

# Clean Economy Rising

## Industrial energy efficiency thrives in Pennsylvania

### Overview

With a strong legacy in manufacturing and fossil fuel generation, Pennsylvania now is harnessing its renewable resources to develop a robust clean energy economy. The state's policies have encouraged the deployment of solar and wind power as well as industrial energy efficiency technologies (which recycle wasted heat to generate electricity and heat on-site, improving resiliency and reducing costs for a variety of businesses). This brief examines the policies driving Pennsylvania's success in the clean energy industry and identifies potential growth opportunities.

## Clean energy policies

Pennsylvania and its cities provide a variety of policies and funding opportunities for clean energy. The state's 2004 Alternative Energy Portfolio Standards law was the first in the United States to include both renewable and alternative energy sources.<sup>1</sup> According to the statute, 8 percent of the state's electricity must come from Tier 1 renewable sources by 2021, which include solar, wind, low-impact hydropower, geothermal, most biomass, biologically- or coal-derived methane gas, and fuel cells. Ten percent must come from Tier 2 alternative energy sources, which include advanced coal technologies, certain biomass projects (energy made from wood and wood waste-derived products such as wood pellets), conventional hydropower, distributed (on-site at homes and businesses) power generation, and utility incentives for customers to reduce their energy consumption.

In addition, the law requires that solar power deliver 0.5 percent of electricity to Pennsylvania consumers by 2021.<sup>2</sup> In the decade since the law's passage, state legislators have defeated multiple attempts to weaken and roll back the requirements,<sup>3</sup> so the standards remain a key driver of clean energy investment. As a result, Pennsylvania now draws 4 percent of its net electricity from renewable energy<sup>4</sup> and is on track to meet the 2021 goal.

The law also requires that the Pennsylvania Public Utility Commission adopt policies to enable distributed generation. These include interconnection standards, which authorize residential and industrial customers to connect to the grid energy systems of up to 5 MW, and net metering, which allows customers to offset their energy costs by returning to the grid excess electricity from distributed systems in exchange for a credit on future utility bills. The commission expanded these programs in 2012 to permit nonutilities, such as solar developers, to own distributed energy systems on a business' or homeowner's property and to reap the financial benefits, so long as the project produces no more than 110 percent of on-site electricity needs.<sup>5</sup>

However, the Public Utility Commission is evaluating proposed changes that could place new restrictions on the state's net metering standards.<sup>6</sup> If adopted, this restriction could stunt deployment of new distributed generation installations by restricting the size of a residential customer's system so that it does not exceed the existing demand for energy.<sup>7</sup>

Finally, the state offers property tax incentives and other financing to encourage clean energy deployment, complementing the federal investment tax credit for solar. Since 2004, the Pennsylvania Energy Development Authority has invested approximately \$10 million annually in clean energy projects,<sup>8</sup> and in June 2014, the authority announced a new grant and loan cycle to encourage development of renewable energy projects, offering \$1.25 million for hydroelectric power, solar, wind, and biomass project developers.<sup>9</sup>

Key State Policies					
<input checked="" type="checkbox"/>	Renewable portfolio standard	<input checked="" type="checkbox"/>	Tax incentives	<input type="checkbox"/>	Green power purchasing
<input checked="" type="checkbox"/>	Net metering and interconnection standards	<input checked="" type="checkbox"/>	Bonds/loans/rebates/other financing	<input checked="" type="checkbox"/>	Nonutility sales of renewable electricity allowed

Source: North Carolina State University, Database of State Incentives for Renewables and Efficiency

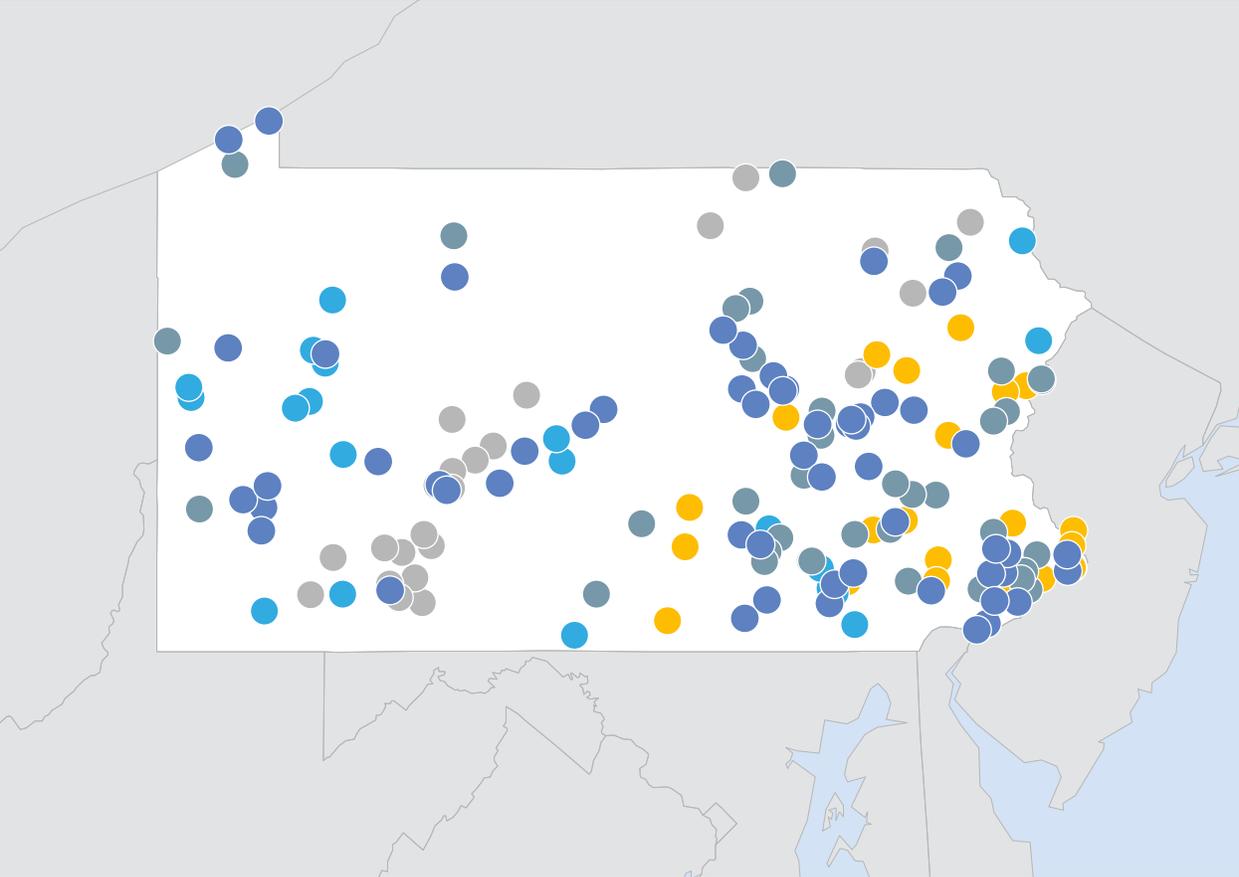
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# Sources of power and economic growth

As one of the top electricity-producers, Pennsylvania is a key supplier of electricity to other states in the Northeast.<sup>10</sup> Historically, the Keystone State’s energy has come from fossil fuel generation. However, clean energy sources are emerging partly because of financial incentives. From 2009 to 2013, Pennsylvania added nearly 1.4 gigawatts of new clean energy capacity—dominated by wind (941 MW) and solar (209 MW)—according to Navigant Research. As of 2013, Pennsylvania had 1.3 GW of installed wind capacity, enough to power over 300,000 average homes.<sup>11</sup>

The use of these technologies is spurring new economic activity in the state. In 2013, Pennsylvania ranked sixth nationally in attracting private investment in clean energy, at \$841 million—culminating five years in which private investment in the sector totaled \$3.5 billion. According to Navigant Research, this investment will grow by another \$17.7 billion from 2014 to 2023. In addition, the state ranks fourth nationally in jobs supported by clean energy and other environment-related activities (nearly 137,000).<sup>12</sup>

## Renewable Electricity Power Plants, >1 Megawatt Capacity



● Hydro ● Wind ● Biomass ● Solar ● Combined heat and power

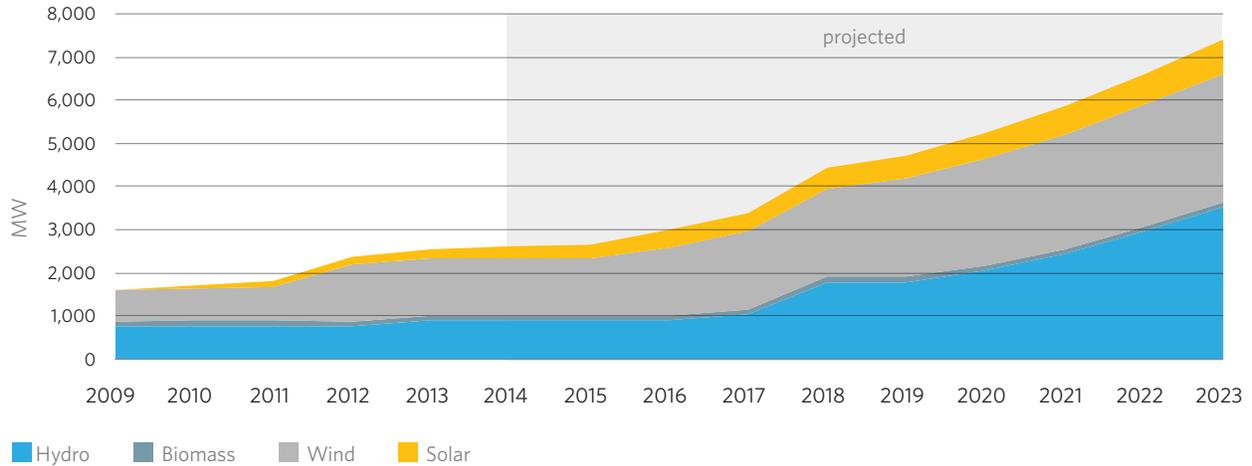
Sources: Energy Information Administration, U.S. Department of Energy state combined heat and power data

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# Snapshot: Pennsylvania's clean energy economy

## Clean Energy Capacity, by Sector and Year

Actual (2009-13) and projected (2014-23) growth in cumulative capacity



Note: Navigant Research provided data and projections of annual capacity additions from 2009 to 2023. These figures were added to baseline 2008 cumulative capacity data from the Energy Information Administration (except for wind and solar, for which cumulative data were available from Navigant Research). Navigant Research's methodology is described at the end of this brief, and that of the Energy Information Administration is in Table 3, available at <http://www.eia.gov/renewable/state/pennsylvania/index.cfm>.

Sources: Navigant Research, Energy Information Administration

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## Clean Energy Investment, by Sector and Year

Actual (2009-13) and projected (2014-23) annual investment



Source: Navigant Research

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## New Clean Energy Capacity Installed in 2013 (MW)

Hydropower accounted for the majority of new projects

 <b>Hydro</b>	<b>138.9</b>
 <b>Solar</b>	<b>38</b>
 <b>Combined heat and power</b>	<b>6.6</b>
 <b>Biomass</b>	<b>0</b>
 <b>Wind</b>	<b>0</b>
 <b>Geothermal</b>	<b>0</b>
 <b>Marine hydrokinetic</b>	<b>0</b>
<b>Total</b>	<b>183.5</b>

Source: Navigant Research

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“Alternative and renewable energy sources are increasingly playing an important role in Pennsylvania’s energy portfolio. Wind, solar, and other alternative and renewable resources are helping to create jobs, stabilize and strengthen our electric grid and diversify our energy portfolio.”

— Pennsylvania State Energy Plan, 2014

## National Rankings

Rank	
<b>4th</b>	in energy- and environment-related jobs, 2011 (136,557)
<b>6th</b>	in private investment, 2013 (\$841 million)
<b>11th</b>	in new renewable capacity installations, 2013 (175 MW)

Sources: Navigant Research, Bureau of Labor Statistics

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## Industrial energy efficiency highlights

Pennsylvania is home to a strong manufacturing industry in traditional sectors such as food processing, chemicals and plastics, steel production, and metal fabrication, as well as in emerging areas such as clean energy and 3-D printing.<sup>13</sup> Manufacturing accounts for nearly 12 percent of the state’s total gross product and employs nearly 10 percent of the workforce.<sup>14</sup> The industrial sector is the largest consumer of electricity in Pennsylvania, at 33.5 percent of the total.<sup>15</sup> Pennsylvania’s industrial energy use ranks seventh nationally.<sup>16</sup>

Industrial energy efficiency technologies—such as combined heat and power, which produces both heat and power from a single fuel source, and waste heat to power, which uses waste heat from industrial processes to generate electricity—offer Pennsylvania’s manufacturers an opportunity to compete globally by significantly cutting their energy costs. Both combined heat and power and waste heat to power qualify as Tier 2 resources under the state’s Advanced Energy Portfolio Standards.<sup>17</sup>

From 2009 to 2013, Pennsylvania’s industrial sector added 57 MW worth of these efficient power generating technologies. A variety of other businesses, multifamily residences, universities, and hospitals also use combined heat and power and waste heat to power to lower costs and provide electricity when the traditional electric grid fails, such as when storms take down power lines.

## Pennsylvania Industrial Energy Efficiency National rankings and statistics, 2013

Key Statistics	
<b>6th</b>	in total capacity (3.3 GW)
<b>8th</b>	in new capacity (6.6 MW)
<b>8th</b>	in private investment (\$9.9 million)
<b>159</b>	projects constructed statewide

Sources: U.S. Department of Energy, Navigant Research

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Industrial efficiency system at the Yuengling Brewery in Mill Creek.



Combined heat and power unit at the headquarters of the Pennsylvania State Employees Credit Union in Harrisburg.

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## Project Spotlights

# Industry Learns to Harness the Heat for Improved Energy Efficiency

Many Pennsylvania companies are embracing the cost savings and environmental benefits of combined heat and power. As one of the top 10 states for potential use of this technology (based on sites that would be suitable), Pennsylvania has the opportunity to add more than 5 GW of capacity across several sectors, including industrial-scale chemical, paper, and food processing plants; commercial buildings; and institutional buildings such as hotels, hospitals, universities, and government facilities.\* The following examples show the variety of applications of this energy efficiency technology in the state:

- **Pennsylvania State Employees Credit Union.** In the fall of 2013, the credit union installed an 800-kilowatt combined heat and power system, developed by UGI Performance Solutions, at its headquarters in Harrisburg. The system reduces operating costs and is expected to have a payback period of roughly six years. It also reduces carbon dioxide emissions by 1,468 tons a year, the equivalent of removing 243 cars from the road.†
- **Geisinger Medical Center.** Installed in 2011 to take advantage of energy efficiency cost savings, a 5-MW combined heat and power facility provides power for most of the Geisinger Medical Center—approximately 2 million square feet and about a dozen buildings in Danville.‡ The system saves the medical center \$2.2 million annually, a 14-month return on investment.§
- **Yuengling's Mill Creek Brewery.** A 400-kW combined heat and power system generates about 20 percent of the plant's total electricity needs.\*\*
- **Phoenix Contact.** Working with Capstone Turbine Corp., Phoenix Contact, a manufacturer of electrical engineering and automation products in Lower Swatara Township, installed a 1-MW combined heat and power facility in the spring of 2014. The system will provide 65 percent of the factory's power and save more than \$300,000 in energy costs annually.††

\* Julie Friedman and Garth Otto, "Combined Heat and Power: A Resource Guide for State Energy Officials," National Association of State Energy Officials (2013), <http://www.naseo.org/data/sites/1/documents/publications/CHP-for-State-Energy-Officials.pdf>.

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## Geographic Spotlight

# Clean Energy Powers Philadelphia

At the municipal level, Philadelphia is a national leader in supporting clean energy. The city increased its clean energy generation sixfold from 2008 to 2012, becoming the largest municipality to join the Environmental Protection Agency's Green Power Communities Program, which sets goals for renewable electricity generation based on population size.<sup>\*</sup>

## City policies

This success is due in part to local policies. In 2009, the city unveiled its Greenworks Philadelphia plan, which included a goal of obtaining 20 percent of its electricity from renewable energy and reducing greenhouse gas emissions 20 percent by 2015. Five years into the program, the city now obtains almost 15 percent of its electricity from clean energy sources and has cut emissions beyond its goal.<sup>†</sup> Philadelphia also has complementary technology-specific targets, which include producing 57.7 MW of solar power by 2021.<sup>‡</sup>

Furthermore, Philadelphia is developing new policies and programs, such as local zoning laws, to continue progressing toward its 20 percent renewable energy target. In the future, Philadelphia may also pursue power purchase agreements, in which developers install solar projects on public buildings, at little or no up-front cost to the local government, and sell the electricity generated back to the city at a fixed rate for a predetermined period.<sup>§</sup>

## District energy system

One of Philadelphia's clean energy projects is a district energy system with a central plant that produces steam, hot water, or chilled water that is piped underground to individual buildings for space heating, domestic hot water heating, and air conditioning. As a result, individual buildings in the area don't need their own boilers or furnaces, chillers, or air conditioners, thereby meeting needs far more efficiently.<sup>\*\*</sup>

Operated by Veolia Energy, a private developer of industrial energy efficiency projects, the Green Steam distributed energy system is the nation's third-largest district heating network (163 MW) and serves more than 500 businesses, universities, hotels, and health care facilities.<sup>\*\*</sup> The project converts wasted heat from power generation into useful thermal energy through combined heat and power, and then supplies this electricity to buildings through underground piping. By producing steam and electricity simultaneously, Veolia's Green Steam system avoids the emission of approximately 430,000 metric tons of carbon dioxide annually, which is equal to removing 70,000 cars from the streets each year and accounts for 10 percent of the city's greenhouse gas reduction goal. In addition to environmental benefits and energy efficiency, Veolia's project supported the local economy with 350 construction-related jobs.<sup>\*\*</sup>

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Veolia's cogeneration plant on the Schuylkill River in Philadelphia.

<sup>\*</sup> Alex Dews and Sara Wu, "Greenworks Philadelphia: 2013 Progress Report," Mayor's Office of Sustainability, Philadelphia, [http://www.phila.gov/green/PDFs/Greenworks2013ProgressReport\\_Web.pdf](http://www.phila.gov/green/PDFs/Greenworks2013ProgressReport_Web.pdf).

<sup>†</sup> Alex Dews, Richard Freeh, and Sara Wu, "Greenworks Philadelphia: 2014 Progress Report," Mayor's Office of Sustainability, Philadelphia, <http://www.phila.gov/green/PDFs/Greenworksprogressreport.pdf>.

<sup>‡</sup> U.S. Department of Energy, "City of Philadelphia: Green Power Purchasing," <http://energy.gov/savings/city-philadelphia-green-power-purchasing>.

<sup>§</sup> Dews, Freeh, and Wu, "Greenworks Philadelphia: 2014 Progress Report"; City of Philadelphia, "Promote Renewable Power Purchase Agreements for Public Buildings," [http://www.phila.gov/green/greenworks/energy\\_Alternative.html#purchase](http://www.phila.gov/green/greenworks/energy_Alternative.html#purchase).

<sup>||</sup> International District Energy Association, "What Is District Energy?" <http://www.districtenergy.org/what-is-district-energy>.

<sup>††</sup> Linda Hardesty, "Veolia Upgraded Philadelphia's District Energy Network," *Energy Manager Today*, Feb. 11, 2013, <http://www.energymanagertoday.com/philadelphias-district-energy-network-gets-upgrade-089066>.

<sup>‡‡</sup> Veolia Energy, "Philadelphia Mayor Nutter and Veolia Mark Completion of Multi-Million Dollar 'Green Steam' Project" (Jan. 13, 2013), <http://www.veoliaenergyna.com/news-media/press-releases/2013-01-14,43101.htm>.

## Solar industry highlights

Favorable state policies, coupled with the federal investment tax credit, have spurred rapid growth of Pennsylvania's solar power. But the industry faces challenges.

When enacted, the Alternative Energy Portfolio Standards' 0.5 percent solar requirement was one of the most ambitious solar provisions in the country,<sup>18</sup> helping Pennsylvania become one of the top 15 states for solar photovoltaic installations as of 2013.<sup>19</sup> In addition, Pennsylvania's Sunshine Solar Rebate Program, managed by the Department of Environmental Protection, played a key role in the industry's growth, providing \$100 million in rebates to help finance solar electric and hot water projects for homeowners and small businesses<sup>20</sup> resulting in nearly 10 MW of new clean electric capacity.<sup>21</sup>

However, demand overwhelmed both incentive programs. Pennsylvania fully expended the funding it had allotted for the Sunshine Solar program within three years, two years early. The state also met its solar requirement in the Alternative Energy Portfolio Standards ahead of schedule. This was partly because Pennsylvania allowed electricity imported from neighboring states to help fulfill this mandate, thereby effectively outsourcing the incentives meant to generate in-state project development.<sup>22</sup>

Furthermore, these imports of electricity made Pennsylvania vulnerable to changes in the prices of renewable energy certificates—credits that solar project owners can sell to utilities to help fulfill the goals of a renewable portfolio standard—in neighboring states. Strong policies tend to generate local demand, and drive up the prices that solar project owners can command for these credits, providing an important source of financing. In contrast, weakened policies cause prices to decline, making solar projects less economical. In 2014, Ohio imposed a two-year suspension of its own state renewable energy standard, which caused the price of certificates to drop in Pennsylvania.<sup>23</sup> These price swings in Pennsylvania's renewable energy certificates underscore the importance of policy that offers certainty and transparency to businesses entering the markets.

## Pennsylvania Solar National rankings, 2013

Rank	
<b>9th</b>	in homes powered by solar (24,644)
<b>11th</b>	in jobs (2,900)
<b>11th</b>	in total capacity (212 MW)
<b>14th</b>	in new capacity (38 MW)
<b>14th</b>	in private investment (\$136.2 million)

Sources: U.S. Department of Energy, Navigant Research

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Even with the challenges of the renewable energy certificate pricing system, Pennsylvania remains competitive in the solar industry. In 2013, the state attracted \$136.2 million in investment in the sector, ranking 14th nationally for new solar capacity, at 38 MW, and 11th in total installed solar energy. Pennsylvania's existing solar energy systems could power nearly 25,000 homes.<sup>24</sup>

More than 440 solar businesses operate in the state, employing nearly 3,000 people.<sup>25</sup> These companies provide jobs and services in manufacturing, installation, financing, and legal services.

## Project Spotlight

### Innovative Financing for Solar

Pennsylvania developers are increasingly leveraging innovative third-party financing mechanisms to spur the deployment of new solar energy projects. These include power purchase agreements, in which a solar developer designs, permits, finances, and installs a project on a property at little or no cost to the property owner. To recoup costs, the developer owns the project and sells power to the host customer at a fixed rate for a predetermined period.\*

A recent project at Temple University used this funding structure to build a solar installation in Philadelphia. Clean energy developer Community Energy Inc. installed a 63-kW system under a 20-year agreement to sell the power to the university. Project costs were financed by Community Energy's Solar Builder program, in which customers can sign up to receive 5 percent of their electricity from solar power at a market variable rate lower than the price of traditional electricity. The Solar Builder program constructs and operates solar facilities across Community Energy's service territory, reinvesting profits into new projects. A reflection of Temple's commitment to sustainability and renewable energy, the system provides electricity to residents in Philadelphia and southeastern Pennsylvania.†



Solar array at Temple University.

\* Solar Energy Industries Association, "Solar Power Purchase Agreements (PPAs)," Dec. 20, 2012, <http://www.seia.org/research-resources/solar-power-purchase-agreements>.

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## Industry Spotlight

# Clean Energy Powers Pennsylvania Sports Venues

- **Philadelphia Eagles' Lincoln Financial Field.** With more than 11,000 solar panels installed throughout the complex and 14 micro wind turbines aligned along the top of the stadium, NRG Energy's system at Lincoln Financial Field can generate more than 3 MW of on-site energy—sufficient to meet the stadium's electricity needs.\*
- **NASCAR's Pocono Raceway.** The raceway, located in northeastern Pennsylvania, features a 40,000-panel, 25-acre solar installation that is expected to produce more than 72 million kWh of energy over the next 20 years—enough to power the raceway and an additional 1,000 homes.†
- **Pittsburgh Penguins' CONSOL Energy Center.** The first National Hockey League arena to secure LEED Gold certification (in 2010), the CONSOL Center installed energy-efficient lighting and high-efficiency ventilation and air conditioning to significantly reduce energy use and deliver cost savings of up to \$260,000 annually.‡
- **Philadelphia Phillies' Citizens Bank Park.** In 2012, through an agreement to buy solar and wind power from Community Energy Inc., the Phillies became the largest purchaser of renewable energy in Major League Baseball. The team will obtain more than 22 million kWh over two years—enough energy to cover all of the ballpark's energy needs.§



The solar array at Lincoln Financial Field, the largest at any National Football League stadium.



Solar installation (left) at NASCAR's Pocono Raceway.

<sup>†</sup> NRG Energy, "Solar Power Installation at Lincoln Financial Field: NRG Fact Sheet," (2013), <http://www.nrg.com/documents/renew/lincolnNRG-1671-Lincoln-Football-Stadium-Fact-Sheets-v8-EMAIL.pdf>.

<sup>‡</sup> Pocono Raceway, "Solar Farm Hits 10,000,000 Kilowatt Hours Produced" (April 7, 2013), <http://www.poconoraceway.com/solar-farm-hits-10000000-kilowatt-hours-produced.html>.

<sup>‡</sup> Sean Conboy, "Greener Pastures: As the Pittsburgh Penguins Prepare to Take Flight at the CONSOL Energy Center, the Team's New Home Holds a Title of Its Own," Pittsburgh magazine, <http://www.pittsburghmagazine.com/core/pagetools.php?pageid=12726&url=%2FPittsburgh-Magazine%2FOctober-2010%2FConsol-Energy-Center%2F&mode=print>.

<sup>§</sup> Philadelphia Phillies, "Phillies Power Up Citizens Bank Park With Pennsylvania Electricity" (June 14, 2012), <http://m.phillies.mlb.com/news/article/33287592/phillies-power-up-citizens-bank-park-with-pennsylvania-electricity>.

## Emerging opportunities

Pennsylvania's numerous waterways, including the Ohio, Susquehanna, and Delaware rivers, provide significant resources to spur clean energy growth with low-impact hydropower installations, projects that reduce the environmental impacts associated with traditional hydropower.<sup>26</sup> These projects are usually located at dams or conduits and must meet certain criteria, such as erosion protection and minimal damage to water flows and fish and wildlife habitat.<sup>27</sup> Low-impact hydropower installations meet the Tier 1 requirements of the state's Alternative Energy Portfolio Standards, making Pennsylvania the first state to make low-impact hydropower eligible for its renewable energy requirements.<sup>28</sup>



Braddock Locks & Dam, the site of Hydro Green Energy's new low-impact hydro project.

As a result of this inclusion of low-impact hydro projects in the Alternative Energy Portfolio Standards, several new installations are taking shape. In June 2014, the Raystown Hydroelectric Project in Huntingdon County became Pennsylvania's first hydropower system to be deemed low-impact. Another facility by Hydro Green Energy is in the permitting process at a site just north of Pittsburgh.<sup>29</sup> Free Flow Power, a hydroelectric engineering firm, has proposed 10 additional projects along the Allegheny, Ohio, and Monongahela rivers, which converge in Pittsburgh.<sup>30</sup> Navigant Research forecasts the addition of 2.6 GW of hydropower in the state from 2014 to 2023, attracting \$13.1 billion in private investment.

## Conclusion

From a foundation of strong renewable energy policies, Pennsylvania has risen as a leader in clean energy. Continued support of existing clean energy technologies such as wind and solar, paired with state policies encouraging emerging sectors, will position the state to take advantage of the benefits of this growing economic opportunity.

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### Acknowledgments

This policy brief is one of a collection examining state clean energy economies. The states selected have demonstrated leadership in clean energy policies, installations, and economies, or are at a crossroads in their energy futures. The brief was prepared by The Pew Charitable Trusts' clean energy initiative, with Kerry Schlichting as lead author. This research was funded in part by The 11th Hour Project.

Unless otherwise specified, data on capacity additions and investment were provided by Navigant Research, an energy market research firm, and include solar photovoltaics, industrial sector combined heat and power, geothermal power (excluding heat pumps), biomass power (excluding landfill-gas, anaerobic digesters, and biogas recovery), hydropower projects, permanently installed (not pilot) marine and hydrokinetic projects, and wind projects greater than 1 megawatt.

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## The Clean Energy Business Network

Pew's Clean Energy Business Network seeks to inform and engage clean energy business leaders in policy issues affecting the industry. For more information or to sign up for this free resource, visit [pewtrusts.org/businessnetwork](http://pewtrusts.org/businessnetwork).

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## For further information, please visit:

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