastructure, and grid management.

Second, a model for estimating the future demand for grid modernization technologies was needed. Estimates of market demand for grid modernization technologies were taken from BCC Research, Technavio and IBISWorld reports for specific grid modernization 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 and O\*Net OnLine. Owner income was also derived from IBISWorld, wherever possible.

Finally, the current market penetration of Washington's grid modernization industry was estimated as a function of current estimated employment in the target industries. IBISWorld's ratio for employment per unit of revenue and the current concentration of firms in Washington were applied to Technavio's and 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 being the market share of the current market leader for each technology. Impacts from improving supply chain concentration utilized both the current Washington economy, an equivalent to the current U.S. economy, and a midpoint between these two extremes. Using Washington's current economy for the first supply chain scenario would indicate that Washington maintains the status quo and attracts no new businesses to supply their grid modernization industry. Using the U.S. economy as a "U.S. Equivalent" scenario would indicate that Washington 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 Washington.

## 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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