



# Iowa Jobs Project

A Guide to Creating Advanced Energy Jobs



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# A Letter from the American Jobs Project

It's 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.<sup>1</sup> Over the last few decades, the loss of middle-income jobs in America has been due largely to the global shift in manufacturing ("tradable jobs") to emerging economies.<sup>2</sup> Of the millions of jobs lost during the recession, most were good paying, middle-class jobs.<sup>3</sup> Unfortunately, many of the jobs created during the recovery have been in low-skill, low-paying occupations.<sup>4</sup> These trends are not going to reverse themselves. 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 the then-President of China, Hu Jintao. "What keeps you up at night?" President Bush asked President Hu as an ice-breaker. As we can easily guess, what kept President Bush up at night was worry about terrorism. Hu Jintao's response was telling: what kept him up at night was, "creating 25 million new jobs a year" for his people.<sup>5</sup>

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 roadmap for 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 solutions. That demand—whether borne out of a need for diverse, reliable and clean power or to achieve energy independence from unstable regimes—creates "the mother of all markets" for local U.S. businesses to build and sell those solutions.<sup>6</sup> Strategically minded businesspeople looking at global growth projections in advanced energy demand are making major investments and reaping large revenues. In 2014, the private sector reported \$1.3

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trillion in global advanced energy revenues, the fastest growing year on record.<sup>7</sup> Advanced energy investments are now bigger than the global apparel sector and almost four times the size of the global semiconductor industry.<sup>8</sup> And jobs? Up to 16.7 million jobs are projected to be in the global advanced energy sector by 2030, almost tripling the 5.7 million people employed in the sector in 2012.<sup>9</sup> The question for the United States is: Where will those new jobs be created?

The American Jobs Project is about finding ways to make our states the answer to this question. If countries across the globe, including the U.S., are seeking technical products and solutions for our 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 U.S. residents with the skills those businesses need to build their advanced energy products?

It is true that the U.S. will not likely be able to attract back the traditional manufacturing jobs of the past; those jobs are gone—either to low-wage countries or to automation—and we have to accept the fact that they are not coming back.<sup>10</sup> But our research shows that with innovative policies and a smart focus on industrial clusters, states can become hubs of innovation and job creation in specific advanced industries that soar with a state's strengths.

The American Jobs Project gives policymakers the tools to create good-paying jobs in their states. We propose innovative solutions built upon extensive research and tailored to each state. Many are best practices, some are new, and all are centered upon 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.

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

## American Jobs Project

The American Jobs Project is a national, interdisciplinary, research-based initiative. Our team has included nearly 100 student researchers with a broad range of expertise, including law, business, engineering, and public policy. We have ongoing relationships with hundreds of on-the-ground stakeholders and are actively collaborating with university partners and industry allies.

## The Center for Global and Regional Environmental Research

The Center for Global and Regional Environmental Research (CGRER) is a state-funded institute devoted to studying and bettering our environment. The Center promotes interdisciplinary research on the many aspects of global environmental change. Areas of focus include regional effects on natural ecosystems, environments, resources, and effects on human health, culture, and social systems. CGRER awards seed grants, fosters interdisciplinary research, manages state-of-the-art research facilities, and hosts seminars and symposia. Through these activities, CGRER assists Iowa's agencies, industries, politicians, and citizens as they prepare for accelerated environmental change. The Center has more than 120 members in universities and colleges across Iowa and throughout the country. Housed in the University of Iowa's Advanced Technology Laboratory, CGRER stresses interdisciplinary involvement with members in 17 different departments. University of Iowa professors, Jerry Schnoor and Greg Carmichael, co-founded and co-direct the center. The State Board of Regents established CGRER in 1990, and the Center continues to receive funding from a utility trust fund, as mandated by the State of Iowa's 1990 Energy Efficiency Act.

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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 sector—and to do so at the state, not the federal level. Policymakers who leverage the unique strategic advantages of their state to grow localized clusters of interconnected companies and institutions are poised to create quality jobs.

A strong advanced energy economy has already taken hold in Iowa and the sector is poised for growth. In 2014, the Iowa Partnership for Economic Progress published a yearlong study to analyze the state's economy and chart a strategic direction for future development. The study concluded that the renewable energy industry is one of the state's leading economic drivers.<sup>11</sup> The report outlines two key elements of future economic development in Iowa: (1) "geographically localized concentrations of firms in related sectors" that engage in business with each other and (2) support for technology and innovation.<sup>12</sup>

Wind power currently dominates the state's advanced energy industry. A range of businesses have set up shop in Iowa to take advantage of existing wind resources, the state's competitive business climate, and its strong manufacturing culture. Iowa-based companies contribute to the sector throughout the entire supply chain, including engineering and research, manufacturing and assembly, installation, sales, and distribution, as well as finance, legal, and other professional services. This type of cluster-based development enables logistical cost savings and efficiencies that give firms a competitive advantage in national and global clean energy technology markets.



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Iowa has started exploring solar energy options. A cluster-based approach could leverage the state's substantial existing solar resources and create lucrative job opportunities for residents. Given Iowa's proven success in cluster-based advanced energy development, the state could galvanize these strengths to enhance existing and emerging advanced energy industries, such as solar. Facilitating growth and development would help active energy sectors innovate, retain, and attract businesses to Iowa, and create good-paying jobs in the state.

Moving forward, the advanced energy industry will contribute to the Iowa's overall economic vitality. Greater investment in energy efficiency and renewable energy could propel a 10 percent growth in advanced energy jobs by 2020.<sup>13</sup> By encouraging technological innovation in the wind and solar sectors, the state will be able to satisfy the demand for advanced energy products from a strong in-state market, and become a key player in regional, national, and international markets. To facilitate growth, Iowa policymakers could enact policies that increase demand for wind and solar in the state and help Iowa businesses remain competitive. Indeed, with the right policies, Iowa's wind and solar industries can support up to 18,000 jobs annually between 2016 and 2030.

This project serves as a research-based roadmap for state and local leaders who seek to develop smart policies focused on leveraging Iowa's resources to create skilled, good-paying jobs. The number of jobs created is highly dependent on action taken by state and local policy makers. Concerted effort at the state and local levels can create an environment that attracts advanced energy businesses to take root in Iowa. Employees in the advanced energy sector will spend their earnings in the local economy at grocery stores and restaurants, and those local establishments will need to hire more employees to satisfy demand. This creates a multiplier effect throughout Iowa's economy, where a single dollar spent in a community circulates through local businesses and their employees numerous times.

## **Summary of Policy Recommendations**

The analysis presented in this report culminates in four thematic sets of recommendations for Iowa's leaders. Each set of recommendations identifies opportunities for barrier removal and future growth in the solar and wind sectors. While the recommendations are intended to be complementary and would be powerful if adopted as a package, each can also be viewed as a stand-alone option. These recommendations chart a course for Iowa policymakers to create and enhance jobs in the advanced energy sector.

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## Wind Technology

***Require Integrated Resource Planning and Collaboration:***

Fostering collaboration of investor-owned utilities, municipal utilities, rural cooperatives, and community stakeholders by implementing Integrated Resource Plans (IRPs). IRPs encourage energy providers to meet forecasted annual peak and energy demand through a combination of supply-side and demand-side resources that guide future generation, energy efficiency, transmission, and distribution investments.

***Attract Wind Turbine Assembly Companies:*** Expanding Iowa's role in the wind supply chain by drawing additional turbine manufacturers to the state through the development of various incentive programs.

***Modernize Transport Pathways to Improve Wind Turbine Export:***

Removing key transportation barriers by optimizing roadways and waterways in Iowa for wind transportation.

***Encourage Distributed Wind Turbine Deployment:*** Expanding the production of distributed wind energy into the local market through distributed generation carve-outs, a small wind tax credit, and an anemometer loan program.

***Encourage Foreign Direct Investment:*** Drawing in foreign companies to boost wind investments within Iowa. Iowa can utilize its tremendous access to waterways to export wind products.

## Solar Technology

***Enable PACE Financing:*** Mitigating the high upfront costs of solar for customers by allowing property owners to finance investments in solar panels with a loan that is repaid through their property tax bill.

***Establish Refundable Tax Credits for Public Entities:*** Allowing public entities such as schools, hospitals, municipalities, and rural cooperatives to directly benefit from solar investment and production tax credits.

***Improve Solar Net Metering:*** Ensuring that all Iowans have equal access to solar energy development opportunities by extending the net metering requirement to municipalities and rural cooperatives, increasing the net metering cap or instituting a capacity limit, and allowing aggregate and virtual net metering.

***Enact Legislation Establishing Third-party Solar Financing:***

Creating policy certainty and market stability by codifying the Iowa Supreme Court's holding allowing third-party solar within the state.



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**Enable Local Communities to Benefit From Community Shared Solar Projects:** Allowing customers to pool resources and invest in a single shared renewable energy system, especially in areas without adequate sunlight for individual solar systems and for customers based in multi-unit buildings.

## Innovation Ecosystem and Access to Capital

**Allow Capital Gains Tax Exemption for Early-stage Investors:** Allowing investors to fully realize all capital gains from investments in early-stage solar and wind companies serves as an incentive for investment.

**Establish a Matching Grant Program for Awardees that Receive Federal Funding:** Assisting businesses moving to the commercialization stages of their businesses by matching federal incentive programs. Iowa can create efficiencies in administering the grant program by coupling its initiatives with federal programs.

**Create an Equity Crowdfunding Hub:** Building venture capital investment in Iowa by allowing larger numbers of investors to contribute small amounts through an online investment platform.

## Workforce Development

**Create Tax Credits to Promote Employment and Training Opportunities in Advanced Energy:** Establishing a system that provides tax credits to employers who employ qualified workers and who offer specialized training to workers.

**Encourage Apprenticeships in the Wind and Solar Industry:** Establishing a specific tax credit to incentivize apprenticeships that promote industry-recognized certifications.

**Establish a Renewable Energy Education Strategic Fund (REESF) for Targeted Curriculum Enhancement and Pre-Employment Training:** Creating clear pathways for young workers to pursue careers in renewable energy. A targeted curriculum can be used by educational institutions to train workers to meet the developing needs of local businesses, making the candidates much more attractive for future employment.

**Upgrade Worker Skills Through Stackable Credentials:** Generating a stackable credential system whereby Iowans can continually develop their technical skills to meet evolving workplace needs.

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# Chapter 1: Introduction

The American Jobs Project aims to spur job creation in the advanced energy sector by identifying innovative and state-specific policy and technology roadmaps. This national initiative takes advantage of the emerging global demand for advanced energy products and services. The American Jobs Project team analyzed the advanced energy economy in Iowa and designed recommendations specifically tailored to the state's strengths. These recommendations were informed by extensive research and at least 40 interviews with local stakeholders and experts.

This report identifies opportunities to boost growth in two economic clusters in the advanced energy sector that leverage the state's legacy industries and current investment activities. State and local leaders who seek to leverage the state's resources to create skilled, good-paying jobs can use this report as a foundation for action.

## Market Opportunity

Demand for advanced energy has soared in recent years and is poised for continued growth. Since 2004, new investment in the advanced energy sector has totaled \$2.32 trillion worldwide.<sup>14</sup> In the United States alone, over \$386 billion was invested in advanced energy between 2007 and 2014; more than \$51 billion was invested in 2014.<sup>15</sup> In nationwide polls, Americans increasingly support renewables over other forms of energy, and demand for renewable energy is likely to continue to grow.<sup>16</sup> By 2030, states will need to significantly reduce pollution from power plants.<sup>17</sup> The best way to meet those targets is from a combination of investing in advanced energy technology, utilizing renewable energy sources, and reducing demand through energy efficiency. Projections show that renewable energy will be responsible for the vast majority of new generation (69-74 percent) between now and 2030.<sup>18</sup> These trends point to a clear market signal: demand for advanced energy will continue to grow over the next fifteen years.<sup>19</sup>

## Economic Clusters

*"Clusters are geographic concentrations of interconnected companies and institutions in a particular field."*

– Michael Porter, *Clusters and the New Economics of Competition*<sup>20</sup>

Economic clusters encompass a variety of linked industries and institutions—including suppliers of specialized services,

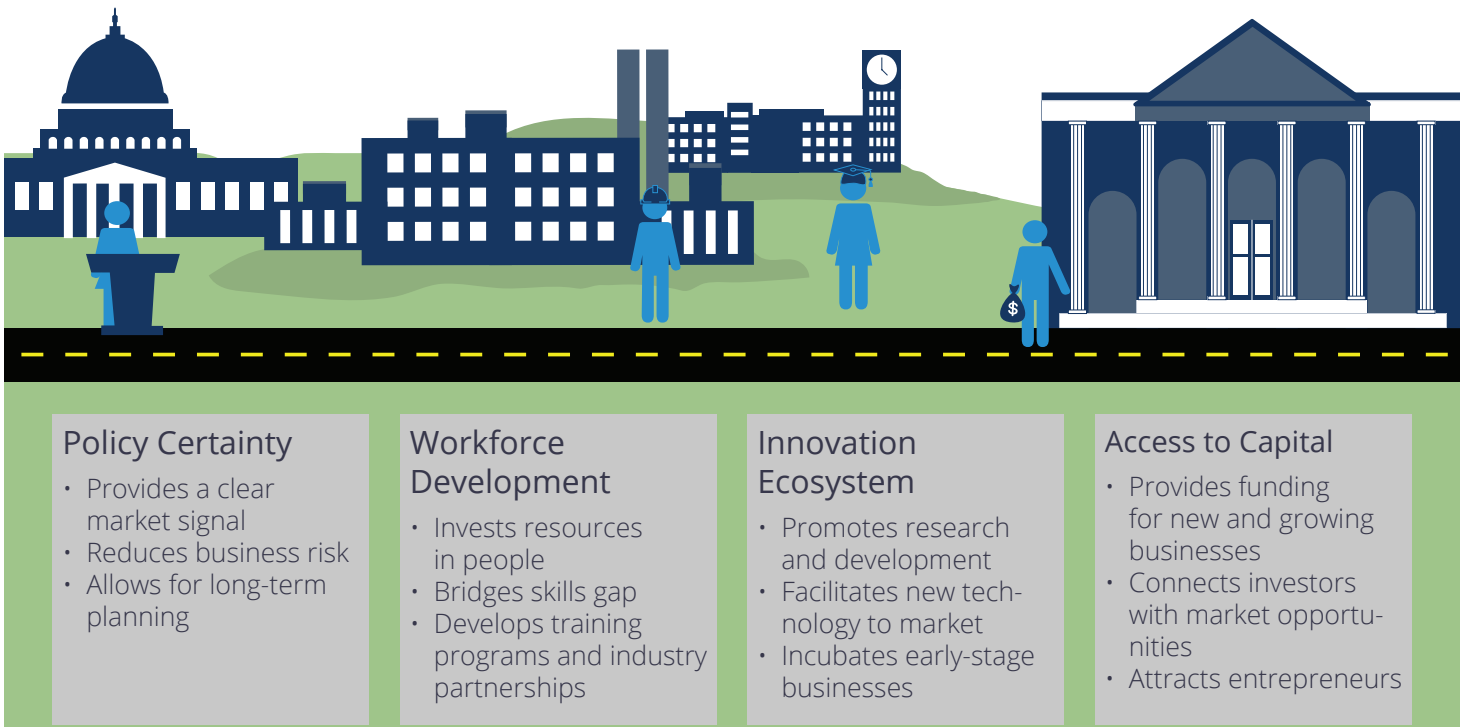


machinery, and infrastructure—which form a supply chain.<sup>21</sup> Clusters also extend to manufacturers of complementary products and to industries with related skills and technologies. By placing themselves in close proximity to industry allies, companies benefit from each other’s unique expertise and skilled workers.<sup>22</sup> Companies in a cluster enjoy closer access to specialized skills and information, which helps increase productivity and efficiency.<sup>23</sup>

Geographic proximity and repeated exchanges of information help foster an environment of coordination and cooperation among companies and institutions. Business clusters are shown to boost productivity in participating companies, fuel innovation in the field, and facilitate the commercialization of this innovation by increasing communication, logistical support, and overall interaction between cluster entities.<sup>24</sup> Clusters also help build a strong foundation for creating and retaining employment opportunities.

## 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.





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## Iowa's Energy Profile

Iowa's energy sector relies heavily on imported fuel. The state ranks twenty-ninth nationwide in electricity production<sup>25</sup> and fifth in energy consumption per capita.<sup>26</sup> In order to meet energy needs, Iowa imports all of its coal and natural gas.<sup>27</sup> As of November 2015, 63 percent of Iowa's energy comes from coal-fired plants;<sup>28</sup> however, none of that coal comes from in-state production.<sup>29</sup> Wind is the second-largest source of power for Iowa,<sup>30</sup> accounting for about 36 percent of total electricity generation at the end of 2015.<sup>31</sup> Natural gas represents 5.2 percent of the state's electricity, while remaining energy needs are met by a single nuclear plant, which provides approximately 9 percent of net generation.<sup>32</sup> In 2012 alone, Iowa utilities spent over \$590 million on coal imports.<sup>33</sup> These expenditures represent a steady loss of capital that could otherwise be spent within the state.

### Advanced Energy Development

In 1983, the state set a major precedent for the use of clean energy by establishing the first renewable portfolio standard (RPS) in the United States.<sup>34</sup> Iowa's Alternate Energy Production Law required its two investor-owned utilities (IOUs) to own or contract a minimum of 105 MW of generating capacity from renewable sources, including wind, solar photovoltaics, solar thermal electric, biomass, hydroelectric, landfill gas, municipal solid waste, and anaerobic digestion.<sup>35</sup> Today, Iowa ranks first in the nation in the percentage of wind power that makes up in-state electricity generation.<sup>36</sup> Large wind farms in Iowa have experienced substantial growth in recent years due to good wind power potential, the federal wind production tax credit, and leadership from IOUs and the state government. The state offers a variety of financial incentives for wind and solar generation, from property and sales tax exemptions to production tax credits.

### Energy Development Future

Wind and solar energy generation have the potential to grow in Iowa. If harnessed, rooftop photovoltaics alone could account for 20 percent of Iowa's electricity needs.<sup>37</sup> Wind energy has the potential to meet total generation forty-five times over, indicating a substantial opportunity to expand.<sup>38</sup> Meeting Iowa's evolving energy needs with solar and wind technologies manufactured within the state offers distinct economic benefits. At least five Iowa coal plants will either switch to gas or shut down as a result of litigation.<sup>39</sup> Since 2012, forty-one coal plants within the Midwest have anticipated closing.<sup>40</sup> If these facilities are replaced with natural gas they will only exacerbate Iowa's fuel import spending.



Alternatively, Iowa could utilize renewable resources and keep the money circulating within the state.

## **Jobs Potential**

Maximizing job creation in Iowa is highly dependent on local action. An original equipment manufacturer (OEM) and its local suppliers employ workers from their community. Those employees spend most of their earnings at businesses in the local economy, such as grocery stores and restaurants. Local businesses also hire employees from within the community, who spend their earnings at other local establishments. This results in a multiplier effect where a single dollar of spending in a community circulates through local businesses and their employees numerous times. Thus, recruiting advanced energy OEMs and their suppliers to a community can result in increases in local spending that are many times greater than the actual expenses of those companies. By implementing strategic and well-researched policies, Iowa's wind and solar industries can support up to 18,000 jobs annually between 2016 and 2030.

## **Report Structure**

This report is divided into four complementary chapters, each covering key elements of building advanced energy economic clusters in wind and solar. Chapters 2 and 3 conduct a supply chain analysis for Iowa's wind and solar clusters, respectively. This analysis culminates in an assessment of Iowa's potential for advanced energy jobs within each cluster, as well as specific policy recommendations tailored to Iowa's needs. Chapter 4 analyzes Iowa's innovation ecosystem and access to capital, both crucial elements of sector development, and provides recommendations for further developing the state's innovation pipeline. Chapter 5 provides recommendations for workforce development programs and policies to prepare Iowans for advanced energy jobs. The conclusion of the report summarizes key themes and the Appendix summarizes jobs modeling methodology.





# Chapter 2: Wind Technology

## Strengths, Weaknesses, Opportunities, and Threats for Wind Technology in Iowa

Iowa's policymakers will play a key role in the future of the state's wind energy industry. By building on the state's existing success in wind energy manufacturing, the state can expand into new markets and export products to meet regional demand for wind-generated energy. With policies that encourage manufacturing and export of wind turbine components, Iowa can meet the demand for wind in regional, national, and international markets while continuing to power the state with wind-generated energy.

This chapter is a guide to further expand Iowa's wind economy. After analyzing Iowa's potential for creating good-paying wind jobs, the chapter culminates in policy recommendations for future growth. These recommendations chart a course for Iowa policymakers to generate and enhance jobs in the wind manufacturing sector.



Photo Credit. Department of Energy

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> <li>• Successful original equipment manufacturer (OEM) companies</li> <li>• Highly skilled manufacturing labor base and reputable workforce training programs</li> <li>• Extensive wind turbine components supplier base</li> <li>• Existing 6,212 megawatts (MW) capacity with potential for 50-fold increase<sup>1</sup></li> <li>• Well-established research institutions and initiatives for technology development<sup>2</sup></li> <li>• Strong land-use compatibility for wind</li> <li>• Advanced rate-making procedures</li> <li>• Existing incentives for wind power generation and installation<sup>3</sup></li> <li>• Designated small wind energy zones with state-provided model language for noise and setback regulations<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Outdated and weak state Renewable Portfolio Standard (RPS)<sup>5</sup></li> <li>• Insufficient transmission line capacity and lack of access to support expansion<sup>6</sup></li> <li>• Deterioration of road, port, and rail infrastructure for large cargo and containers</li> <li>• Lack of collaboration among energy providers to take advantage of wind resources</li> </ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> <li>• Onshore wind potential with current technology estimated at 307 gigawatts (GW)<sup>7</sup></li> <li>• Nearby major wind installation states provide export potential</li> <li>• Regional demand for renewable energy</li> <li>• Potential for wind turbine installation on existing farmland (Iowa is 86 percent farmland)<sup>8</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Competitive wind industry growth in nearby states</li> <li>• Burdensome siting and permitting requirements</li> <li>• Competition from out-of-state companies innovating wind technology</li> <li>• “Brain drain,” or outmigration of well-educated Iowans to other states<sup>9</sup></li> </ul>

Transmission planning and investment is one of the greatest challenges to Iowa’s wind industry. However, most of Iowa’s transmission issues exist on the regional and federal level, not the state level. While the American Jobs Project acknowledges the need for proactive regional and federal transmission policy, we focus only on state-level policy and therefore not discuss transmission barriers in depth in this report.



## Wind-Generated Energy in Iowa

As a leader in wind-generated power and wind component manufacturing,<sup>10</sup> Iowa is well-positioned to grow the in-state market and export related products and services to neighboring states. With supportive policies and strong winds, the Hawkeye State has been able to meet nearly 30 percent of its electricity demand with wind power.<sup>11,12</sup> This is the largest ratio of wind to total electricity generated in the nation.<sup>13</sup> Iowa currently ranks second in the country for net electricity generation for wind—only Texas ranks higher.<sup>14</sup> In 2014, Iowa installed an additional 511 MW of utility-scale wind, increasing the state-wide capacity to 5,688 MW.<sup>15</sup> At the end of 2015, Iowa had a total of 6,212 MW of installed wind capacity.<sup>16</sup>

Despite Iowa's existing wind zones, there remains considerable untapped wind energy potential in the state. Estimates suggest that 75 percent of Iowa's landmass is compatible with wind energy development, with the potential to generate 307 GW of power using current wind technology at 110-meter hub height.<sup>17,18</sup> The Department of Energy projects that wind-generated energy could supply 40 percent of Iowa's total electricity demand by 2020.<sup>19</sup>

The wind industry provides significant economic benefits for Iowans, generating more than 6,000 jobs in operations and maintenance, construction, manufacturing, and support sectors.<sup>20</sup> Iowa farmers received more than \$17 million in annual lease payments from wind developers. This amount could triple by 2030.<sup>21</sup>

Private companies have also found ways to capitalize on Iowa's existing wind resources and swathes of open land. For example, several technology companies—including Google and Facebook—have constructed energy-intensive data centers in Iowa. Given the large size of these facilities, the relatively low cost of land in Iowa is a strong financial incentive. For many companies, however, tapping into the state's wind-generation capacity to power these data centers is part of a broader corporate commitment to renewable energy.<sup>22</sup>

## Wind Market Trends

### Rising Demand for Wind Energy

Between 2004 to 2013, global investment in wind power grew from \$14 billion to \$80 billion.<sup>23</sup> Total global installed wind capacity currently stands at 370 GW, which covers nearly 5 percent of electricity demand worldwide.<sup>24</sup> Additionally, 2014 brought a

record growth rate in global installations: the 50 GW of added capacity surpassed the 35.6 GW installed in 2013 and 45 GW installed in 2012.<sup>25</sup>

National demand for wind power tripled from 2008 to 2013, while large-scale wind installations increased 300 percent in capacity from 2013 to 2014.<sup>26,27</sup> In 2014, 24 percent of all new electric generating capacity came from wind power.<sup>28</sup> The number of total wind installations increased by 77 percent between 2014 and 2015, which added another 8,598 MW of capacity. All together, installed wind capacity in the United States totals 74,472 MW.<sup>29</sup> Growth in the domestic wind sector is projected to continue: forecasts estimate that installed wind capacity in the United States will likely triple between now and 2030 (see Figure 1).<sup>30</sup>

The distributed wind market, in particular, also has significant growth potential. As a result of the 74,000 distributed wind turbines installed across the country, onshore distributed wind capacity in the United States totaled 906 MW in 2014.<sup>31</sup> While this is a promising start, the distributed wind market has substantial room for growth--the installed capacity of distributed wind in the United States could reach 1,000 GW by 2030.<sup>32</sup>

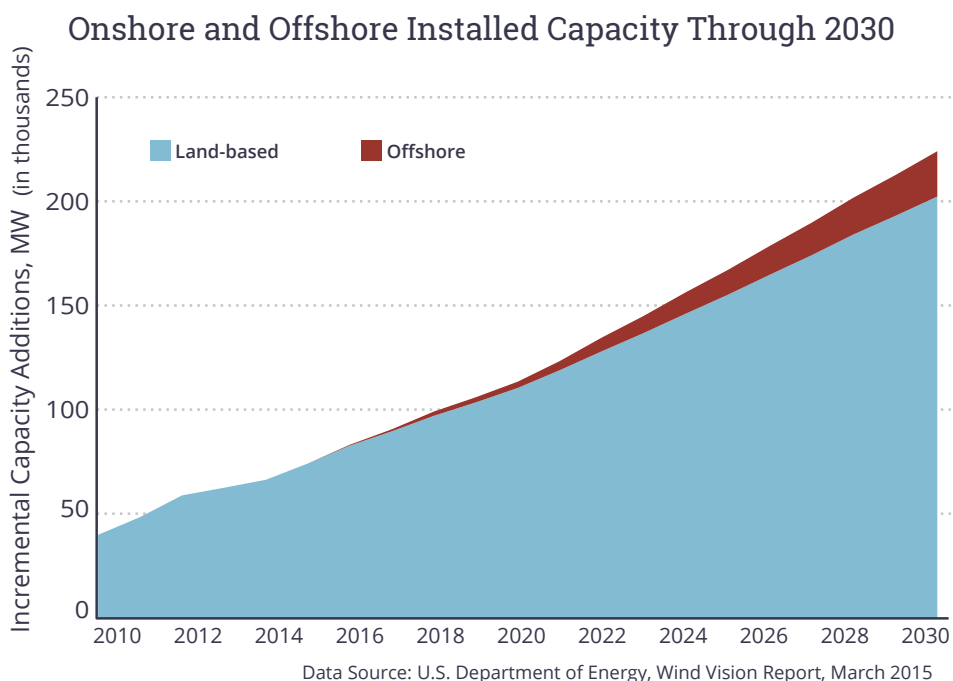


Figure 1. Installed capacity for onshore wind will reach 200 GW by 2030

## Distributed Wind Systems

Distributed wind systems include power-generating technologies that produce electric power close to the site of consumption. These technologies can be either off-grid—meaning they only serve the facility they are located on—or connected to the grid, where the majority of consumption still occurs on site.<sup>33</sup> However, distributed wind is not sent to substations for distribution to distant users. Distributed wind systems can range in size from a 10-kilowatt (kW) turbine used on a farm to a several megawatt (MW) turbine used at a university.<sup>34</sup>

## Small, Medium, and Large Wind Systems

According to NREL, wind turbines can be classified as small, medium, and large. Small turbines are those up to 100-kilowatts, while mid-size turbines are those that range from 101-kilowatts to 1-megawatt. Any turbine over 1-megawatt is considered a large turbine.<sup>35</sup>



## Falling Cost of Wind Energy

### What is Levelized Cost of Electricity?

The levelized cost of electricity (LCOE) is a summary measure of the cost of energy-generating technologies. The LCOE represents the per-kilowatt-hour cost of building and operating a generating plant based on the plant's assumed lifespan and utilization level. To calculate the LCOE, a variety of factors and inputs are assessed, including capital costs, fuel costs, operation and maintenance costs, and financing costs.<sup>36</sup> LCOE is often reported in dollars per kilowatt hour, which allows utilities or policymakers to compare costs of installing a wind power system to other generation sources, such as a coal-fired power plant. Wind technologies have no fuel costs for generation and relatively low variable operations and maintenance costs, so the LCOE is determined mostly by capital and financing costs.<sup>37</sup>

Costs for wind-generated energy will continue to fall as technology develops and global investments increase. Most studies estimate a 20 to 30 percent decrease in onshore wind's LCOE between 2010 and 2030.<sup>38</sup> Indeed, this trend is already apparent—wind power costs fell by more than one third between 2008 and 2015.<sup>39</sup> As a result of increased design and production scale, improved operations, and growing global investment, the national average cost of onshore wind power has dipped to \$0.05 per kilowatt hour (kWh).<sup>40</sup> The price of wind-generated energy in Iowa is substantially lower than the national average, even without federal tax subsidies.<sup>41</sup> The Midwest also has a regional advantage of lower costs due to greater resource availability.<sup>42</sup>



Photo Credit. (Left) janie.hernandez55 / Foter / CC BY  
(Right) Ad Meskens / Wikimedia Commons

# Anatomy of a Wind Turbine

## BLADES

Onshore wind turbine blades are 50 meters long, nearly as tall as an 15-story building. Due to massive size and weight, turbine blades are difficult to transport.

*Future Innovation:* Lighter blade materials such as carbon fiber composites could increase turbine efficiency and ease transport.

## NACELLE/DRIVETRAIN

The nacelle sits atop the tower and is connected to the rotor. The nacelle's fiberglass composite shell protects components, such as the drivetrain, from the elements. The drivetrain includes all of the components that contribute to turning mechanical energy into electrical energy, including the main shaft, gearbox, and generator.

*Future Innovation:* Gearless drivetrain technology might decrease the frequency of costly maintenance repairs.

Rotor

Low-speed shaft

Pitch system

Gear box

Brake

Generator

## TOWER

The tower is the largest, heaviest wind turbine component and is generally composed of three or four joined steel tube subsections that raise the rotor to the height of strong winds. Modern towers are between 80 to 100 meters tall and weigh about 200 tons, as much as a Boeing 747 loaded with six Ford F150s.





## Iowa's Wind Industry: A Strong Foundation for Growth

### Strengths

Iowa is a national leader in the wind manufacturing industry, with more than 15 percent of all manufacturing facilities in the country located in the Hawkeye State.<sup>43</sup> The state also houses a robust and active wind energy supply chain that includes seventy five companies supporting the production of all major wind turbine components.<sup>44,45</sup>

Additionally, geographic proximity to other markets and multi-modal transport systems enable manufacturers to ship and receive turbine components.<sup>46</sup> The Mississippi and Missouri rivers border the state and provide a valuable shipping asset for transporting large components into and out of Iowa.<sup>47</sup> Turbine manufacturers have developed in strategic clusters in order to capitalize on these logistical and cost-saving assets, increase supply chain efficiencies, and produce high-quality products at competitive prices.<sup>48</sup> Wind industry clusters have emerged in Des Moines, Cedar Rapids, and Iowa City.

Distribution of Wind Farms and Wind Manufacturing Facilities in Iowa.<sup>49</sup>

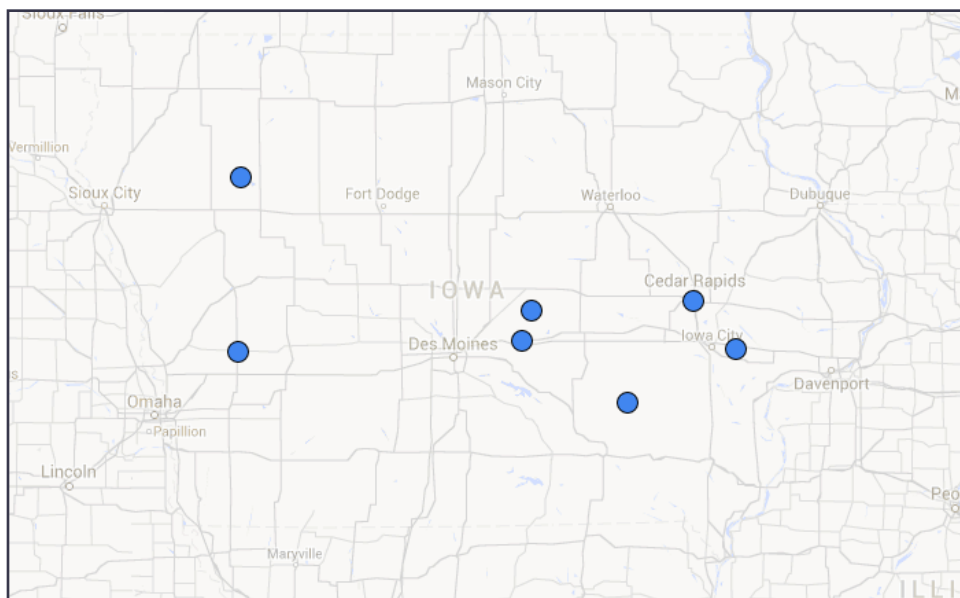


Figure 3. Wind industry clusters are located near Des Moines, Cedar Rapids, and Iowa City



At least thirteen different wind manufacturing facilities currently contribute to Iowa's economy.<sup>50</sup> Acciona manufactures wind turbines, while Siemens and TPI Composites are major blade manufacturers.<sup>51</sup> TPI Composites is located in Newton, Iowa and employs more than 700 people.<sup>52</sup> Siemens is one of the largest providers and installers of wind turbines in Iowa, with nearly 600 employees at their Fort Madison blade manufacturing plant.<sup>53</sup> Several companies, such as Clipper Windpower, produce service hubs and gearboxes. Trinity Structural Towers manufactures tubular steel towers for the wind industry.<sup>54</sup> Trinity provides diverse tower design applications and expertise through its parent and affiliated companies.<sup>55</sup> Table 1 shows the types of companies in the Iowa wind industry cluster.

Table 1. Overview of Iowa Wind Industry

TYPE OF FACILITY	NUMBER OF COMPANIES	DETAILS
<i>Manufacturing</i>		
Turbine Assembly	2	OEM wind turbine manufacturers
Blades and Towers	5	Blades, pitch system, spinner, tower, and supporting components
Components	44	Power inverter, logic boards, control systems, main shaft, gearbox, generator, equipment to connect wind farm to grid
Mid-Scale Wind	9	Community and distributed wind turbine development
<i>Service</i>		
Developers	5	Wind generation project developers
Services	15	Repair, measurement, operations, and maintenance services
<b>Total Companies</b>	<b>80</b>	

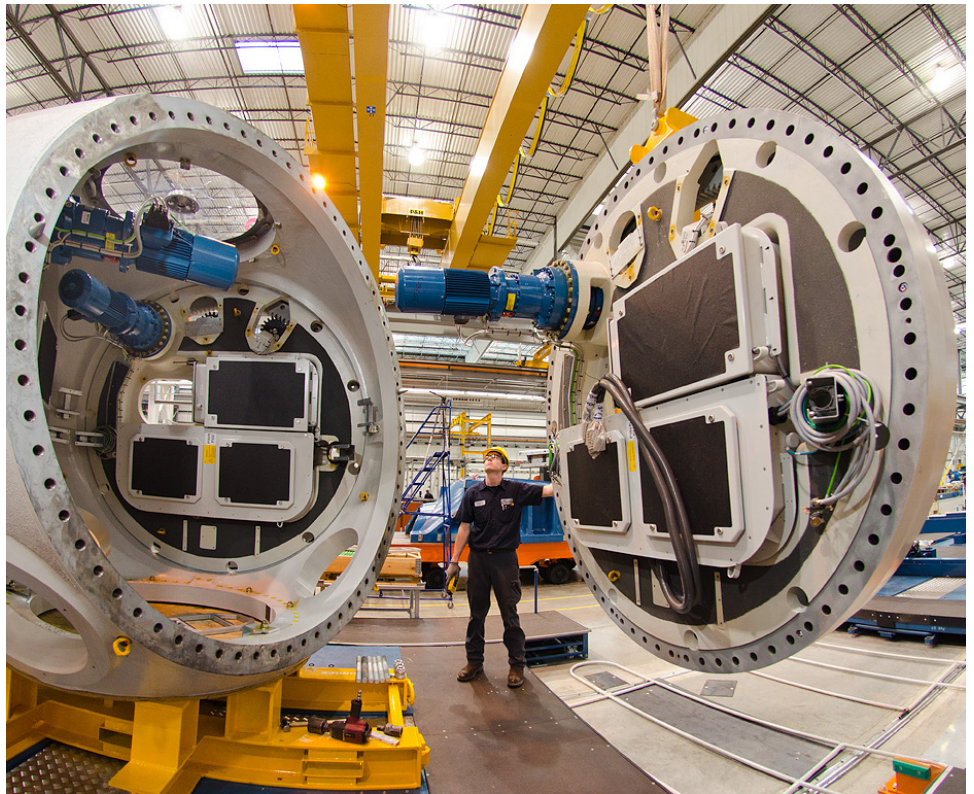
## Opportunities for Growth

Although Iowa-based companies currently manufacture wind turbine components, such as blades and towers, the state's economy and local wind industry would benefit from additional assemblers. Only two manufacturers in Iowa currently assemble completed wind turbines: Acciona and Siemens. By leveraging the state's existing component, blade, and tower manufacturing capabilities, Iowa could attract additional turbine assembly firms,



which would help boost growth in the local wind sector and create good-paying jobs for residents.

Smaller-scale distributed wind energy systems present another area for growth in Iowa's wind sector. Currently, Iowa is experiencing a dearth of distributed wind turbine manufacturers. State leaders could encourage targeted foreign direct investment aimed at filling this specific gap in the wind power supply chain. Attracting companies such as Vestas, a Danish company with a history of manufacturing in the United States, would bolster the state's distributed wind industry and create jobs for Iowans.



Manufacturing a wind turbine  
Photo Credit. U.S. Department of Energy

## Iowa's Wind Employment Potential

As demand for wind energy skyrockets, Iowa has the opportunity to expand the wind economy, increase in-state spending, and employ an average of over 10,000 Iowans annually over the next fifteen years. If optimistic projections prove to be correct and Iowa's wind companies are able to fill a larger share of their supply chain needs with in-state purchases, up to 153,000 direct, indirect, and induced job-years would be supported. While nearly 35,000 of those would be direct job-years in the state's wind industry, over 118,000 indirect and induced job-years could be supported if wind companies were able to procure more of their supplies from in-state companies.

These projections for job-years potential in Iowa's wind industry are based on tools and analysis by the Energy Information Administration, the Department of Energy's Office of Energy Efficiency and Renewable Energy, and Bloomberg New Energy Finance. Additionally, the Jobs and Economic Development Impacts tool (JEDI) was utilized to estimate job-years at different levels of local supply chain concentration for wind.

To highlight why clustering supply chain businesses in Iowa is so important, we have estimated the number of direct, indirect, and induced jobs based on future demand and the percentage of supply chain purchases made within the state. Figure 2 shows how the number of wind job-years vary as the local share changes. The figures show the number of direct, indirect, and induced jobs based on local share percentages of 25 percent, 50 percent, 75 percent.

Since projections often vary, we analyzed how those supply chain differences affect three reputable estimates of future demand for wind energy: Office of Energy Efficiency & Renewable Energy's Wind Vision as a high-demand scenario, Bloomberg New Energy Finance's forecast as a medium-demand scenario, Energy Information Administration Annual Energy Outlook 2015 Clean Power Plan's Base Policy analysis as the as a low-demand scenario. Figure 2 presents estimates for wind construction, operations, and maintenance jobs.

In all of the demand scenarios, increasing the percentage of local spending by Iowa's wind companies creates thousands of job-years. For example, in the high-demand scenario, increasing in-state supply chain purchases from 25 percent to 75 percent would create over 73,000 direct, indirect, and induced job-years. Even in the low-demand scenarios, an increase of in-state supply chain purchases for wind companies from 25 percent to 75 percent would create over 22,000 job-years.

### What is a Job-Year?

A job-year is one full-time equivalent job for one year (i.e., forty hours per week for fifty-two weeks, which is 2,080 hours per year). If two people each work a part-time job for twenty hours per week for fifty-two weeks, this is counted as one full-time equivalent job for one year, i.e., one job-year. If one person works forty hours per week for ten years, this it is counted as ten job-years.

### Why Use Job-Years?

By using job-years, our analysis can take into account the length of a job. In energy projects, many construction and installation jobs are short-term, while manufacturing and maintenance jobs may be long-term. Using job-years allows us to accurately count both types of jobs. For example, if ten full-time wind turbine installation workers are expected to each spend 208 hours on a wind project, this is measured as one job-year. Alternatively, if one full-time engineer is expected to spend fifteen years operating that same wind farm, this is measured as fifteen job-years. In our analysis of Iowa's wind supply chain, total job-years are aggregated over the 2016 to 2030 period.





## Direct, Indirect, and Induced Job-Years

In order to estimate the potential economic impact of Iowa's wind supply chain, direct, indirect, and induced job-years are measured:

- Direct job-years: reflect jobs created in the wind industry to meet demand
- Indirect job-years: reflect jobs created at supply chain companies resulting from increased transactions as supplying industries respond to increased demand from Iowa's wind industry
- Induced job-years: reflect jobs created throughout the local economy as a result of increased spending by workers and firms in Iowa's wind and wind supply chain industries

If a concerted effort were made by the state to fill in the supply chain and strengthen the wind cluster, Iowa companies could meet the expected demand for wind, supporting up to 153,000 job-years. Increasing the number of supply chain businesses can create thousands of good-paying, skilled jobs and make Iowa a leader in the wind industry.

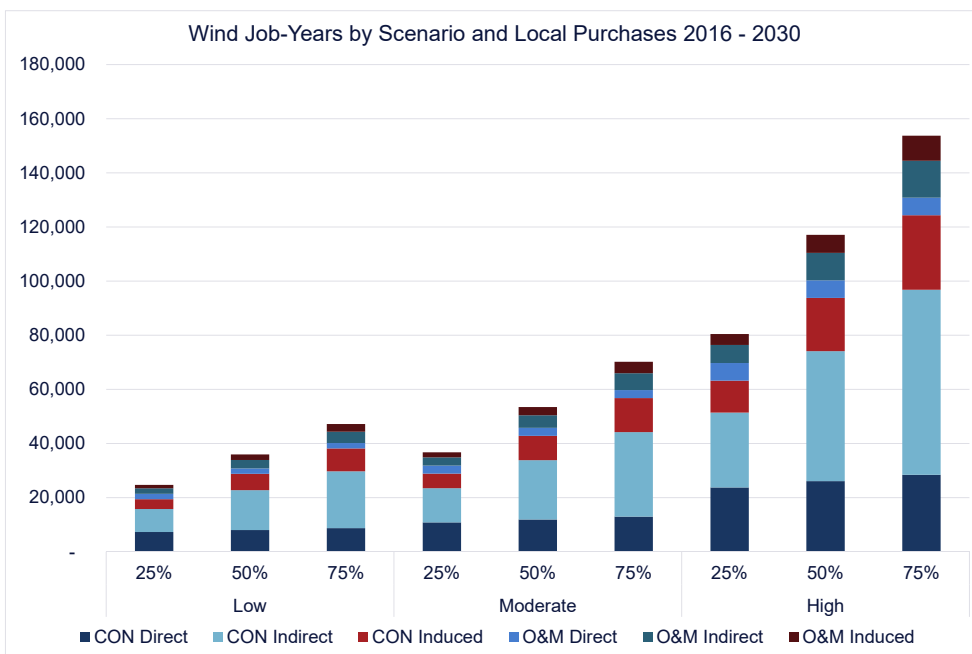


Figure 2. Increasing the percentage of local spending will increase job-years for Iowans

## Local Share

Local share is the percentage of expenditures that are spent in Iowa. For example, if a wind installation company plans to spend \$3 million on imported wind turbines and \$1 million on additional supplies from companies in Iowa, the local share is 25%. In the JEDI model, local share is an independent variable.



Drawing a wind turbine up for placement  
Photo Credit. Dennis Schroeder / NREL

## Policy Recommendations

Iowa can leverage its existing wind sector by focusing on innovative policies that remove obstacles and boost demand within the state. Creating a robust in-state market will attract private investment, strengthen the economy, and create new value chains, which will subsequently stimulate and accelerate new export markets, including small-scale wind.

### Policy 1: Require Integrated Resource Planning and Collaboration

Currently, Iowa's energy providers must engage in energy efficiency planning and submit annual reports to the Iowa Utilities Board (IUB) regarding the previous calendar year's operations.<sup>56,57</sup> A utility's generation decisions are finalized through various IUB filing procedures, making it potentially challenging for the public to gain a comprehensive understanding of how utilities are planning for their customers' energy needs.<sup>58</sup>

To encourage collaborative energy development, the state legislature could require inter-jurisdictional resource planning and siting through an Integrated Resource Plan (IRP). Energy providers use IRPs to create long-term plans to help meet projected future demand through supply-side and demand-side resources that guide future generation, energy efficiency, transmission, and distribution investments.<sup>59</sup> Iowa could look to successful examples of IRPs in other states, such as Arizona.

#### Arizona's Integrated Resource Plan<sup>60</sup>

The Arizona Corporation Commission's IRP was first adopted in 1989. Under the current system, utilities are required to submit updated fifteen-year IRPs every two years. Advisory group meetings and public input must occur before the official IRP is filed, allowing the utilities to incorporate public opinion. IRPs must consider environmental impacts, ratepayer costs, and transmission planning.

Before utilities submit official plans to the IUB, Iowa's IRP process could require preliminary input from the IUB, investor-owned utilities (IOUs), municipalities, rural cooperatives, regional transmission organizations, project developers, and advocates. To streamline wind planning and effectively engage stakeholders, the IRP process could also include discussion of transmission infrastructure projects, permitting process inefficiencies, methods to reduce wind project risk, and coordination of balancing areas.<sup>61,62</sup> Iowans directly impacted by energy projects could participate in stakeholder engagement activities to receive more

#### Transmission Infrastructure Planning

Iowa's IRP process could include engagement with other organizations such as MISO and the Southwest Power Pool (SPP). Many of Iowa's transmission problems require regional and federal policy solutions, which could be incorporated into Iowa's IRP process.

#### Planning for Fluctuations in Wind-Generated Energy

Wind often blows the strongest at night, resulting in an abundance of power on the grid that does not get used. The IRP process could alleviate this problem by creating industry partnerships and/or programs that encourage nighttime energy use.



information and voice concerns.

A public and transparent resource planning process will help Iowans balance high-value projects with public opinion, produce a diverse and equitable energy supply, and create good-paying jobs for local residents.

## Policy 2: Attract Wind Turbine Assembly Companies to the State

### Iowa's Business Incentives

Iowa's New Jobs Tax Credit, New Jobs Training Program, and High Quality Jobs Program provide tax credits or funding to eligible companies. Qualifying businesses must enter into New Jobs Training Agreements, implement training and development for expanded workforces, or modernize manufacturing plants.<sup>65</sup> These incentive programs could be leveraged to promote growth and workforce training in the wind industry.

Iowa's advanced energy economy includes well-established wind turbine component manufacturers, but the state could further boost its wind power sector by attracting additional turbine assemblers. Currently, only two companies in Iowa—Acciona and Siemens—install finished wind turbines. Florida's industry tax incentives serve as an example of successful targeting strategies that fill gaps in the advanced energy economy supply chain and attract good-paying jobs.

### Florida's Target Industry Incentives

Florida's Qualified Target Industry Tax Refund incentive includes refunds on eligible "income, sales, ad valorem, intangible personal property, [and] insurance premium." Qualifying new or expanding companies or corporate headquarters are eligible for the tax refund. The value of the refund is determined by several factors including location of new jobs, employee wages, and increased quantity of exports.<sup>63</sup> Florida also boasts a Capital Investment Tax Credit, which attracts capital-intensive industries, such as clean energy and silicon technology. Companies must invest \$25 million and create at least 100 jobs in order to qualify for the Capital Investment Tax Credit, which offsets corporate tax liability.<sup>64</sup>

Iowa policymakers could adopt and modify these types of incentives to include qualifying criteria such as job creation, workforce development initiatives, or capital investments. The tax credits could be used in combination with Iowa's existing business incentives to attract large wind turbine assembly firms to the state and create a more robust wind power supply chain.

## Policy 3: Modernize Transport Pathways to Improve Wind Turbine Export

Transporting wind turbines requires considerable planning and expense due to size and weight of components. Each blade can weigh approximately 77 tons per transportation unit and towers can be up to 410 feet tall.<sup>66</sup> Transportation and logistics efforts can account for as much as \$150,000 per turbine, or about 20 percent of total installed cost.<sup>67</sup> As a result of this high cost burden,

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wind turbine manufacturers must give serious consideration to transportation and logistics issues as facility locations are chosen.<sup>68</sup>

In order to attract turbine manufacturers, capitalize on the wind components export market, and help meet demand in neighboring states, Iowa should consider various ways to improve ground and inland water transportation pathways.

## **Ground Transport**

Nearly half of Iowa's roads are considered to be in poor or mediocre condition and are anticipated to cost Iowa motorists \$756 million (\$381 per motorist) annually in vehicle repair and operating costs.<sup>69</sup> The current state of Iowa's roads are not sufficient to accommodate cost-effective and continued movement of heavy components like wind turbine towers or blades. In order to prepare Iowa's highways and rural roads for wind turbine transportation, Iowa policymakers could allocate state Department of Transportation (DOT) funds for road upgrades. Additionally, the state could consider adopting Florida's model of transportation development, which encourages private-sector involvement and investment.

Under the advisory of the state DOT, the Iowa Transportation Commission prepares an annual Transportation Improvement Program, which outlines proposed investments in the state's multimodal transportation system for the next five years.<sup>70</sup> This proposal could be revised to include an assessment of the economic benefits associated with road upgrades that would facilitate movement of large goods, such as wind turbine components. If the Iowa DOT determines that these investments provide sufficient returns to the state, a portion of DOT funds could be allocated to road upgrade projects.

Iowa leaders could also adopt and customize Florida's model, which encourages new private-sector development through locally managed transportation improvements. Florida's Economic Development Transportation Fund, also known as the "Road Fund," provides funds to help solve transportation problems that hinder economic development. Grant funds are awarded to a local government on behalf of specific businesses that want to establish or expand a facility, but cannot locate due to inadequate local infrastructure.<sup>71,72</sup> Infrastructure upgrades that qualify include construction of access roads, installing signals, and widening roads.

Iowa leaders could encourage private road development by extending the sales and use tax exemptions for "wind energy conversion property" to include materials used directly for the road upgrades necessary for wind energy production and



transportation.<sup>73</sup> A dual public and private sector approach to modernizing Iowa's roads will bolster the local wind power sector by mitigating transportation challenges associated with exporting to other states.

## Water Transport

Currently, only 40 percent of the United States' inland water system is fully utilized, representing an opportunity to improve transportation of large or heavy goods.<sup>74</sup> River shipping is typically less expensive and more efficient per ton-mile.<sup>75</sup> For example, an average fifteen-barge tow can accommodate the equivalent of 216 rail cars.<sup>76</sup> Additionally, barges allow for design and loading flexibility: a single barge can fit up to eighteen wind turbine blades.<sup>77</sup>

### Equivalent Lengths



Two important shipping pathways border Iowa: the Mississippi River and Missouri rivers.<sup>78</sup> Most of the Mississippi River has terminals that can accommodate transport of wind turbines, while the Missouri River has fewer terminals, such as Big Soo, that are currently able to serve the needs of the wind industry.<sup>79,80</sup> To fully maximize the potential of freshwater transportation in Iowa and increase export efficiency, the state could incentivize barge transportation improvements. Iowa policymakers could look to Virginia's barge and rail tax credit as a model for encouraging alternative transport methods for large, heavy goods.<sup>81</sup>

### Virginia's Barge Usage Tax Credit

To decrease movement of goods along highways and incentivize river and railway transport, Virginia offers a barge and rail tax credit. The credit can be claimed against a number of state taxes including individual income tax, corporate income tax, and tax on public service corporations. The tax credit equals \$25 per 20-foot equivalent unit of shipping container.<sup>82</sup> This modest incentive encourages the use of alternative transport methods, such as railways and waterways.



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In addition to a barge tax credit similar to Virginia's, Iowa policymakers could encourage the construction of specialty barges that move goods along the Mississippi and Missouri rivers. The state could extend the sales and use tax exemptions for "wind energy conversion property" to include construction of specialty barges that transport wind turbine components along the rivers.<sup>83</sup> Incentivizing inland water transportation of wind turbine components would bolster Iowa's wind power export market and help meet demand in other states.

## **Policy 4: Encourage Distributed Wind Turbine Deployment**

Of the 3.7 MW of small wind turbines sold in the United States in 2014, 82 percent came from domestic suppliers.<sup>84</sup> Small- to medium-sized wind turbine manufacturers in the U.S. have exported products to more than 130 countries, with exports accounting for up to 80 percent of total sales in recent years.<sup>85</sup> With distributed wind capacity potential in the U.S. expected to reach 1,100 GW by 2030, Iowa could increase production of small wind turbines to help fulfill that potential.<sup>86</sup> Iowa could simultaneously stimulate the in-state market for small, distributed wind.

### **Distributed Generation Carve-out**

To increase in-state demand for distributed wind, Iowa could institute a distributed generation carve-out. Iowa leaders could look to successful policy examples in New Mexico or Colorado.

#### **Distributed Generation Carve-outs in New Mexico and Colorado**

New Mexico and Colorado are leaders in promoting in-state generation of wind energy. New Mexico has implemented a distributed generation carve-out that requires 3 percent of the state's electricity to be produced at the point of consumption by 2020.<sup>87</sup> The electricity can be used on-site or transmitted to a local investor-owned utility (IOU) or rural cooperative to be used by customers in the surrounding service area.<sup>88</sup> Similarly, Colorado has established a distributed generation carve-out of 3 percent of IOU sales by 2020, ramping up from a 1 percent requirement in 2011.<sup>89</sup>

Increasing demand for locally generated electricity could send a clear, consistent market signal to business leaders, encouraging small wind installers and manufacturers to expand in-state operations. By establishing a distributed generation carve-out, Iowa could bolster the in-state demand for locally generated energy and create good-paying jobs for Iowans.



## Small Wind Tax Credit

To encourage Iowans to install distributed wind systems, the state could implement a small wind tax credit. The credit could be an extension of Iowa's Energy Systems Tax Credit or modeled after North Carolina's solar and wind tax credit. North Carolina provides a personal and corporate tax credit of up to \$10,500 per installation to eligible taxpayers.<sup>90</sup> Installations must not be used for the purpose of selling electricity, and allowable credit must not exceed 50 percent of an individual's tax liability.<sup>91</sup> Iowa's Solar Energy Systems Tax Credit, which gives 60 percent of the federal residential tax credit and is capped at \$5,000,<sup>92</sup> could be amended to include small wind systems. Either an extension of Iowa's solar credit or a credit similar to North Carolina's would encourage widespread adoption of distributed wind systems.

## Create an Anemometer Loan Program

### Anemometer

An anemometer is a device used to measure wind speed.

A wind resource assessment is the first step to installing a small wind turbine in a household, farm, school, or business. However, lack of access to assessment tools and expertise can prevent residents and businesses from installing a small wind system. To empower Iowans with the knowledge and tools needed to install a small wind turbine, state leaders could create an anemometer loan program.

The State of Maryland's Community Wind Competitive Grant Program encourages distributed wind adoption through competitive grant funds and an anemometer loan program.<sup>93</sup> Iowa could create a similar anemometer education and loan program that provides interested parties with the tools and information needed to assess wind resources. The project could be implemented on a county level.

## Annual Net Metering

Due to seasonal variations in wind resources, a consumer-owned wind turbine may produce power in excess of the household's demand for only a few months out of the year. Through an annual net metering program, customers would be able to bank excess generation from windy months and apply retail credit toward electricity bills at other times throughout the year. The ability to account for seasonal variation in wind resources would ensure that customers receive equitable and consistent electricity rates.<sup>94,95</sup>

## Policy 5: Encourage Foreign Direct Investment

Iowa is a leader in wind turbine manufacturing and is strategically located along major waterways, making exportation more efficient. Iowa could strengthen its supply chain and recruit more distributed turbine manufacturers in order to capitalize on growing wind power demand throughout the Midwest. An influx of foreign wind manufacturers would not only encourage wind energy development, but also increase the state’s capacity to export necessary components and ultimately create new jobs for Iowans.

Iowa has a strong history of recruiting international companies to the state. Since 2003, more than sixty foreign direct investment (FDI) projects have been announced in Iowa, amounting to \$3.66 billion in capital investment.<sup>96</sup> Recruited companies come from a variety of industries including food, materials, industrial machinery, and renewable energy. Iowa’s executive branch could continue this trend to fill gaps in the state’s wind power supply chain and attract more small-scale wind manufacturers. Table 2 below shows a list of potential investors based on turbine component and sector.

Table 2. Potential Foreign Direct Investors in Turbine Components

Turbine Component or Sector	FDI Target
Distributed Wind, Large-Scale Wind	Vestas (Denmark)
Large-Scale Turbine Blades	DeWind (Germany), SGL (Germany) and LM Wind Power (Denmark)
Wind Towers	Marmen Inc. (Canada)
Wind Generators	Ingeteam (Spain)

By recruiting these foreign companies, Iowa stands to attract foreign capital, expand the state’s wind sector, and create good-paying jobs for residents.

## Chapter Summary

With a robust wind turbine manufacturing industry and prime location for exporting, Iowa is poised to lead the nation in wind turbine manufacturing and wind energy generation. Given the rapidly increasing global demand for wind energy, Iowa leaders must act quickly. State policymakers could strategically recruit foreign companies to fill gaps in the supply chain, create demand for small-scale wind turbines, upgrade the state's transportation networks to increase export volumes, and unite stakeholders in an effective way to plan for Iowa's future energy needs. Implementing these recommendations would increase local generation of wind energy, strengthen Iowa's economy, and provide good-paying jobs for its citizens.



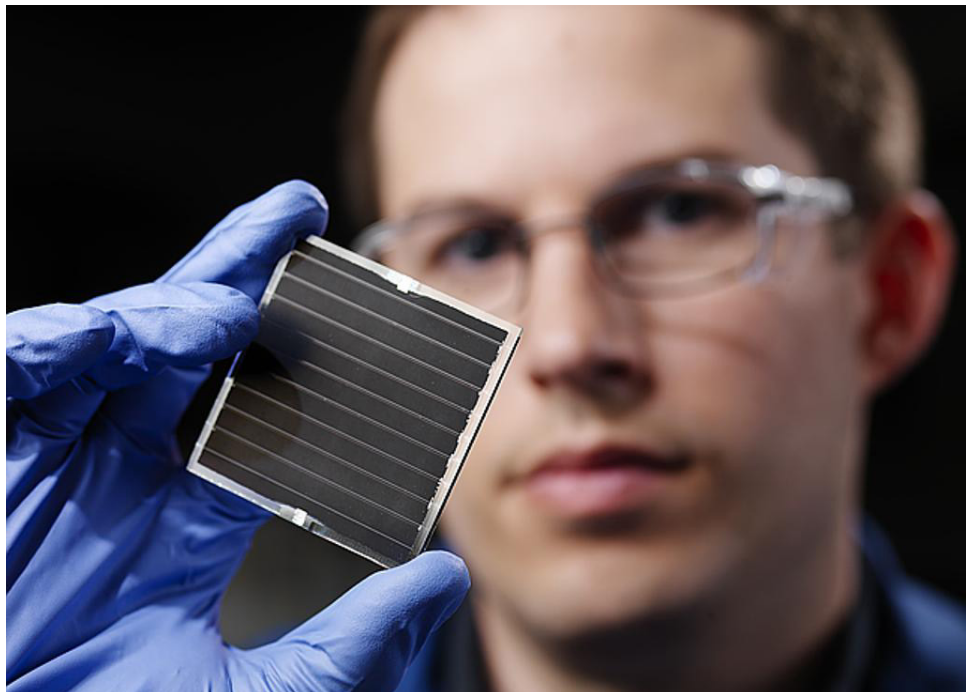
Transporting a wind turbine blade  
Photo Credit. Evert Kuiken / Foter / CC BY-ND



# Chapter 3: Solar Technology

Iowa's policymakers will play a decisive role in the future of solar energy in the state. Over the last decade, solar energy deployment has grown rapidly in the United States due to falling solar photovoltaic (PV) cell prices, technological advancements, favorable government policies, available financing, and increased consumer demand for clean and renewable sources of energy. By targeting the state's emerging solar cluster with smart and strategic policy choices, Iowa's leaders can attract jobs, while helping the state meet a portion of its energy needs. With policies that encourage growth and technological innovation, Iowa can meet the demand for solar products from a strong in-state market and capitalize on export opportunities in regional, national, and international markets.

This chapter is a guide to strengthen and develop Iowa's emerging solar economy. After analyzing Iowa's existing solar supply chain and discussing the state's potential for creating good-paying solar jobs, the chapter culminates in policy recommendations for future growth. These recommendations chart a course for Iowa policymakers to generate and enhance jobs in the solar sector.



Solar cell

Photo Credit. Pacific Northwest National Laboratory - PNNL / Foter / CC BY-NC-SA

# Strengths, Weaknesses, Opportunities, and Threats for Solar Technology in Iowa

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> <li>• Favorable business climate</li> <li>• Significant technical potential for solar PV energy generation</li> <li>• Total solar rooftop potential can power 20 percent of Iowa's electric needs</li> <li>• Growing solar demand from homeowners, farmers, municipalities, and rural co-ops</li> <li>• World-class research community colleges, institutes, and universities</li> </ul>	<ul style="list-style-type: none"> <li>• Minimal infrastructure and resources for solar panel manufacturing</li> <li>• Lack of training opportunities in advanced manufacturing of solar equipment</li> <li>• Net metering only applicable to investor-owned utilities</li> <li>• Competition for land space with agriculture for large arrays</li> <li>• Lagging performance in innovative entrepreneurial development</li> <li>• Weak population growth</li> </ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> <li>• Large downstream market potential</li> <li>• Declining solar panel costs</li> <li>• Existing solar tax incentives</li> <li>• Third-party solar financing</li> <li>• Renewable energy demand in-state and nearby</li> <li>• Municipalities interested in installing solar</li> <li>• Interest in community solar</li> <li>• Existing solar Renewable Energy Certificates (RECs)</li> <li>• Mandate for all energy providers to give customers option of purchasing green power<sup>1</sup></li> <li>• Statewide efforts to improve STEM education</li> </ul>	<ul style="list-style-type: none"> <li>• Outsourcing solar manufacturing to China</li> <li>• Unfavorable solar economics due to low energy costs</li> <li>• Incompatible grid technology</li> <li>• Scaling and business plan challenges among solar companies</li> <li>• Solar energy system tax credit cap (\$5 million per year)</li> <li>• Land use competition from farming, wind, and biomass</li> <li>• Outmigration of Iowans to states advancing clean technology innovation</li> <li>• Proposed changes in rate structure increase costs for solar customers</li> </ul>





Iowa ranked as the fourteenth best state to do business in the United States.<sup>2</sup> A welcoming business climate, proactive state government, and favorable tax incentives contribute to the strong commercial conditions within Iowa.<sup>3</sup> The state also has considerable solar resources, ranking sixteenth in the nation in technical potential for solar PV energy production.<sup>4</sup> Indeed, estimates suggest that rooftop solar alone could supply enough energy to meet 20 percent of Iowa's annual electricity demand.<sup>5</sup>

With a strong foundation in the solar sector, Iowa leaders are well-positioned to facilitate significant growth in the industry. One energy expert states that the solar industry is at the same stage of growth as the wind industry in the early 2000s, just before the wind industry "exploded."<sup>6</sup> Declining solar costs and expanding financial incentives for renewable energy have increased solar demand from Iowa's homeowners, farmers, municipalities, and rural electric cooperatives. Additionally, solar energy capacity grew by 45 percent from September 2014 to September 2015.<sup>7</sup> The Iowa Supreme Court's 2014 ruling established the legality of third-party financing for solar power, which could facilitate market expansion throughout the state.<sup>8</sup>

### **The Iowa Energy Center**

Iowa has a firm foundation in technological innovation for advanced energy sectors. The Iowa Energy Center at Iowa State University utilizes grant funding to research solar panel efficiency and stability.<sup>9</sup> The center showcases PV research and education activities at the Ames Laboratory and the Biomass Energy Conversion (BECN) facilities.<sup>10</sup>



Roof-integrated photovoltaic shingles  
Photo Credit. U.S. Department of Energy



Currently, solar deployment is falling short of the state's success with wind—the state has 27 megawatts (MW) of solar capacity,<sup>11</sup> compared to 6,212 MW of wind capacity.<sup>12</sup> To realize a future of reliable, affordable clean energy, Iowa must reduce dependence on any single energy source. Increasing solar power production is a critical component of diversifying the state's energy resource mix and reducing its dependence on imported fuel. Barriers such as insufficient workforce training, minimal infrastructure for solar installations, a low net metering cap, competition for land, and policy uncertainty have hindered widespread residential and commercial adoption. As a result, Iowa has not yet tapped into the full economic potential of solar technology investments. Smart, strategic policies aimed at overcoming these barriers can eliminate costly energy waste, bolster the state's solar cluster, and create thousands of good-paying jobs for Iowans.

## Solar Market Trends

### Rising Demand

The past several years have been characterized by a surge of innovation and growth in the solar industry. For example, global PV installed capacity has increased by a factor of nearly seventy over the last decade, from 2.6 gigawatts (GW) in 2004 to 177 GW in 2014.<sup>13</sup> As a result of this growth, investment dollars are flooding the market, prices are falling, and the industry is undergoing a period of rapid innovation.

In the United States, solar PV cells are a primary source of new electricity generating capacity. In the first half of 2015, solar represented 40 percent of new electric-generating capacity, the most out of any other energy sources.<sup>14</sup> Strong demand for solar has made the United States the world's fifth largest solar market in terms of installed capacity.<sup>15</sup> Forecasts show significant growth continuing through 2030 (see Figure 4).<sup>16</sup>



Dual surface panels produce up to 30 percent more power  
Photo Credit: Department of Energy



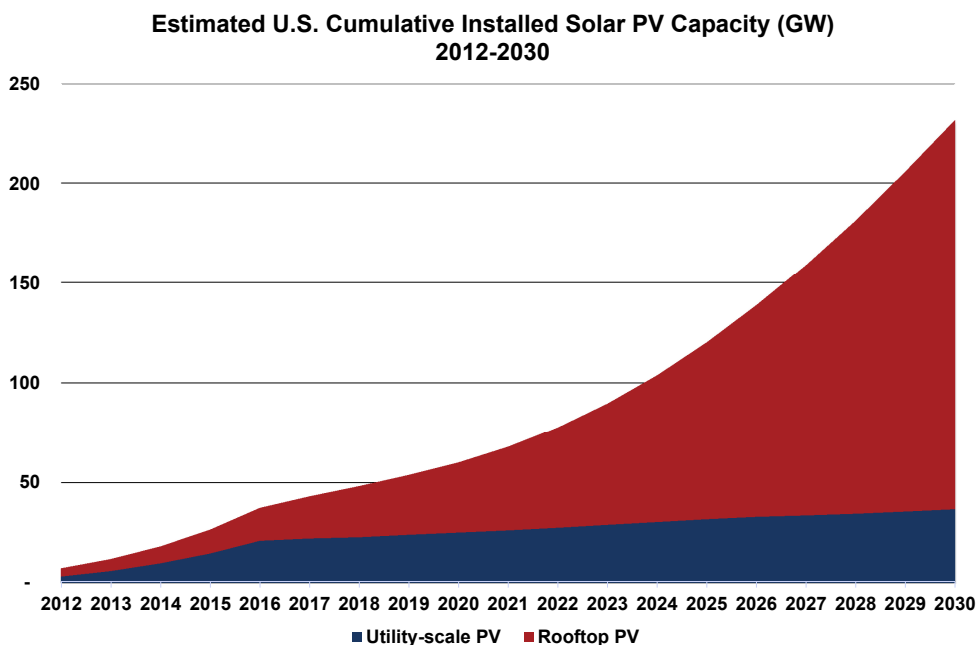


Figure 4: U.S. cumulative installed solar PV capacity, 2012-2030 (Forecast) Source: Bloomberg New Energy Finance. 2015 New Energy Outlook - Americas. June 23, 2015.

### Falling Costs and Increasing Efficiencies of Solar

In 1961, President Kennedy issued a challenge to the nation to land a man on the moon and return him safely to Earth by the end of the decade. Driven by competition against the Soviet Union and the mystery of space, the United States achieved one of the most remarkable accomplishments in human history. In the same spirit, the Department of Energy's SunShot Initiative has challenged the nation once again. This time the challenge is not about space but energy.<sup>17</sup>

The SunShot program uses the levelized cost of electricity (LCOE) as a way to compare the cost of installing a solar system to the rate utilities charge for electricity. The program has set the goal of reducing the LCOE for utility-scale solar energy to \$0.06 per kilowatt-hour (kWh) by the end of this decade.<sup>18</sup> Technology-driven innovation will make solar energy cost-competitive with traditional energy sources by 2020. Today, solar is cost-competitive in fourteen states where the solar LCOE ranges from \$0.10 to \$0.15 per kWh and retail electricity price comes in at \$0.12 to \$0.38 per kWh.<sup>19</sup>

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### **What is Levelized Cost of Electricity?**

The levelized cost of electricity (LCOE) is a summary measure of the cost of energy-generating technologies. The LCOE considers an assumed lifespan and utilization level in order to quantify the per-kilowatt-hour building and operating costs of a generating plant.<sup>20</sup> To calculate the LCOE, a variety of factors and inputs are assessed including capital costs, fuel costs, operation and maintenance costs, and financing costs.<sup>21</sup> The LCOE provides a way to compare the cost of installing a solar system to the rate for electricity charged by utilities. Due to nonexistent fuel costs for generation and very low variable operations and maintenance costs, LCOE for solar technology is largely determined by capital and financing costs.<sup>22</sup>

While the cost of solar energy has declined, the efficiency of solar technology has increased. In 2014, the average capacity factor of solar projects built in 2013 was 29.4 percent, compared to 24.5 percent for 2011 projects.<sup>23</sup> This means that the same sized system can produce 20 percent more electricity than in the past.

### **What Does Rising Solar Demand and Falling Cost Mean for Iowa?**

The offshoring of manufacturing jobs was not driven by intrinsic geographic, technological, or cultural factors; rather, aggressive policy and low wages in competitor nations shifted American jobs overseas.<sup>24</sup> The International Energy Agency conducted a detailed analysis of the manufacturing shift to China, which “suggests that the historical price advantage of a China-based factory over a U.S.-based factory is not driven by country-specific factors, but by scale, supply chain development, and access to finance.”<sup>25</sup> State policy that helps build a market and develop the solar supply chain, promotes access to capital, and invests in solar workforce development will attract solar companies. With the right combination of policies, solar resources, available land, and access to capital, Iowa can compete nationally and globally for market-driven solar manufacturing, generation, installation, and exports.

Solar in Iowa is poised for growth. With considerable interest among homeowners, farmers, and businesses, the state has the opportunity to expand its energy generation portfolio and manufacturing economy.<sup>26</sup> Several positive developments occurred in 2014, including the approval of third-party power purchase agreements (PPAs),<sup>27</sup> investigations by the Iowa Utilities Board into the potential future implementation of distributed generation, and the renewal and expansion of the state solar



systems tax credit. These events are expected to increase the demand for solar energy conversion systems in the residential and commercial markets.<sup>28</sup>

Iowa can spur the machinery manufacturing industry by targeting specific solar components within the value chain and leveraging the state's existing strengths. Specifically, the national inverter and solar racking industries are projected to grow at an accelerated rate. The North American flat roof racking industry is projected to grow by an annual rate of 17.5 percent through 2018<sup>29</sup> and the solar inverter industry will see an estimated 10 percent growth by 2019.<sup>30</sup> Iowa-based companies, such as CED Greentech and Geode Energy, LLC, can capitalize on this growth and become national leaders in solar manufacturing.

### Exporting Solar Components

Increased manufacturing in Iowa would create the possibility for exporting solar components to neighboring states. Iowa is well-positioned to be an exporter of solar technology, which will increase economic and job growth in the state.

The Solar Energy Industry Association's "Featured States" in the solar value chain include many of Iowa's neighbors, including Illinois, Wisconsin, Minnesota, and Missouri.<sup>31</sup> As vibrant technology hubs spread across the Midwest,<sup>32</sup> in what many refer to as the Silicon Prairie, Iowa has the potential to close gaps in its solar supply chain and take advantage of in-state solar resources.<sup>33</sup> Iowa's solar sector could expand its solar racking and inverter capabilities to complement the state's existing solar panel installation and maintenance operations.

As of December 2014, approximately 23,000 people were employed in the advanced energy industry in Iowa,<sup>34</sup> and increased investment could create over 10 percent more jobs by 2020.<sup>35</sup> Additionally, Iowa ranks sixteenth in the nation for solar technical potential.<sup>36</sup> With a strong foundation and growing in-state demand, Iowa leaders are well-positioned to facilitate significant growth in the solar sector in coming years.



Photo Credit. David Schroeder / U.S. Department of Energy

## Solar Technology Manufacturing

There are many types of solar cells with different manufacturing processes and assembly configurations. In order for Iowa policymakers and leaders to craft forward-thinking policy that reflects the future of solar technology, it is important to understand the solar manufacturing process and advances in the space.

### Iowa's Solar Supply Chain

The solar supply chain is comprised of companies working across a variety of technology categories. Several businesses in Iowa are already working in the solar industry, in areas such as advanced materials, manufacturing, and installation. Table 3 describes each of these technology categories and lists the number of in-state companies.

Table 3. Companies in Iowa's Solar Supply Chain

CATEGORY	TOTAL BUSINESSES	DESCRIPTION
<b>Manufacturing</b>		
Full System	3	Manufactures full PV solar systems
Advanced Materials	2	Manufactures materials used to develop solar cells
Mounting/Racking	5	Manufactures structural components to mount solar systems
Frames	2	Manufactures structural frames for solar cells
Tracking System	2	Manufactures components such as tracking systems, gears, and motors
Manufacturing Machines	1	Produces tools used in the process of manufacturing solar systems
Inverters	2	Manufactures inverters used in solar systems
Controllers	0	Manufactures solar cell controllers
Sealants and Protective Films	1	Creates structural sealants used to hold cells and structural frames together or manufactures films used to protect the surface of the solar cells
<b>Services</b>		
Contractors/Installers	30	Installs rooftop or utility-scale solar systems
Project Developers	4	Assists with development of full-scale utility solar system projects
Distributors	2	Distributes solar systems
Consultants	4	Assists in various stages of project development
<b>Total</b>	<b>58</b>	

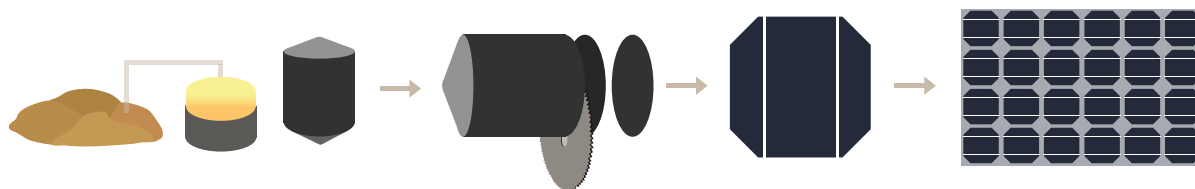
Sources: SEIA Solar Jobs Company Database and independent analysis





## The Solar Manufacturing Process

Crystalline silicon panel technology is the current standard for panels installed in the United States. There are four main steps to assemble a crystalline silicon panel.



### Extracting and Purifying Silicon

The production of a PV panel begins by deriving silica from sand. After the silica is extracted, it is purified to make a high-purity silicon powder.

### Manufacturing the Wafer

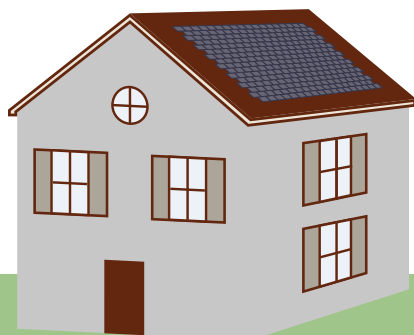
With the silicon powder, a wafer can be manufactured by doping the molten high-purity silicon with boron. Molten silicon is poured into a mold creating blocks of solid polysilicon. The block is then cut, polished, and cleaned.

### Assembling the Modules

During cell manufacturing, one side of the wafer is doped, usually with phosphorous. A conductive grid and anti-reflective coating are adhered to the top and a conductive back plate is assembled to the bottom of the cell. Cells are then combined electrically to form a module. A glass or film sheet is placed on the front and back. The module is covered by an outer frame, usually made of aluminum.

### Assembling the Array

The finished solar panels are delivered to the customer. Downstream solar activities involve distribution, engineering design, contracting, installation, and servicing. There are also ancillary services involving financial, legal, and nonprofit groups that provide support for solar projects.



## The Future of Solar

Research and innovation in the solar industry is leading to exciting breakthroughs

### Building with Solar Cells

In the future, solar technology will be incorporated into the structure of a new building, rather than installed on a roof after construction is complete. For example, the near-medium-term future could see walls, skylights, windows, and shingles manufactured with solar materials.

### Solar for the Home of the Future

“Smarter” solar panels will incorporate technology and sensors to provide real-time information about energy generation and demand. Unprecedented interconnectedness and energy management software will open the door for increased customization.

### Organic Solar

Organic solar cells are a new type of carbon-based solar cell. This technology can be manufactured in innumerable applications, such as transparent paint. For example, windows could be coated in a transparent organic paint that provides electricity to the building.

### Ultra-High Efficiency Solar Cells

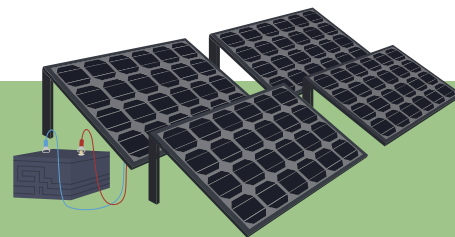
The higher the efficiency of a solar panel, the more electricity it can create from the sun's rays. With ultra-high efficiency cells, less area is needed to obtain the same amount of electricity. Researchers project that solar cells could be four times more efficient in the near future.

### Solar Soft Costs and Information Technology

Data-driven innovations will help reduce the soft costs of solar marketing and provision. Better data analytics will improve system design and uptake through performance modeling and investment projections. Lead generation firms and price comparison tools are already streamlining customer acquisition by connecting homeowners to solar installers.

### Solar and Energy Storage

Solar panels only generate electricity when the sun is shining. New battery storage technology allows solar energy to be stored when excess electricity is generated during the day and then dispatched in the absence of sunlight.





## Strengths and Areas for Growth

In total, fifty-eight companies in Iowa play a role in the solar supply chain, including installation, manufacturing, and supply companies. The solar industry supports 975 workers in the state, including 349 workers that spend more than 50 percent of their time in solar.<sup>37</sup> Iowa is also home to PowerFilm Solar, which manages a particularly innovative manufacturing facility.<sup>38</sup> PowerFilm Solar is the only company in the world that sells monolithically integrated solar panels with a plastic backing allowing easier storage, transportation, and flexibility.<sup>39</sup> Solar Dynamics in Ottumwa is a consumer products firm that buys solar cells and produces solar-powered ventilation fans for attics.<sup>40</sup> Baird Mounting Systems makes metal frames that serve as movable mounts for large solar arrays.<sup>41</sup> Iowa could strengthen its solar economy by boosting the number of companies manufacturing solar products—there are many opportunities for manufacturing cells, panels, racking, and balance-of-system components. Beyond manufacturing, Iowa has an extensive list of contractors and installers to facilitate the growth of statewide solar deployment.

Additionally, Iowa's solar supply chain has opportunity for growth in the full panel manufacturing and thin film spaces. One of the most significant gaps in the state's solar supply chain is the lack of a full panel manufacturing facility that has extensive reach outside the state. To position the state as an industry leader, Iowa could expand this portion of the solar supply chain.

Attracting foreign direct investment from established companies in the global sector is a viable option for kick-starting the state's solar sector and filling key gaps in the supply chain. Currently, there is a deficit of companies manufacturing silicon wafers in Iowa. Leading wafer companies, including China's LDK Solar and Germany's Wacker Chemie, could help Iowa overcome this deficit. The state could also target SolarWorld (German company); Sharp, Panasonic, and Mitsubishi (Japanese companies); and Yingli and Suntech (Chinese companies). Placing an emphasis on foreign direct investment could attract the manufacturing expertise and resources that are currently lacking in the state's solar economy.

### Expanding the "Silicon Prairie"

As tech companies seek employees willing to reside in areas with lower costs of living, the "Silicon Prairie" is seeing significant growth.<sup>42</sup> This represents an opportunity for Iowa to leverage the influx of new workers in advanced technology to grow its solar cluster.



### Iowa Solar Supply Chain Map

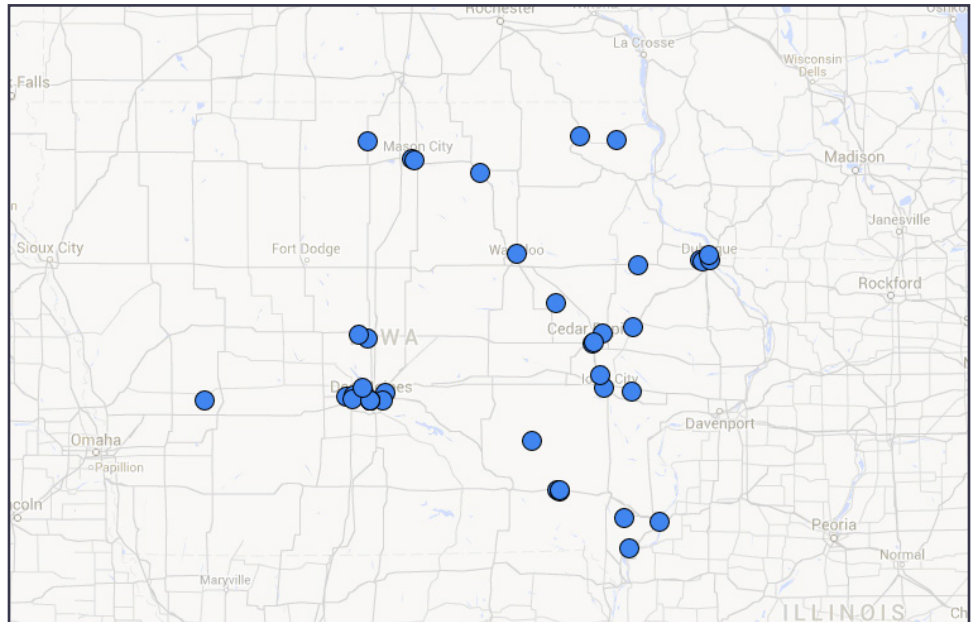


Figure 5. Companies are growing around Des Moines, Cedar Rapids, and Dubuque



Cleaning solar panels at the car ports at Googleplex  
Photo Credit. Avinash Kaushik / Foter / CC BY

## Solar Employment Potential

As demand for solar skyrockets, Iowa has the opportunity to expand the solar economy, increase in-state spending, and employ an average of over 7,700 Iowans annually over the next fifteen years. If optimistic projections prove to be correct and Iowa's solar companies are able to fill most of their supply chain needs with in-state purchases, over 116,000 direct, indirect, and induced job-years would be supported. While nearly 42,000 of those would be direct job-years in the state's solar industry, over 75,000 indirect and induced job-years could be supported if solar companies were able to procure supplies from in-state companies.

These projections for job-years potential in Iowa's solar industry are based on tools and analysis by the DOE Office of Energy Efficiency & Renewable Energy, Energy Information Administration, and Bloomberg New Energy Finance. Additionally, the Jobs and Economic Development Impacts tool (JEDI) was utilized to estimate job-years at different levels of local supply chain concentration for rooftop solar (residential and commercial buildings). Our projections did not indicate a significant outlook for utility-scale solar.

To highlight why clustering supply chain businesses in Iowa is so important, we have estimated the number of direct, indirect, and induced jobs based on future demand and the percentage of supply chain purchases made within the state. Figure 6 shows how the number of rooftop solar job-years vary as the local share changes. The figure shows the number of direct, indirect, and induced jobs based on local purchase percentages of 25 percent, 50 percent, and 75 percent. This range was chosen to represent reasonable goals for average local purchases, as 0 and 100 percent both represent extremes of purchasing behavior that we do not believe are realistic. Since projections often vary, we analyzed how those supply chain differences affect three reputable estimates of future demand: Bloomberg New Energy Finance as a high-demand scenario, the DOE Office of Energy Efficiency & Renewable Energy's Wind Vision as a moderate scenario, and Energy Information Administration Annual Energy Outlook 2015 Clean Power Plan Base Policy as a low-demand scenario. Figure 6 presents estimates for rooftop construction, operations and maintenance jobs.

In all three demand scenarios, increasing the percentage of local spending by Iowa's solar companies creates thousands of job-years. For example, in the high-demand scenario, increasing in-state local purchases from 25 percent to 75 percent would create almost 50,000 direct, indirect and induced job-years. In the moderate-demand scenario, that same increase in in-state

### What is a Job-Year?

A job-year is simply one full-time equivalent job for one year (2080 hours, or 40 hours/week for 52 weeks). This measure takes into account the length of a job. For example, if a utility solar construction job is estimated to last 24 months, this would be measured as 2 job-years. Alternatively, if 10 people spend 208 hours on a rooftop solar project, this would be measured as 1 job year. In order to estimate the potential impact of Iowa's solar supply chain, total job-years are aggregated over the 2016-2030 time period.

### Why use job-years?

By using job-years, our analysis can take into account the length of a job. In energy projects, many construction and installation jobs are short-term, while manufacturing and maintenance jobs may be long-term. Using job-years allows us to accurately count both types of jobs. For example, if ten full-time solar construction workers are expected to each spend 208 hours on a large commercial solar project, this is measured as one job-year. Alternatively, if one full-time engineer is expected to spend fifteen years operating that same solar array, this is measured as fifteen job-years. In our analysis of Iowa's solar supply chain, total job-years are aggregated over the 2016 to 2030 period.





## Direct, Indirect, and Induced Job-Years

In order to estimate the potential economic impact of Iowa's solar supply chain, direct, indirect, and induced job-years are measured:

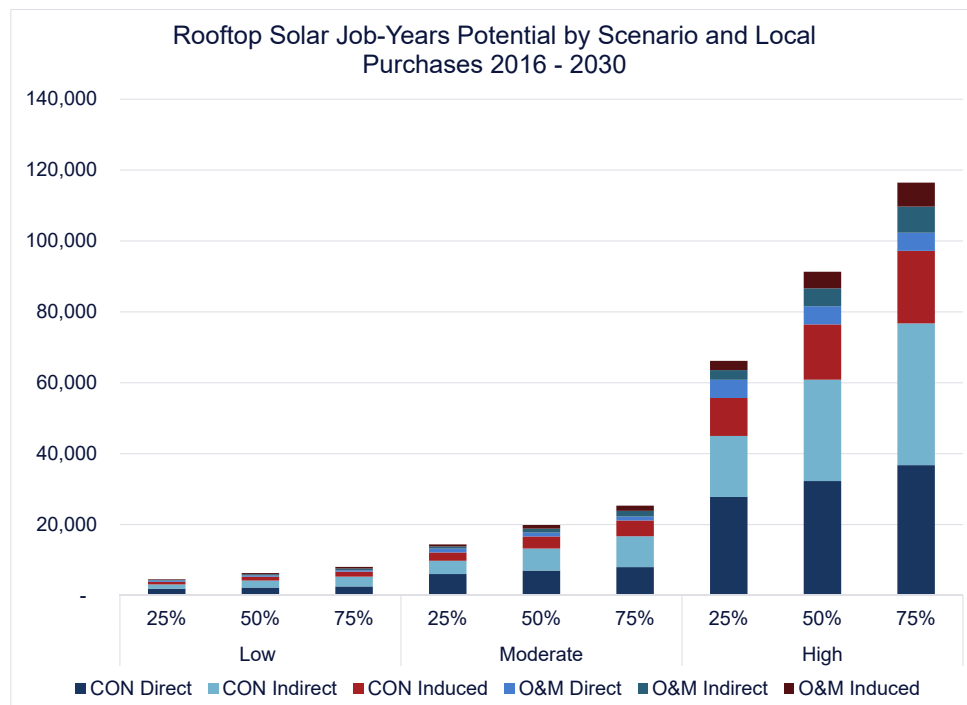
- Direct job-years: reflect jobs resulting from initial changes in demand in Iowa's solar industry
- Indirect job-years: reflect jobs resulting from changes in transactions between industries as supplying industries respond to increased demand from Iowa's solar industry
- Induced job-years: reflect jobs resulting from changes in local spending as a result of increased demand in Iowa's solar and indirect industries

## Local Share

Local share is the percentage of expenditures that are spent in Iowa. For example, if a solar installation company plans to spend \$3 million on imported solar PV panels and \$1 million on additional supplies from companies in Iowa, the local share is 25 percent. In the JEDI model, local share is an independent variable.

local purchases would create over 10,000 job-years. Even in the low-demand scenario, increasing the percentage of in-state local purchases from 25 percent to 75 percent would create nearly 3,500 direct, indirect and induced job-years.

If a concerted effort were made by the state to fill in the supply chain and strengthen the solar cluster, Iowa companies could meet the expected demand for solar, supporting up to 116,000 job-years. Increasing the number of supply chain businesses can create thousands of good-paying, skilled jobs and make Iowa a leader in the solar industry.



Figures 6. Increasing the percentage of local spending will increase job-years for Iowans



Installing solar panels  
Photo Credit: Dennis Schroeder / NREL

## Policy Recommendations

Demand for solar PV cells is set to increase over the next fifteen years<sup>43</sup>—the time to take advantage of the market for solar is now. Smart, strategic policies are needed to ensure that Iowa is at the forefront of this emerging market. If policymakers act quickly to capitalize on the opportunity presented in the marketplace, 7,700 jobs can be created annually through 2030. Iowa has a chance to lead in the solar sector, but without a targeted effort, other states will reap the benefit of this opportunity.

Iowa can bolster its solar cluster by focusing on innovative policies that stimulate demand for solar within the state. Creating a robust in-state market will attract private investment, strengthen the economy, and create new value chains. Iowa can create thousands of skilled, good-paying jobs by stoking competition and encouraging demand.

### Policy 1: Enable PACE Financing

High upfront costs of solar systems can be a barrier to investment for property owners. For homeowners and commercial property owners interested in owning and operating their own solar systems, property-assessed clean energy (PACE) financing can be used to mitigate the high upfront costs of solar systems. About 50 percent of U.S. states have passed legislation allowing PACE or have PACE programs; Iowa has not passed legislation enabling PACE financing.<sup>44</sup> PACE legislation allows local governments to create “land-secured financing districts” that property owners can join to fund solar energy systems and other renewable energy and energy efficiency projects.<sup>45</sup> The funding for solar installation is secured by a tax lien on the property and owners repay the money on their annual property tax bill over a five- to twenty-year term.<sup>46</sup> Two historical barriers to PACE in Iowa are the uncertainty caused by the 2010 Federal Housing Finance Agency (FHFA) and the logistical challenges getting PACE programs off the ground.<sup>47</sup>

#### PACE Financing Programs

Property Assessed Clean Energy (PACE) programs allow property owners to finance investments in renewable energy and energy efficiency with a loan that is repaid through their property tax bill. The loans are attractive for borrowers because energy investments often require more capital than would otherwise be available to many residents or commercial property owners. Lenders are willing to offer attractive interest rates because their loan is secured by a tax lien on the property. PACE financing is now available in over 800 U.S. municipalities and over 80 percent of the country’s population lives in states that provide PACE financing.<sup>48</sup>

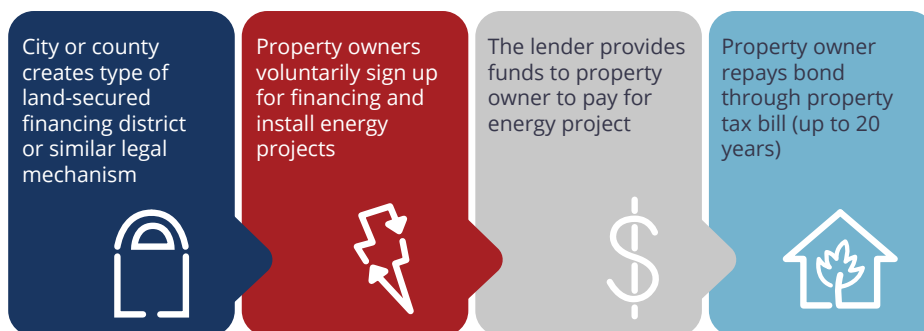


Figure 7. Property Assessed Clean Energy Finance (Source: Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy)



## A Roadblock to PACE Loans

The reach of PACE programs was put in jeopardy in 2010 by a Federal Housing Finance Agency (FHFA) decision.<sup>50</sup> The decision advised Fannie Mae and Freddie Mac to avoid buying homes with PACE liens on them.<sup>51</sup> The FHFA was concerned about the senior status that PACE liens have above a mortgage in a foreclosure proceeding.<sup>52</sup> This decision has limited the use of PACE for financing residential energy efficiency improvements. In 2015, the HUD announced that it is coordinating with the FHFA, the Consumer Financial Protection Bureau, and the Department of Treasury to provide new PACE guidance.<sup>53</sup>

### Best Practice: Local PACE Financing

PACE programs can be implemented in a variety of ways, making local adoption a daunting process. Texas has led the way with the creation of the “PACE in a Box” toolkit. The Texas toolkit project was seeded with \$200,000 from the Texas State Energy Conservation Office and \$800,000 from foundations and PACE stakeholders.<sup>49</sup> With that funding, the program researched best practices and developed a uniform, scalable, turnkey program, including such details as bond requirements, uniform lending documents, model municipal resolutions, and underwriting and technical standards.

Other states, such as California, have eased banks’ concerns about the 2010 FHFA decision by creating a PACE loss reserve fund. With a loan-loss fund in place, any PACE loan money lost by a bank in a foreclosure will be repaid with money from the PACE loss reserve fund.<sup>54</sup> In the year after California created a \$10-million PACE loss reserve fund, \$300 million in private financing was pledged to create a new multi-county PACE program.<sup>55</sup>

Iowa can overcome these challenges and allow PACE programs to spring up around the state by creating its own PACE-enabling legislation and providing tools for communities to establish the program. Iowa policymakers can create a high-quality PACE toolkit based on the Texas model, conveniently available online. Similar to Texas, Iowa could seed the project with minimal funding and look for partners to provide the bulk of the money. Additionally, Iowa could stimulate private investment by creating its own PACE loan-loss reserve program. The creation of such a fund would attract private investment to the state. By establishing a PACE toolkit and a loan-loss reserve, Iowa could empower local governments to quickly and efficiently implement PACE programs, stoke in-state solar demand, bring millions of dollars of private investment to the state, and create good-paying, skilled jobs for residents.

## Policy 2: Establish Refundable Tax Credits for Public Entities

Iowa offers a variety of tax incentives to help encourage the development of solar systems, including property and sales tax exemptions, as well as production tax credits. However, public entities such as schools, hospitals, municipalities, and rural co-operatives cannot fully benefit from these credits since they do not have a tax liability and the tax credits are only transferable. Iowa policymakers could institute a refundable investment or production tax credit program specifically for eligible public entities. This would enable these entities to benefit from the same incentives to which individuals and business currently have access.



Refundable tax credits for public entities are already employed in Iowa to encourage investment in historic preservation. The state currently provides a refundable Historic Preservation and Cultural and Entertainment District Tax Credit, which helps offset the costs of restoring historic properties.<sup>56</sup> The program provides an income tax credit of up to 25 percent of restoration costs for eligible projects.<sup>57</sup> Because the tax credit is refundable, nonprofit groups have a greater incentive to take on costly restoration projects.

Providing a refundable tax credit for renewable energy investment and production would enable and encourage public entities to develop solar energy capacity. Eligibility for the solar tax credit could be limited to certain groups that cannot currently take advantage of existing tax credits, including schools, hospitals, and consumer-end utilities. Additionally, the program could be capped at a certain dollar amount per year to ensure feasibility and cost-effectiveness for the state. Given that there are waiting lists for the existing tax credits, the caps could be increased to allow public entities to participate. This could be achieved by increasing the caps and setting aside a portion of the new allocations for public entities. Extending the benefits of tax incentives to public entities is a valuable mechanism to encourage greater deployment of solar across the state.

### Policy 3: Improve Solar Net Metering

Currently, only the state's two investor-owned utilities (IOUs) practice net metering.<sup>58</sup> Municipalities and rural cooperatives are not required to provide net metering to their customers,<sup>59</sup> leaving about 30 percent of Iowa's population without access to this incentive.<sup>60</sup> Net metering is also capped at a relatively low system size, reducing the number of facilities that could qualify for the incentive. Last, there is no aggregate or virtual net metering authorized in the state. Iowa's legislature could help increase the adoption of solar in the state by removing these barriers to solar freedom.

First, legislation could be enacted to apply net metering provisions to municipalities and rural cooperatives. This would ensure that all Iowans have equal access to solar energy development opportunities and provide incentives to an additional 30 percent of the population.

Second, policymakers could increase the net metering cap or switch to a capacity limit. Currently, net metering is capped for systems sized greater than 500 kW.<sup>61</sup> Many other states have net metering caps much higher than Iowa's, ranging from 1,000 MW to no limit.<sup>62</sup> A capacity limit refers to phasing out net metering at a percentage of the customer's total load. For example, Arizona's cap for net metering is set at 125 percent of a customer's total

#### What is Net Metering?

Net metering is a primary mechanism for compensating residential and small-scale solar projects. Under net metering, customers with renewable electric generators can reduce their electric bill by generating some or all of their power and receive a credit from their electric provider for any excess generation.



connected load.<sup>63</sup> This provides a greater financial incentive for owners or managers of large properties, such as schools, manufacturers, or agricultural facilities, which have the potential to install more than 500 kW of electricity from solar. Iowa could also look into capacity limits based on customer demographics, similar to West Virginia, which has variable limits for residential, commercial, and industrial customers.<sup>64</sup> Raising the net metering cap or transitioning to a capacity limit would make Iowa more competitive with other states.

Last, the new net metering legislation could include aggregate and virtual net metering. Aggregate net metering relates to properties with multiple meters on the same property or adjacent properties.<sup>65</sup> Virtual net metering relates to property owners with multiple meters to distribute credits to multiple accounts.<sup>66</sup> Virtual and aggregate net metering policies enable renters, multi-property owners, and customers in multi-unit residences, commercial spaces, and government-owned facilities to take advantage of net metering incentives that are currently only available to single-property owners. Virtual net metering can be an important component of the development of community solar installations. Neighboring Minnesota is one of several states that allow both aggregate and virtual net metering.<sup>67</sup>

Establishing consistent statewide net metering rules and policies sends a positive market signal to investors and solar developers. By extending the net metering policy to all energy providers, raising the system size cap or replacing it with a capacity limit, and expressly authorizing aggregated and virtual net metering, Iowa could ensure more equitable access to this important policy mechanism.



Working on a solar energy system  
Photo Credit. Jamie Nolan / U.S. Department of Energy

## Policy 4: Enact Legislation Establishing Third-Party Solar Financing

Utilities in Iowa operate with the exclusive right to provide service to customers within their territories. However, in July 2014, the Iowa Supreme Court found that third parties that offer power purchase agreements for solar energy are not operating as utilities. This ruling allows third-parties to offer power purchase agreements to customers and provides access to an important financing tool for residential and commercial solar customers. However, there remains considerable uncertainty among solar developers in the state over the implementation of the court ruling due to the fact that it is silent on net metering and interconnection rules.<sup>70</sup> Without clear legislation implementing this judgment, uncertainty could hinder solar market growth and job creation.

Legislators in Iowa can look to Georgia's 2015 Solar Power Free-Market Financing Act for an example of how to provide market certainty with legislation. Georgia's legislators recognized the efficiency and effectiveness of allowing free market forces to finance solar systems. The law establishes the legality of PPAs, limits on the size and type of systems permitted, and outlines interconnection requirements.<sup>71</sup>

Third-party solar financing presents an opportunity for a new solar market in Iowa, as well as greater accessibility to the state's solar incentives for public entities and property owners. Iowa policymakers could enact legislation expressly permitting third-party solar financing and detailing net metering and interconnection standards. Clear implementing legislation is needed for residents and developers to fully capitalize on this growing market opportunity.

## Policy 5: Enable Local Communities to Benefit from Community Shared Solar Projects

Nearly half of all energy customers in the United States—49 percent of homes and 48 percent of businesses<sup>72</sup>—are locked out of the solar market. Iowa is no exception.<sup>73</sup> High PV project costs and a lack of property rights (for renters) are excluding access to the market. Additionally, many property owners have land or buildings that are not suited for solar due to size, orientation, or shade from nearby buildings and trees. To provide greater access to solar, fourteen states and the District of Columbia have offered a new solar delivery option for customers: community shared solar.<sup>74</sup> Community solar allows customers to buy or lease part of a shared solar system and their share of electricity generation is

### What Does Third-Party Solar Financing Mean?

Third-party solar financing offers a mechanism providing access to solar for parties that are interested in solar but do not want to assume the added risk of system ownership. A customer can buy power from a third-party-owned PV system built on their property.<sup>68</sup> Under a long-term contract called a power purchase agreement (PPA), lessees benefit from reduced upfront capital costs for system installation and minimal system maintenance.<sup>69</sup> Additionally, since the lessors can take advantage of tax incentives and secure a long-term contract, the price of the solar electricity to the customer is often cost-competitive with retail electricity prices. The lessors also assume responsibility for the costs associated with ownership of a solar system, reducing long-term risk for customers.



## Solar Made Simple: The Benefits of Community Solar<sup>76</sup>

- Customers buy only that amount of solar allowed by their budgets, rather than having to invest in a whole system.
- Permitting, site assessments, and interconnection hassles are all dealt with at the project level and not by individuals, saving time for customers.
- Utilities can also participate and help ensure benefits to the grid.
- Programs can be designed to allow customers to transfer their energy to new homes.
- Renters in multi-unit buildings and business owners are able to participate.

credited to their electricity bill.<sup>75</sup> Developing a community shared solar project can be cumbersome without enabling legislation. Iowa could pass community shared solar enabling legislation to facilitate project development and help customers overcome traditional, technical, and financial barriers to solar.

Iowa could draw from efforts in Colorado, which has been a leader in the growth of community solar. In 2010, the state passed the Colorado Community Solar Garden Act.<sup>77</sup> The response in Colorado was overwhelmingly positive: “shares in the facilities sold out in as little as 30 minutes after they were announced.”<sup>78</sup> The Colorado legislature recently passed new legislation expanding this original program.<sup>79</sup> Colorado’s legislation also served as a model for Minnesota’s successful community solar program.<sup>80</sup>

### Community Solar in Kalona, Iowa

Farmers Electric Cooperative, a nonprofit electric distribution cooperative, wanted to source 15 percent of its electricity from renewable sources by 2025.<sup>81</sup> However, the organization is located in southeast Iowa where wind resources are inconsistent and insufficient.<sup>82</sup> To solve this problem and tap into other energy resources, the organization developed a community solar garden for families, businesses, churches, and nonprofits.<sup>83</sup> The project has received positive feedback and currently has a waiting list for participation.<sup>84</sup> In 2014, the cooperative completed what was then the largest solar array in the state, generating enough electricity to power 120 homes.<sup>85</sup>

There are two common project models: (1) community-owned projects, where community members organize to purchase and own a shared solar project, or (2) subscription-based projects, whereby an electric utility, municipality, or cooperative builds, owns, and operates a project to which customers can subscribe.<sup>86</sup> Iowa could allow both under its legislation in order to maximize local access and control. For community-owned projects, the legislation could extend the same net metering laws as applied to individual residents. For subscription-based projects, the legislation could stipulate that customers will not be forced to buy power from a community solar installation. However, the electric utility, municipality, or cooperative could be given authority to determine whether residents need to “opt in” or “opt out” of purchasing power from a community solar arrangement. Furthermore, Iowa could give priority to public land leases designated for community solar. Passing and implementing the recommended policies would give all Iowans the opportunity to choose solar power.

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## Chapter Summary

Smart, strategic policies can help Iowa leverage the state's strengths to create a thriving solar economy. As clusters coalesce around a nucleus of activity and relationships, Iowa's policy-makers could consider removing barriers and stoking in-state demand to create a more diverse and robust solar sector. By enabling local communities to develop solar projects, clarifying net metering and third-party solar financing regulations, establishing PACE programs, and providing renewable energy tax credits for public entities Iowa could strengthen and expand its advanced energy economy.









# Chapter 4: Innovation Ecosystem and Access to Capital

## Innovation Ecosystem

- Promotes research and development
- Facilitates movement of 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

## Non-Dilutive Capital

Non-dilutive capital funding, such as grants and loans, does not affect ownership of a company. These funding sources may carry interest rates or have restrictions on how they are used, but will not affect the shares of the company.

In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem and break down barriers to capital. 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. State and local government institutions, as well as private entities, can take action and collaborate to maximize the impact of innovation, support new and expanding businesses, and create good-paying jobs in Iowa.

Innovation ecosystems promote research and development (R&D), bring new technologies to market, and incubate early-stage businesses. Allowing ideas to be easily transferred 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.

"One of the reasons the innovation sector still creates plentiful jobs is that it continues to be a labor-intensive sector, since the main production input in scientific research is human capital—in other words, people and their ideas."

– Enrico Moretti, *"The New Geography of Jobs"*

Access to capital is critical for the success of advanced energy technologies. New and growing businesses will face severe financial hurdles during technology development, commercialization, and expansion. Having access to investors and non-dilutive capital can be the difference between success and failure. In order to maximize the success of advanced energy businesses that create good-paying jobs, states should consider actively facilitating access to capital.

Seamless connections between researchers, entrepreneurs, investors, and non-dilutive capital are vital for advanced energy technology businesses to thrive. The new energy economy is a race, and only businesses capable of bringing innovative ideas to the marketplace quickly and efficiently will be considered winners.

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## Iowa's Innovation Ecosystem

Iowa supports a diverse innovation ecosystem that is anchored by the U.S. Department of Energy's Ames Laboratory (Ames Lab), three flagship public research institutions, and a strong advanced manufacturing sector. However, the state lags behind other states in entrepreneurship, new company formation, and job creation by new companies.<sup>1</sup>

Iowa's universities and Ames Lab are capable of developing high quality technologies that could serve as foundations for startup companies.<sup>2</sup> However, the state has less of an entrepreneurial culture, especially compared to the east and west coasts.<sup>3</sup> The state saw negative small business growth between 2010 and 2013 and has one of the lowest venture capital investments per capita in the country.<sup>4</sup> Iowa has an opportunity to spark more new tech-based businesses by leveraging the university research already being done in the state.

### Research Institutions and Initiatives

Iowa's leaders have been making strides to strengthen the state's industrial and university-based research and development. The state has increased its R&D expenditures with a higher than average expenditure per state GDP than the national average.<sup>5</sup> Overall, the state has a good network between universities and businesses for research and technical assistance. In addition to the research activities, Iowa's public universities have collaborative research centers that work between programs, universities, and businesses.

Iowa State University (ISU) has nearly 100 institutes and centers, including specialized research facilities.<sup>6</sup> ISU is home to Ames Lab, a government-owned, contractor-operated national laboratory of the U.S. Department of Energy. Ames has worked closely with ISU for the last 65 years.<sup>7</sup> Through its Critical Materials Institute, Ames Lab conducts extensive materials research for use in renewable energy technologies, such as wind turbines and solar PV panels.<sup>8</sup> ISU's Microelectronics Research Center also conducts research on PV materials and devices, and the Center for Building Energy Research's focus includes building-integrated renewable energy systems.<sup>9,10</sup>

Both of Iowa's public Research-1 universities have research centers focusing on wind energy. The ISU College of Engineering Research Wind Energy Initiative conducts research, education, and outreach to lower the cost of wind energy.<sup>11</sup> In addition, University of Iowa's College of Engineering houses the Wind Energy Resources group. Their research in wind spans everything from meteorology to components and manufacturing.<sup>12</sup> The



Wind Energy Resources group cross-collaborates with the hydroscience, computer science, and environmental research groups on campus.<sup>13</sup> At the state level, the Iowa Alliance for Wind Innovation and Novel Development (IAWIND) coordinates wind energy research.<sup>14</sup>

## Resources for Startups

Since 1987, the Iowa State University Research Park has been an incubator for startups driven by Iowa-based technologies and expanding businesses.<sup>15</sup> Part of Research Park's mission is to help participants connect and collaborate with the research institutions and centers on campus.

Iowa State University connects businesses to the innovative research being conducted on campus. The Office of Economic Development and Industry Relations is a one-stop-shop connecting companies and individuals with the university's technical assistance, R&D, and workforce development.<sup>16</sup> In 2014, the Office assembled data on the impact of the University's economic development units and found that the university provided business and technical assistance to nearly 3,000 clients and helped start 251 new businesses, creating over a thousand jobs.<sup>17</sup>

Iowa is home to a few business incubators and accelerators that have sprung up in the last few years. In 2013, Iowa Startup Accelerator (ISA) was formed with the mission of providing tech-based companies with mentorship, three months of training, startup support, and \$20,000 in exchange for 6-percent equity in the company.<sup>18</sup> In addition to the brand new ISA, the North Iowa Area Community College hosts a new business incubator on their campus. The program provides a space for new businesses to develop technologies and expand operations.<sup>19</sup>

The Iowa Innovation Corporation, a business-led nonprofit, facilitates economic development through public-private partnerships that connect businesses with public funds, private investments, and federal funding.<sup>20</sup> The Iowa Innovation Council, a council of advisors established by the legislature, provides recommendations to the Iowa Economic Development Authority to promote the innovation economy.<sup>21</sup>

## Government Programs

Iowa's state government has implemented programs to drive investment in new ventures, particularly in the clean energy sector. The state has several tax incentives and innovation funds, as well as job training programs.

To help bring innovative technologies to market, Iowa created the

Iowa Energy Center in 1990. The Center’s mission is to support “economic development, environmental sustainability, and social well-being” through advances in “energy innovation, education, and entrepreneurship.”<sup>22</sup> They do so by sponsoring and conducting research on energy systems, including investments in wind and solar energy technologies.<sup>23</sup> They also provide competitive grant programs for research in renewable energy and energy efficiency.

Established companies may be eligible for financial assistance through the High Quality Jobs program. The program provides assistance to offset the costs of locating, expanding, or modernizing facilities in Iowa. Businesses that meet the required wage threshold may be eligible for loans, forgivable loans, tax credits, exemptions, and/or refunds.<sup>24</sup>

With advanced research facilities, a federal lab, and programs to connect businesses with the university resources, Iowa’s universities provide a strong research base for wind power. Although there is less research in solar power, many of the state’s research strengths in wind could potentially be utilized for solar research. The state’s research foundation presents a significant opportunity to establish a robust innovation ecosystem. The state already has several programs to transfer research to the marketplace and spur startups, but the uptake has been slow and there is room for greater growth.

## Access to Capital

Access to capital is essential for entrepreneurs to grow their businesses and bring their products to market. Many entrepreneurs are not able to find the necessary capital to sustain their companies long enough to reach the commercialization phase. As shown in Figure 8, companies nationwide often face funding shortages during the prototyping and commercialization

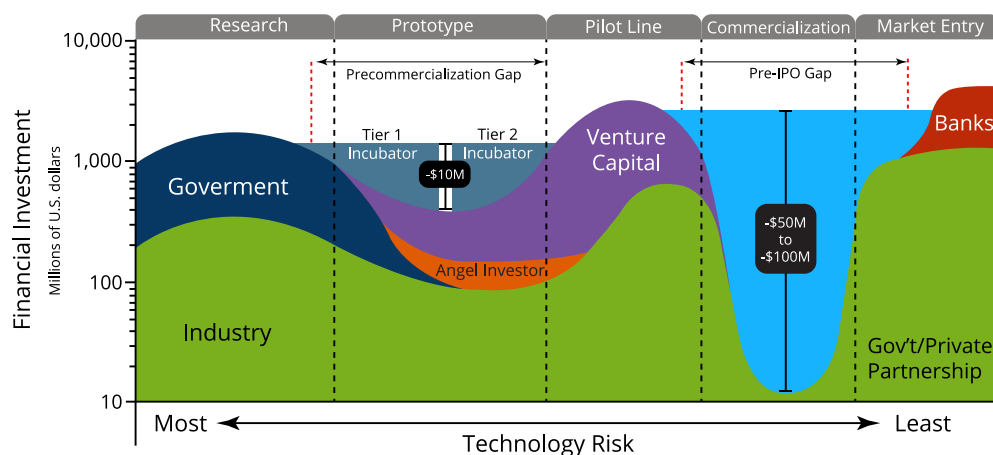


Figure 8. New technologies need help crossing the second “valley of death” during the commercialization process (Source: Department of Energy)



phases, commonly known as the “valleys of death.” In 2014, 75 percent of venture capital funding went to companies in California, New York, and Massachusetts.<sup>25</sup> Businesses in the other forty-seven states compete over the remaining 25 percent, making state-based policies for venture capital investments incredibly important.<sup>26</sup> Iowa has worked hard to drive new research and support technologies during the prototype stage, but the state could focus more attention on bringing innovative technologies to market.

Because Iowa lagged behind other states in creating new businesses and bringing new technologies to market, the state has made efforts over the last decade to spur greater investment in new businesses. Iowa now has several incentives for investors in early-stage businesses. The state has seen some uptick in private investment in new companies, but the record has been mixed.

## Venture Capital

Private investment into Iowa’s nascent energy clusters is the largest financial hurdle to supporting advanced energy growth. In 2013, an estimated \$22.5 million was invested in the state (0.08 percent of total venture capital investment in the United States), putting Iowa at 36th in the nation for venture capital activity.<sup>27</sup> There are only six venture/angel/seed capital firms located in the state.<sup>28</sup>

The majority of Iowa’s public funds available for grants and low-interest loans require some degree of fund matching with private capital. Despite hosting an array of state-based and regional venture and angel/seed capital funds by the Iowa Capital Investment Corporation, attempts to improve private investment in Iowa have proven less than fruitful.<sup>29,30</sup>

The Iowa Fund of Funds provided funds for venture capital investments made in Iowa in order to encourage economic development.<sup>31</sup> Unfortunately, few institutions were willing to invest and the program has been regarded as unsuccessful. The Fund has since been set to terminate upon the resolution of its debt.<sup>32</sup>

## Non-Dilutive Capital

Iowa enables access to early-stage capital through grants provided by the Iowa Demonstration Fund (IDF) and the Innovation Acceleration Fund.<sup>33,34</sup> The state also supports small business loans through the Alternate Energy Revolving Loan Program and the Iowa Small Business Loan Program.<sup>35</sup> Several of these programs have provisions designed to accelerate private



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investment by awarding public funding that matches qualified private capital investments.<sup>36</sup>

Recently, \$13 million was invested in small-to-medium-sized enterprises through the IDF, helping support commercialization activities by Iowa companies in advanced manufacturing, biosciences, and information technology industries.<sup>37</sup> The IDF contributed to the creation of more than 600 jobs and generated \$2.1 million in tax revenue.<sup>38</sup>

The Innovation Acceleration Fund provides loans to commercialize research, launch startups, and accelerate private investment, creating high quality jobs for Iowans.<sup>39</sup> Eligible businesses receive financing through three program components corresponding to the stages of growth. The three stages include the Iowa LAUNCH program (for pre-seed stage financing), the Iowa Propel program (for seed stage financing), and the Iowa Innovation Expansion Program (for expansion stage financing).<sup>40</sup>

Notably, the state has established the Iowa Energy Bank to finance a variety of energy-related projects for new and existing businesses/projects.<sup>41</sup> The bank is coordinated by the Iowa Area Development Group, which also assists in preparing financial packages for new businesses and in siting project locations.<sup>42</sup>

The Iowa Energy Center offers three competitive grants for businesses with projects related to “energy research, development, demonstration, deployment, education, and workforce development.”<sup>43</sup> The first grant provides funding for activities that bring together partners in planning and responding to external funding opportunities. The grant supports strategy meetings, gathering teams, proposal-writing workshops, and meeting with sponsors. The second grant focuses on early-stage experiments, such as proof-of-concept tests and economic viability analyses. The grant’s purpose is to support projects that are close to market. The third grant is a matching grant where the Energy Center will commit 20 percent of the total external money expected to come to Iowa. The grant cap is \$200,000 per year.<sup>44</sup>

## Tax Incentives

Iowa’s Innovation Fund Tax Credit program is designed to promote venture capital investment in innovative, early-stage businesses in Iowa that include activities in advanced manufacturing, bioscience, and information technology. The state has allocated \$8 million for the fund this year.<sup>45</sup> Investors in certified funds receive tax credits of 25 percent of an equity investment.<sup>46</sup>

The Iowa Angel Investor Tax Credit is aimed at increasing venture capital for seed stage businesses. The law gives investors a tax credit of 25 percent of the equity investment in qualifying



Iowa businesses.<sup>47</sup> The tax credits are fully refundable.<sup>48</sup> The incentive is capped at \$100,000 for each individual per qualifying investment and \$500,000 for equity investments in any one qualifying business.<sup>49</sup>

Iowa has worked to increase investment in new companies by offering tax credits for investors, providing grant programs, investing directly in local projects, and creating revolving loan funds. Unfortunately, these programs have had a mixed record of success. The state could leverage its resources by pursuing smart policies that will effectively and strategically promote business growth.

## Policy Recommendations

In order to take full advantage of the strengths of Iowa's university research and development activities, the state must continue to invest in commercializing its research activities. The following policy recommendations encourage investment in new companies and should get entrepreneurs excited about starting companies in Iowa.

### Policy 1: Allow Capital Gains Tax Exemption for Early-Stage Investors

In Iowa, capital gains are taxed as ordinary income.<sup>50</sup> The highest bracket applies a rate of 9 percent.<sup>51</sup> This is high compared to the 5 to 6 percent rates of Illinois, Mississippi, and Wisconsin.<sup>52</sup> Iowa's high capital gains tax is a barrier for investors because it cuts into the profit they make from investing in the state.<sup>53</sup>

#### Capital Gains Taxes

The capital gains tax is a tax on the sale of an asset that was purchased at a lower cost than it was sold. For example, an individual purchases stock in a company and then sells that stock at a later date when the company is worth more. The tax is applied to the positive difference between the purchase and sale price, or the capital gain.

In the United Kingdom, the government implemented the Enterprise Investment Scheme (EIS) and Seed Enterprise Investment Scheme (SEIS), which are two incentive programs that provide tax relief to investors in small and early-stage companies. The EIS started in 1994 with the aim to help small companies raise capital by offering tax relief to investors. About 22,900 companies have benefited from the EIS, raising over £12.2 billion in funds since the program began in 1994.<sup>54</sup>

In 2012, the government established SEIS, which offers tax relief at a higher rate for early-stage investment, recognizing the difficulties companies face in getting investors early on.<sup>55</sup> Both programs offer an element of income tax relief, as well as complete capital gains tax relief after a three-year investment period.<sup>56,57</sup> In 2013 and 2014, SEIS spurred investments in nearly 2,000 companies, which raised £164 million.<sup>58</sup>

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Iowa could pursue a similar strategy to promote investment in wind and solar companies. The legislature could pass a capital gains tax exemption for investments in small and early-stage advanced energy companies. Encouraging capital to flow to Iowa's wind and solar businesses will grow the sector and create good-paying, skilled jobs for Iowans.

## **Policy 2: Establish a Matching Grant Program for Awardees that Receive Federal Funding**

Iowa's early-stage businesses receive far more support than businesses in the commercialization stage, i.e., the phase when businesses bring their products to market. Early-stage businesses looking for capital are supported by several groups and programs, including the Iowa Innovation Corporation, the Iowa Startup Accelerator, and the Iowa Energy Center. In addition, early-stage companies benefit from the state's strong research base and assistance for proof-of-concept stage technology. The state lacks similar support for companies entering the commercialization stage.

To attract and retain companies and support them during this critical phase of growth, Iowa could create a matching fund for businesses that are awarded funding by the federal Small Business Innovation Research (SBIR)<sup>59</sup> and Small Business Technology Transfer programs.<sup>60</sup> This support could be coupled with increased commercialization planning assistance. The fund could be targeted at federal award grantees that align with renewable energy technologies. Iowan businesses have received over 360 federal grants through the SBIR program, with more than a quarter of these in phase two (prototype phase).<sup>61</sup>

Kentucky has a matching grant program that matches federal grants with a state award.<sup>62</sup> Awards are given to companies either already located in Kentucky or willing to move at least 51 percent of the company to Kentucky within 90 days of the match.<sup>63</sup> Other states match fifty cents per dollar.<sup>64</sup> The administrative burden to the state is low because there is no additional screening process; the federal awardee process has already vetted companies.

Support for businesses that have seed funding is crucial to ensuring they survive through the commercialization phase.<sup>65</sup> The state can use its existing Iowa Innovation Council and Iowa Innovation Corporation for planning assistance and the Iowa State University Office of Economic Development and Industry Relations for technical and business assistance. Giving businesses matching funds can encourage businesses to stay in the state and could recruit new businesses to Iowa.



## Policy 3: Create an Equity Crowdfunding Hub

Iowa has one of the lowest rates of venture capital investments per capita in the country.<sup>66</sup> The state has made twenty-seven venture capital deals from 2009 to 2014, where the national average is about 445 deals and nearby states have had over 100 deals over the same period.<sup>67</sup> Iowa needs innovative ways to attract private money to new companies.

Online equity crowdfunding hubs allow businesses to advertise their companies and ideas to gather small investments.<sup>68</sup> They create a single source that in-state and out-of-state investors and individuals can go to and invest in new businesses.

### USEED

USEED is a service that helps educational institutions of all sizes develop customized crowdfunding portals. USEED runs the day-to-day operations of the platform for any campus group—whether it is the advancement office, specific departments, or student groups.<sup>69</sup>

PennState created a customized platform, PennState Crowdfunding, through USEED and piloted 12 projects.<sup>70,71</sup> Wisconsin offers a licensed crowdfunding hub called CraftFund where Wisconsin investors can browse specialized companies seeking investors.<sup>72,73</sup>

The Iowa Innovation Corporation or one of the state universities could be allocated funds to coordinate an equity crowdfunding hub for private investors and individuals. Iowa has already passed legislation exempting intrastate crowdfunding from registration and compliance obligations required of large public companies.<sup>74</sup> Iowa's leaders could also provide a matching grant to help secure funds through the online platform for activities in wind and solar research.

## Chapter Summary

Iowa has a well-established innovation ecosystem that includes programs to drive research, tax incentives for companies, government grants, and more. The state's universities and research labs provide Iowa with a broad foundation for spurring growth in advanced energy businesses. Policymakers can build upon this foundation by creating an intrastate equity crowdfunding platform, establishing a matching grant program, and providing capital gains tax exemptions for investments in early-stage Iowa companies. These types of pro-market, forward-thinking policies would allow Iowa's advanced energy entrepreneurs to continue to innovate, bring ideas to market, and create good-paying jobs for Iowans.



# Chapter 5: 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 for their sector, they will be better equipped to identify their employment needs and find the workers with needed skills to fill available jobs.

Workforce development can include everything from career counseling to training and educational services. 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.<sup>1</sup>

Although Iowa has the sixth lowest unemployment rate in the nation,<sup>2</sup> the state faces barriers to continued economic growth including the lack of skilled workers and an aging workforce. Business leaders report continued shortages of skilled workers—a challenge for policymakers in a rapidly changing economy.<sup>3</sup> Another setback is the skills gap for middle-skill jobs, or jobs that require training beyond high school education but do not demand a four-year degree.<sup>4</sup> As older Iowans retire, closing the skills gap will be essential since “56 percent of the jobs in Iowa are middle-skill, while only 33 percent of workers possess middle-skills.”<sup>5</sup> Compounding these issues is the lack of interest among youth to pursue careers in manufacturing.<sup>6</sup>

Iowa’s manufacturing sector boosts the state’s economy and creates good-paying jobs, employing 13.75 percent of the workforce with an average annual wage of \$63,683.<sup>7</sup> Advanced energy manufacturing has played an increasing role in job creation. In 2014 alone, the wind power industry was responsible for over 6,000 direct and indirect jobs in Iowa,<sup>8</sup> and Iowa’s nascent solar sector employs more than 700 workers.<sup>9</sup> Continued growth is predicted for Iowa’s manufacturing sector due to a variety of factors, including renewable energy targets, increased tax incentives, and the state’s competitive business landscape (which is ranked as the 12th best state for business).<sup>10</sup> Employment



growth within the wind and solar sectors will continue to rise if state policy makers make a concerted effort to further galvanize Iowa's key strengths.

## Workforce Development Strengths

Iowa has several workforce development strengths that can be leveraged to support the emerging advanced energy sectors in the state. The Iowa Workforce Development Board was established in 1996 to "streamline employment and training programs."<sup>11</sup> To assess workforce challenges and seek solutions on a local level, the Board appointed fifteen Regional Workforce Development Boards to assess and propose solutions for their respective regions. Workforce development efforts in renewable energy and energy efficiency increased in 2010 when the Board was awarded a federal grant to expedite job training and placement in the sector. Businesses, dislocated workers, and under- and unemployed Iowans benefited from these efforts.<sup>12</sup>

Community colleges are an important source of workforce training. Iowa has fifteen community colleges that provide innovative educational frameworks for two-year vocational training programs.<sup>13</sup> These programs can provide a swift, affordable, and reliable means of earning certifications toward a career in clean energy, particularly for the wind sector. Community colleges are becoming the primary pipeline into the clean energy sector as well as the nexus between private sector participation and clean energy job training.

The Iowa Apprenticeship Program, the Industrial New Jobs Training Program, the Jobs Training Program, and the Accelerated Career Education Program all attempt to close the skills gap for middle-skill jobs and recruit talent for the manufacturing sector.<sup>16</sup> Program highlights include:

- The Industrial New Jobs Training Program funded 243 training contracts with 240 companies over the last two years, promising a total of 10,777 new jobs.<sup>17</sup>
- The Jobs Training Program awarded funds to 183 businesses and consortiums in 2015 to train 9,592 employees.<sup>18</sup>
- The Accelerated Career Education Program supported 165 companies and 1,300 positions in 2015.<sup>19</sup>

Since 2006, Iowa has sponsored over \$260 million in job training programs, which has trained over 20,000 state employees in the last two years only.<sup>20</sup>

• The Wind Energy and Turbine Technology Program at **Iowa Lakes Community College** is a two-year associate's degree program that readies students to become entry-level wind technicians. Students gain on-the-job experience through an on-site, 1.65 MW working turbine.<sup>14</sup>

• The alternative energy program at **Hawkeye Community College** now includes solar as part of its hands-on experience. Students learn about the design and operation of solar systems and get to work with real solar panels.<sup>15</sup>



## The Benefits of Apprenticeships

Apprenticeships incentivize participation from students and private stakeholders in the advanced energy field. Firms train apprentices to meet existing and future industry requirements, thereby providing valuable on-the-job skills for students to pursue gainful employment. Private companies are able to bolster their image as a community service provider while participating in low-risk training, and educators are able to develop marketable curriculums linked to real-world jobs.

## Iowa Apprenticeship Program

On May 27th, 2014, Governor Terry Branstad enacted the Iowa Apprenticeship and Job Training Act, which increased funding for apprenticeship programs in the state.<sup>21</sup> Through training grants, the act aims to increase the number of registered apprenticeships. In 2015, \$3.15 million were distributed to sixty-seven sponsors representing 4,767 apprentices.<sup>22</sup> Apprenticeships in the wind sector, such as Wind Turbine Mechanic and Wind Tunnel Mechanic, are eligible to register with the Department of Labor.<sup>23</sup> However, no such wind or solar apprenticeships currently exist in the state.<sup>24</sup>

## Iowa Alliance for Wind Innovation and Novel Development (IAWIND)

IAWIND is a statewide partnership between colleges, state and local governments, and the private sector.<sup>25</sup> Within IAWIND, nine university and community college wind technology training programs encourage students to enter the wind sector. IAWIND programs cover a wide-ranging spectrum, including the production, manufacturing, operation, and maintenance of wind turbines.<sup>26</sup>

## Wind and Solar Skills

Although the wind and solar sectors have different innovation and employment landscapes, considerable overlap exists between the skills needed to succeed in these sectors and the type and functionality of the occupations. Businesses involved in installation, maintenance, sales, and distribution represent about 69 percent of Iowa's advanced energy businesses.<sup>28</sup> However, as the state grows its clean energy clusters, the spectrum of jobs available for Iowans will expand.

## Wind: Jobs, Skills, and Training Needs

Jobs in a robust wind cluster fall into a few key categories: manufacturing, project development, and operations and maintenance. Within each category are job-specific skill sets for the various sub-sectors of each employment type.<sup>29</sup>

### Manufacturing

In the manufacturing sector, employment opportunities are housed under two general classifications: (1) research and development, which typically involves engineers, and (2) general manufacturing, which encompasses a variety of different

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production occupations.<sup>30</sup> In general, the core skill sets for engineers require technical expertise in mathematics, chemistry, physics, computer-aided design and programming, supply chain analysis, and electrical competency. General manufacturing jobs entail the physical assembly of wind turbines. The skill sets for these jobs are less technical and specialized, and many vocational and certification programs target this area of employment. In particular, general manufacturing jobs involve competency in industrial machinery, computers, mathematics and science, and “soft skills” such as communication, which enable manufacturers to interact with participants along the supply chain.

### **Project Development**

Wind project development involves a wide range of occupations, including land acquisition specialists, asset managers, logistical coordinators, construction workers, and project managers. Land acquisition specialists, asset managers, and logistical coordinators require expertise in finance, supply chain analysis, and commercial real estate in order to determine the feasibility of wind projects. Project development also involves construction workers to assemble wind turbines. While some construction workers are trained on the job, prior experience working with construction equipment as well as coursework in “English, mathematics, physics, mechanical drawing, blueprint reading, welding, and general shop” can be beneficial for training programs.<sup>31</sup> Project managers are also involved in the project development phase. Project managers tend to have a more rounded skill set that enables them to be effective communicators to the various members of the project development team, from the logistical planners to the construction workers. As a result, project managers usually have a construction background with a college degree.<sup>32</sup>

### **Operations & Maintenance**

Once the wind turbines are successfully installed, operations and maintenance professionals such as wind turbine technicians are required. Wind turbine technicians must have mechanical aptitude and understanding of “basic turbine design, diagnostics, control and monitoring systems, and basic turbine repair” in order to effectively maintain wind turbines.<sup>33</sup>

## **Solar: Jobs, Skills, and Training Needs**

The state’s solar workforce is primarily concentrated in third-party installation companies. However, a more robust solar energy cluster will involve a wide range of occupations in a variety of industry segments, including research and development, manufacturing of solar power components, solar power plant development, construction of solar plants, operations for solar plants, and solar power installation and maintenance.<sup>34</sup>



## Partnerships for Solar Training

In April 2015, Van Meter Inc. (an electrical supply wholesaler) and the Midwest Renewable Energy Association collaborated to provide contractors with solar PV training, giving opportunities for career advancement. The training, which occurred over the course of three days, was designed for people with industrial skills interested in solar installation.<sup>27</sup> The training session taught participants to install systems and qualified as Continuing Education Units for electrical license renewal.

## Manufacturing

Solar power manufacturing requires a workforce trained in electronics and “computer-controlled machine tooling” to manage the technical aspects of the manufacturing process, such as the panel shape and the use of protective chemical coatings.<sup>35</sup>

## Development and Operations

For larger solar arrays, solar power plant development demands the collaboration of real estate brokers and scientists to complete a proper site selection and assessment. Real estate brokers usually need a four-year degree with knowledge of finance, accounting, taxes, and environmental regulations in order to make decisions regarding solar development and property analysis.<sup>36</sup> After settlement and construction, there is a demand for power plant operators. Power plant operators require knowledge of electronics and computer-monitoring services to regulate electricity flow through the solar system. These positions include power plant workers, as well as electricians.<sup>37</sup>

## Installation

Solar installers, site assessors, and sales representatives evaluate and arrange solar panel installation with customers. Electricians then install electrical equipment, such as the wiring, inverters, and panels. The skill sets for these positions typically involve an understanding of basic physics, construction, electricity, and safety procedures.<sup>38</sup>



Photo Credits. (Left) pennstatenews / Foter / CC BY-NC-ND (Right) NREL

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## Workforce Development Recommendations

Once Iowa has made a commitment to grow its wind and solar manufacturing industries and has taken steps to recruit businesses, it needs to enhance its training programs to provide the talent needed to ensure the industry's success. While many notable apprenticeships, community college certifications, and training programs exist, Iowa can do more to close the skills gap and attract workers to manufacturing jobs.

### Policy 1: Create Tax Credits to Promote Employment and Training Opportunities in Advanced Energy

Jobs in advanced energy require highly-skilled employees or specialized training. Individuals seeking employment and firms in need of trained workers must therefore pay to improve skill sets. Investing personal or company funds for workforce development can be a barrier to upgrading skills. However, Iowa can turn this barrier into an opportunity by incentivizing investment in solar and wind workforce development through specialized tax credits for employing and training qualified workers.

Iowa can look to Oklahoma's successful Aerospace Engineer Workforce Tax Credit as a potential model for establishing an advanced energy tax credit. The Aerospace Engineer Workforce Tax Credit was created in 2011 to attract and retain high-skilled workers for Oklahoma's aerospace industry.<sup>39</sup> The tax credit is multifaceted: it includes an employer income tax credit at 10 percent of paid compensation for employees, an employer tax credit for tuition reimbursement, and an employee tax credit worth a maximum of \$5,000 per year for 5 years.<sup>40</sup> Qualified employees for Oklahoma's tax credit are limited to undergraduate or graduate degree holders. Local business leaders and policy makers have credited this policy with helping attract hundreds of jobs and increasing Oklahoma's tax base.<sup>41</sup>

The Iowa legislature could create a tax credit to include modest incentives for employers who employ qualified workers and reimbursements for employers who offer specialized training to their workers. The tax credit for employees could equal a small percentage of a new employee's salary. Training reimbursement tax credits could be limited to programs that provide workers with an industry-recognized credential, degree, or certificate to ensure that the funds are targeted at increasing skills that are relevant for advanced energy.





## Policy 2: Encourage Apprenticeships in the Wind and Solar Industry

There are no wind- or solar-specific apprenticeships in Iowa. Considering the current education and workforce development trends in renewable energy, there is considerable potential to develop a demand-driven pipeline for wind turbine and solar panel design and installation through recognized apprenticeship programs. In order to encourage the growth of both industries, the Iowa State Legislature, in coordination with the Iowa Economic Development Authority and Department of Commerce, could establish a specific tax credit to incentivize apprenticeships that promote industry-recognized certifications.

Iowa's tax credit can draw upon a successful policy in South Carolina that utilizes tax credits to promote apprenticeships. South Carolina has demonstrated how a small investment in apprenticeships can have huge payoffs for workers and the state. South Carolina's Apprenticeship Carolina™ program expanded apprenticeships through a simple model including outreach and tax credits. South Carolina's training consultants guide employers through the process of establishing an apprenticeship program, and employers receive a modest \$1,000 state tax credit per apprentice per year.<sup>42</sup> The program has served over 14,000 apprentices and averages more than 120 new apprentices per month.<sup>43</sup>

Registered apprenticeship programs have a significant return on investment: over the span of an average U.S. apprentice's career, tax revenues are more than \$27 per \$1 invested<sup>44</sup> and career earnings for those who completed their program are on average \$240,037 higher than similar nonparticipants.<sup>45</sup> The social benefit of a registered apprenticeship exceeds the social cost by an estimated \$49,000 over the course of a worker's career.<sup>46</sup> While South Carolina's tax credit focuses on apprenticeship generally, Iowa could specifically target wind and solar jobs with this tax credit. By establishing a modest tax credit that creates apprenticeships in these renewable energy industries, the state could help increase the pipeline of available workers in Iowa.

## Policy 3: Establish a Renewable Energy Education Strategic Fund (REESF) for Targeted Curriculum Enhancement and Pre-Employment Training

Iowa's *Re-Envisioned Economic Development Roadmap* surveyed 395 corporate executives representing twelve targeted industry clusters who reported concerns regarding workforce availability.<sup>47</sup> Iowa's overall low population growth and high



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rate of retiring citizens signal a need for targeted workforce incentives to fill gaps in key industry clusters, as well as a need for a dynamic and technically-skilled workforce. Therefore, policy makers must create clear pathways for young workers to pursue careers in renewable energy. To accomplish this goal, Iowa could create curricula enhancements for wind and solar in the main credentialed programs in universities, apprenticeship programs, and community colleges.

Iowa has taken the initiative to provide energy education in pre-college and college-levels. On the college-level, the University of Northern Iowa and the University of Iowa have prepared students for a wide range of highly valued, technically skilled professions through emphasizing renewable energy within engineering curriculums. In the pre-college landscape, the University of Northern Iowa and the U.S. Department of Energy established an “Alternative Energy Sources” module for Grades 5-8 that focuses on wind and solar energy.<sup>48</sup> Given the strong base of relevant education and training programs available in the state, Iowa could enhance its current workforce training programs rather than establishing completely new programs. Weaving wind and solar education into traditional pre-employment curriculums enhances opportunities for Iowa’s key industry sectors, while also offering more opportunities for career advancement than other shorter-term, focused programs like wind technician and solar installer.<sup>49</sup>

Funding for these enhancements could come from the development of a Renewable Energy Education Strategic Fund (REESF), which could be managed through the Iowa Workforce Development Board. Iowa’s REESF can draw upon Washington’s success with its “High Skills, High Wage Strategic Fund,” which utilizes about \$625,000 in Workforce Investment Act dollars in order to address the workforce needs of key industry clusters such as marine engineering and renewable energy planning.<sup>50</sup> Washington’s Fund helped create jobs and training opportunities in these critical industries.<sup>51</sup> Iowa’s REESF could support education-to-work programs and add modules to pre-existing programs. Overall, these programs could incentivize public-private partnerships between schools and key industry stakeholders, allowing companies to hire from a pool of highly qualified candidates.

## **Policy 4: Upgrade Worker Skills Through Stackable Credentials**

Iowa’s focus on workforce innovation, retention, and recruitment is a key strategy to drive growth of established and emerging industries.<sup>52</sup> Nearly 30 percent of those who are employed with an associate’s degree or higher work in jobs that do not require an associate’s degree.<sup>53</sup> With renewable energy as one of the state’s



## Stackable Credentials

A system of stackable credentials is an organized sequence of certificates that can be earned over time to strengthen skills and to advance along or up a career pathway to different and higher-paying jobs.<sup>56</sup> This sequence has shorter-term skill development blocks that allow students to exit and enter while still having gained marketable skills, which reduces educational and employment barriers for non-traditional and disadvantaged students.<sup>57</sup>

twelve key industries,<sup>54</sup> Iowa could create and incentivize skill or certification standards in wind and solar industries.<sup>55</sup> In order to identify, promote, and validate these skill certifications, Iowa's community college consortium, universities, industry leaders, and workforce development strategists could collaborate to offer stackable credentials in Iowa.

Iowa could look to North Carolina when designing its stackable credentials policy. As a model state, North Carolina has experienced success through its own structure of stackable credentials, which provide academic and skill-based continuity from the community college to state university system. North Carolina's program design ensures that students are able to accomplish this by: (1) streamlining course titles and requirements across the entire state university system; (2) allowing students to obtain credit for competency-based skills gained through on-the-job experience or training; and (3) ensuring that students who complete courses and degree programs receive credentials and certifications that are recognized and valued by industry.<sup>58</sup>

Stackable credentials are designed to give students the opportunity to build qualifications and training over time, progressing towards higher educational achievement and earnings.

Stackable credentials would allow Iowans to continually validate skills in partnership with key industry stakeholders and community colleges. Credentials could target the incumbent workforce and include specialized training in the key industry sectors (i.e., wind or solar). Credentials could be reassessed every one to two years to ensure they align with industry needs. A stackable credential system can be a tool used to train workers at all skill levels—closing the skills gap in Iowa to provide good-paying jobs in advanced energy.

## Chapter Summary

While Iowa has workforce development challenges—most notably a shortage of skilled workers, an aging workforce, and a general lack of interest in the manufacturing sector among Iowa's youth—the state has an impressive array of programs that train workers in the clean energy sector. However, many of these programs target college-aged students and do not address the skills gap in Iowa. Innovative workforce strategies that encourage public-private collaboration, target specific populations such as mid-career workers, and incentivize apprenticeships can prepare Iowa to meet the demands of the advanced energy industry and train Iowans for good-paying jobs.



# Conclusion

In order to build on Iowa's success in the advanced energy space and position the state for continued growth, policymakers will need to make advanced energy a priority. The purpose of *The Iowa Jobs Project: A Guide to Creating Advanced Energy Jobs* is to analyze the state's advanced energy economy in order to create recommendations specifically tailored to the state's needs. The policies recommended in this report are complementary and intended to help the state grow demand for advanced energy technologies, manufacture products within the state, enable entrepreneurship for technological advances, fund innovation with accessible capital, and equip workers with the skills required for the state's future economy.

Policy leadership in the advanced energy space can play an important role in promoting Iowa's advanced energy clusters and creating quality jobs for Iowans. Advanced energy clusters focused on wind and solar offer a great opportunity for the state to grow its economy, create jobs for the state's residents, and become a leader in the production and deployment of advanced energy technology.

If Iowa's policymakers take swift and purposeful action to grow the wind and solar clusters, these industries can support up to 18,000 jobs annually through 2030.

Iowa has the right mix of strengths to leverage this opportunity. With smart, forward-thinking policies, the state can diversify its economy and create thousands of middle class jobs for hard-working Iowans.

For more information about advanced energy technologies and best practice policies, visit <http://americanjobsproject.us/>.

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# Appendix

## Economic Impact Methodology

The American Jobs Project combines existing tools, analysis, and projections from several reputable sources to estimate job creation. Rather than providing a specific estimate, we show jobs potential across a range of possible outcomes. All jobs are shown in job-years that exist during the analysis timeline (2016-2030).

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.

The solar and wind jobs analyses used the Job and Economic Development Impacts (JEDI) model and evaluated growth estimates across different levels of local-share spending for scenarios from the EIA's Annual Energy Outlook 2015 Clean Power Plan Analysis, EERE's Wind Vision, and Bloomberg New Energy Finance.

## Tools for Economic Impact Analysis

A number of modeling tools are available for estimating economic impacts from advanced energy industry growth. This report employs two of the most common tools available for advanced energy: Jobs and Economic Development Impact (JEDI) and Impacts for PLANning (IMPLAN). Results from the JEDI model only show job gains and do not evaluate losses in other industries. They are based on approximations of industrial input-output relationships, and do not include intangible effects.<sup>1</sup> The JEDI model is widely used because it estimates construction and other project economic impacts at the local (usually state) levels.<sup>2</sup> IMPLAN estimates the economic impact of each dollar invested into a sector and the resulting ripple, or multiplier, effects across the economy.<sup>3</sup> Multipliers are used to generate the economic impacts of the project across three different categories of jobs: direct, indirect, and induced.<sup>4</sup>

It is important to note the limitations of these modeling methods. As mentioned, the estimates shown are only gross job-year creation. Job losses in industries that compete with those in our analysis are not evaluated. Models do not dictate behavior, so indirect and induced jobs 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.

## Estimates Used in the Iowa Report

### Solar

JEDI was used to estimate jobs potential for the solar industry in Iowa. We show the jobs potential from several scenarios based on different percentages of local share, i.e., how much of the total industry supply chain and service expenditures could happen in the state to serve local and national demand. In the report, we show a range of 25 percent to 75 percent of local share at 25 percent increments—0 percent would represent an unlikely situation where no products or services are purchased in the state and 100 percent would represent an equally unlikely scenario in which all products and services are provided by a perfect in-state supply chain. The true potential likely lies somewhere in between, but is dependent on the options and incentives for purchasing local goods and hiring local firms to provide services. In cases where there were only regional estimates, we assume that Iowa would maintain its current weighted average of solar capacity in the region over time. Where detailed information was not available for rooftop solar, estimates are based on “Tracking the Sun” weighted average distribution for residential, small commercial and large commercial buildings.<sup>5</sup> This was also used for average capital costs per MW for analyses in JEDI. Job-years included in this analysis represent all job-years that exist during the timeframe of 2016-2030.

### Wind

JEDI was used to estimate jobs potential for the wind industry in Iowa. We show the jobs potential from several scenarios based on different percentages of local share, i.e., how much of the total industry supply chain and expenditures could occur in the state to serve local and national demand. In the report, we show a range of 25 percent to 75 percent of local share. Job-years included in this analysis represent all job-years that could exist during the timeframe of 2016-2030.

Data used in the JEDI analysis were collected from the three sources listed below.

### DOE Office of Energy Efficiency and Renewable Energy: Wind Vision

The Wind Vision Study Scenario includes projections for utility-scale solar PV and rooftop solar PV deployment.<sup>6</sup> The input parameters are similar to those found in the DOE’s 2012 SunShot



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Vision Study, a comprehensive review of U.S. solar electricity generation potential that was managed by NREL.<sup>7,8</sup> The Wind Vision projections are based on updated assumptions about the phasing out of the solar investment tax credit.<sup>9</sup> Wind Vision's cost assumptions are based on SunShot Vision Study's 62.5 percent solar cost reduction scenario, where the 62.5 percent reduction is reached in 2020 and a 75 percent reduction is reached in 2040.<sup>10</sup> Wind Vision's authors compared those cost estimates to a sample of leading costs projections and found them to be consistent with the average estimates in the literature.<sup>11</sup>

## **Energy Information Administration: Annual Energy Outlook 2015 Clean Power Plan**

This report considers the proposed Clean Power Plan as modeled using EIA's National Energy Modeling System (NEMS). NEMS is a modular economic modeling system used by EIA to develop long-term projections of the U.S. energy sector, currently through the year 2040.<sup>12</sup>

The level of regional disaggregation in NEMS varies across sectors. For example, Lower 48 states electricity markets are represented using 22 regions, coal production is represented by 14 regions, and oil and natural gas production is represented in 9 regions. In many but not all cases, regional boundaries follow state borders. To the extent possible, this analysis represents the Clean Power Plan using regional targets derived from the state-level targets in the EPA's proposal.

The Reference case projections developed in NEMS and published in the Annual Energy Outlook 2015 generally reflect federal laws and regulations and state renewable portfolio standards (RPS) in effect at the time of the projection. The Reference case does not assume the extension of laws with sunset provisions. In keeping with the requirement that EIA remain policy-neutral, the Reference case does not include proposed regulations such as the Clean Power Plan.

By explicitly modeling the intensity targets, NEMS does not require or assume specific levels for individual compliance strategies. The discussion of EIA's analysis presents results in terms of the compliance options used to meet the regionalized Clean Power Plan targets.<sup>13</sup>

This report uses the Base Policy Scenario for its analysis.



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## **Bloomberg New Energy Finance**

Data from the “Medium-term outlook for US power: 2015 = deepest de-carbonization ever” report were provided by Bloomberg New Energy Finance (BNEF).<sup>14</sup> BNEF projections build off an empirical process of research, based on market projections, EIA information and interviews with industry stakeholders. These projections are updated and published annually, though the back-end data is private and cannot be shared except by permission. BNEF graciously provided the data to us on the condition we would not publish it and only use it for our economic impact analyses. This in no way implies an endorsement of our project or our projections by BNEF.



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