

Alternative Energy Portfolio Standards Act Compliance for Reporting Year 2018



*Prepared by the
PA Public Utility Commission
in cooperation with the
PA Department of Environmental Protection*



pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION



Alternative Energy Portfolio Standards Act of 2004 Compliance for Reporting Year 2018

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*Front cover and title page: The 3MW solar farm Dickinson Solar, Dickinson College, Carlisle
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Contents

Executive Summary.....	3
1. AEPS Program	7
AEPS Resources.....	10
2. Compliance Summary	12
A. Tier I Compliance.....	15
B. Tier II Compliance.....	17
3. Costs and Benefits of Alternative Energy Generation	18
A. Current Estimated Costs of Future Alternative Energy Generation.....	19
B. Future Estimated Statewide AEPS Cost of Compliance	20
C. Renewable Energy Economic Benefit – Jobs, Exports, Wages	21
4. Market Trends	25
A. Solar	31
B. Wind	36
C. Hydropower	38
5. Status of Pennsylvania's Alternative Energy Portfolio Standards Marketplace	40
6. Renewable and Alternative Energy Generation Capacity in Pennsylvania and PJM	48
7. Recent Activity Since End of Compliance Year	55
8. Appendix	59
Appendix A	60
Appendix B	68
Tier I Resources	68
Tier II Resources	71
9. Glossary	71



Executive Summary

Alternative Energy Portfolio Standards Act

Compliance for Reporting Year 2018

Tier I Solar Compliance

- **All EDCs and all but one EGSs** met their requirements. One EGS paid the required ACPs to achieve compliance. One EGS failed to comply.

Tier II Compliance

- **All EDCs and all but one EGSs** met their requirements. Two EGSs paid the required ACPs to achieve compliance. One EGS failed to comply.

Tier I Non-Solar Compliance

- **All EDCs and all but one EGSs** met their requirements. Three EGSs paid the required ACPs to achieve compliance. One EGS failed to comply.

Total Number of Credits Retired:

21,406,971 credits retired by 11 EDCs and **120** EGSs.

Source of Tier I Solar AECs Retired

- Pennsylvania – 35%
- Other States – 65%



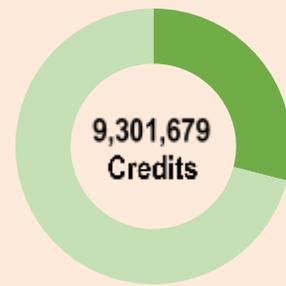
Source of Tier II AECs Retired

- Pennsylvania – 67%
- Other States – 33%



Source of Tier I Non-Solar AECs Retired

- Pennsylvania – 29%
- Other States – 71%



The Alternative Energy Portfolio Standards Act of 2004¹ (AEPS Act) requires electric distribution companies (EDCs) and electric generation suppliers (EGSs) to ensure that by 2021 at least 18% of the total electricity supplied in Pennsylvania is generated from qualified alternative energy resources.

The AEPS Act identifies the energy resources that are eligible for consideration in the program. These resources are classified into two groups, Tier I and Tier II resources. Additionally, although solar photovoltaic is a Tier I resource, it has a standalone requirement. For each reporting period, the EDCs and EGSs are required to acquire and retire Alternative Energy Credits (AECs) in quantities equal to a percentage of their total retail sales of electricity in Pennsylvania. This percentage gradually increases each year, through 2021. Each successive 12-month reporting year begins on June 1 and concludes on the following May 31, and compliance is monitored during this period. Throughout this report, the terms “reporting year” and “compliance year” are synonymous and used interchangeably.

For the 2018 reporting year (June 1, 2017 through May 31, 2018) the Tier I requirement was 6.5% of all retail sales, of which at least 0.34% of all retail sales was to come from solar photovoltaic (PV) sources. The requirement for Tier II resources was 8.2% of all retail sales. In 2009, a few more alternative energy resources (as identified in the table in Section 3 of this report) were added to the Tier I group. To account for these additional resources, an annual adjustment to the non-solar portion of the Tier I requirement was added. For this reporting period that adjustment is 0.40% for a total Tier I requirement of 6.9%.

For the 2018 reporting year, all the EDCs and all but four EGSs met their requirements by acquiring and retiring sufficient AECs. Three EGSs submitted the proper alternative compliance payments to come into compliance. One EGS, discussed later in this report, filed for bankruptcy and failed to comply. Of the total number of AECs retired, 49.7% of AECs were generated within Pennsylvania. A

¹ See generally 73 P.S. § 1648.1 et seq.

more detailed breakdown of the retired AECs is provided in Chart 1, located in Section 2 of this report.

Analysis of existing and prospective resources suggests that sufficient Tier I, Tier I Solar PV, and Tier II AECs will likely be available to meet the AEPS Act requirements through the 2021 reporting year. The AEPS Act was amended by Act 40 of 2017 that was signed into law on October 30, 2017. This amendment does not allow solar alternative energy credits generated by solar facilities outside of Pennsylvania's borders to be used to satisfy Tier I Solar obligations. There are exceptions for certain existing contracts that have been reviewed and approved for use by the Commission.² Analysis shows that sufficient solar AECs are expected to be available for Solar PV compliance if new solar electricity generation facilities are developed in Pennsylvania at the current pace, coupled with the addition of the approved out-of-state solar credits (NSTI credits).

² *Implementation of Act 40 of 2017*, Final Implementation Order at Docket No. M-2017-2631527



1. AEPS Program

The AEPS Act requires that EDCs and EGSs obtain a prescribed percentage of their retail electric sales from qualifying alternative energy resources. This is accomplished by procuring and retiring an equivalent number of AECs. AECs are tradable instruments created as the AEPS-certified alternative energy resources generate electricity. EDCs and EGSs must acquire sufficient AECs from qualifying resources corresponding to the percentage of electricity sold in order to meet their AEPS requirement.

AECs are used to track and verify generation of electricity from AEPS-certified alternative energy resources. ***When a certified alternative energy resource, located within the PJM footprint, generates one megawatt hour (MWh) of electricity, one AEC is created.*** The AECs are created, serialized, tracked and verified via creation of certificates. The credit certificates are serialized for tracking purposes. The AECs can be used and retired by the generating entity itself, sold, or traded to another entity in the marketplace. PJM Environmental Information Services Inc.'s (PJM-EIS) Generation Attribute Tracking System (GATS) is the PUC designated AEC registry used to track generation, ownership and retirement of AECs. An EDC or EGS may acquire AECs from the marketplace and retire them. Retirement of AECs is necessary to ensure that the same AECs are not used again anywhere, by any other entity, for any other purpose. Retirement of AECs removes them from the marketplace. Pennsylvania EDCs and EGSs are permitted to obtain AECs from resources located within the entire PJM Interconnection, LLC³ (regional transmission organization) area, except as limited by Act 40 of 2017, as discussed later in this report.

AECs are eligible for use during the reporting year in which they were created. If unused, these AECs may be banked for later use during either of the following two reporting years.

The Pennsylvania Public Utility Commission (PUC) and the Pennsylvania Department of Environmental Protection (DEP) work cooperatively to monitor the performance of the AEPS program and prepare an annual report, which is provided

³ PJM Interconnection, LLC is the regional transmission organization for all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. <http://www.pjm.com/about-pjm/who-we-are/territory-served.aspx>.

to the Chairman and Minority Chairman of the Senate Environmental Resources and Energy Committee and the Chairman and Minority Chairman of the House Environmental Resources and Energy Committee.

The law provides for a three-month true-up period that runs from the conclusion of each reporting year, May 31, until September 1 of the same calendar year. During the true-up period, EDCs and EGSs may acquire any additional alternative energy credits needed for compliance. After the conclusion of the true-up period, the PUC verifies compliance and imposes alternative compliance payments (ACPs), as appropriate, by providing notice of the payment due as well an opportunity to challenge whether the ACP was appropriately applied.

The PUC is responsible for carrying out and enforcing the provisions of the law. DEP is charged with rendering determinations of resource eligibility and ensuring that AEPS-certified generating entities are following applicable environmental laws and standards. The PUC and DEP are charged with monitoring compliance with the Act, monitoring the alternative energy market and its associated costs of energy generation as well as conducting an ongoing alternative energy planning assessment. The PUC and DEP are to report their findings and any recommendations for changes to the Act to the General Assembly via an annual report.

On July 19, 2007, Act 35 of 2007 was signed into law, amending the AEPS by changing the compliance schedule for the Solar PV requirement. Act 35 also amended other provisions of the law, including definitions for customer-generator and net metering. On December 20, 2008, a PUC rulemaking based on the Act 35 changes became effective.⁴

The 2008 final rule provides clarification of the solar PV obligation and includes the revised 15-year schedule for solar PV requirements. The clarification of the Solar PV obligation affirms that the percentage requirement is a percentage of all retail sales and that the solar percentage is a part of the total Tier I obligation. Table 1 in

⁴ See, 38 Pa. B. 6908 at <https://www.pabulletin.com/secure/data/vol38/38-51/2286.html>

Appendix A provides an overview of the AEPS percentage sales requirements with the revised solar PV schedule.

Table 1 in Appendix A shows the AEPS percentage sales requirements for each of the 15 compliance years mandated by the law. Appendix B provides general information about the Tier I and Tier II resources.

AEPS Resources

Qualifying alternative energy resources are grouped into two categories, Tier I and Tier II, as described in the following table.

Alternative Energy Portfolio Standards Resources		
Tier I		Tier II
<ul style="list-style-type: none"> Solar Photovoltaic (PV) (Solar PV is a Tier I resource but also has a stand-alone requirement) 	<ul style="list-style-type: none"> Wind power Low-impact hydropower Geothermal energy Biologically derived methane gas Fuel cells Biomass energy Solar thermal Generation of electricity inside of Pennsylvania utilizing by-products of the pulping process and wood manufacturing process[#] Certain muni and coop-owned hydropower[#] 	<ul style="list-style-type: none"> Waste coal Distributed generation systems Demand-side management Large-scale hydropower Municipal solid waste Generation of electricity outside of Pennsylvania utilizing by-products of the pulping process and wood manufacturing process

[#]These were added to Tier I in 2009. To account for these additional resources, an annual adjustment is added to the non-solar portion of the Tier I requirement.

Although Solar PV is a Tier I resource, it also has a standalone requirement for each reporting year.

The AEPS Act establishes a 15-year phased-in schedule to reach the final goal of 18%, after which, the requirements are maintained at this level in perpetuity or until the AEPS Act is amended.



2. Compliance Summary

As of reporting year 2018, nearly 15% of electricity sold to retail customers was generated by qualifying alternative energy resources. The program target is to increase this percentage to 18% by reporting year 2021, which ends on May 31 of 2021.

Of all the AECs retired for compliance, 49.7 percent were generated in Pennsylvania and the remaining 50.3 percent were generated from other states in the PJM service territory.

Chart 1 shows the percentage of AECs that were retired in Pennsylvania in the 2018 reporting year and their states of origin.

For the Solar PV requirement, 35% of retired AEC credits originated in Pennsylvania, 54% came from North Carolina, 5% came from Virginia and the other 6% came from several other states.

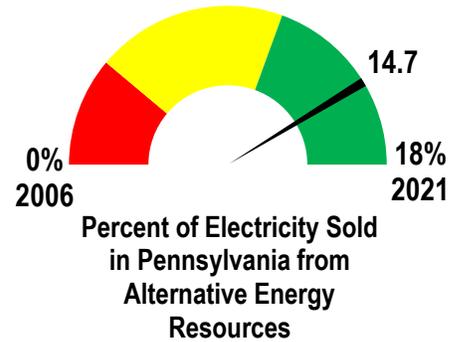
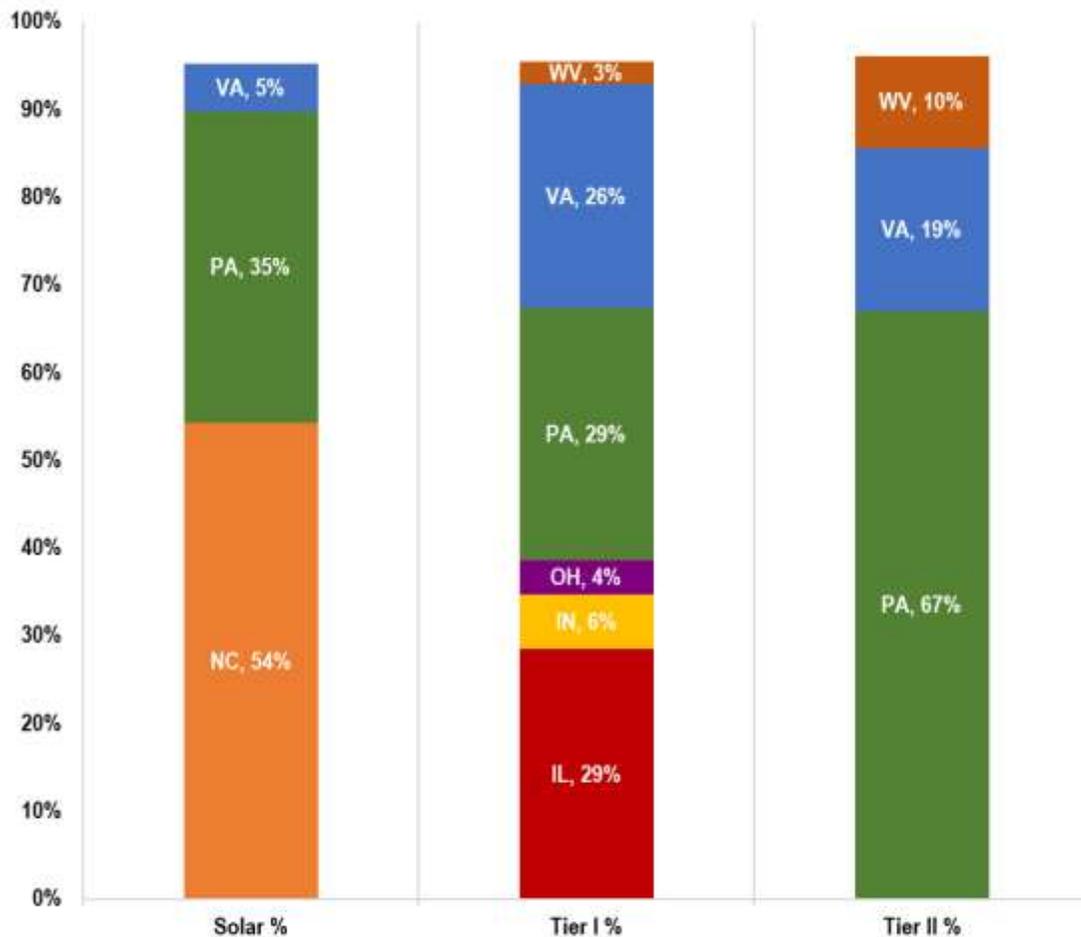


Chart 1: Percentage of AECs Retired in Pennsylvania in 2018



Note: Total may not add up to 100% because states supplying less than 3% of credits in any category are not shown and due to rounding.

For the Tier I requirement, exclusive of the Solar PV requirement, 29% of retired AECs came from Pennsylvania. Another 29% came from Illinois, 26% came from Virginia and the remaining 16% came from other states.

For the Tier II requirement, 67% of retired AECs came from Pennsylvania. Another 19% came from Virginia, 10% came from West Virginia and the remaining 4% came from four other states.

Table 2 in Appendix A shows a summary of compliance for the current reporting year and Table 4 in Appendix A shows the states that generated the retired AECs and the number of AECs retired for each state.

During the 2018 reporting year, 11 EDCs and 120 EGSs had compliance obligations. All EDCs achieved compliance in the reporting year by retiring the requisite number of AECs. Four EGSs did not retire sufficient AECs and three of the EGSs paid the required ACPs. One EGS, Aspurity Energy, LLC did not pay the required ACPs as they are no longer in business.

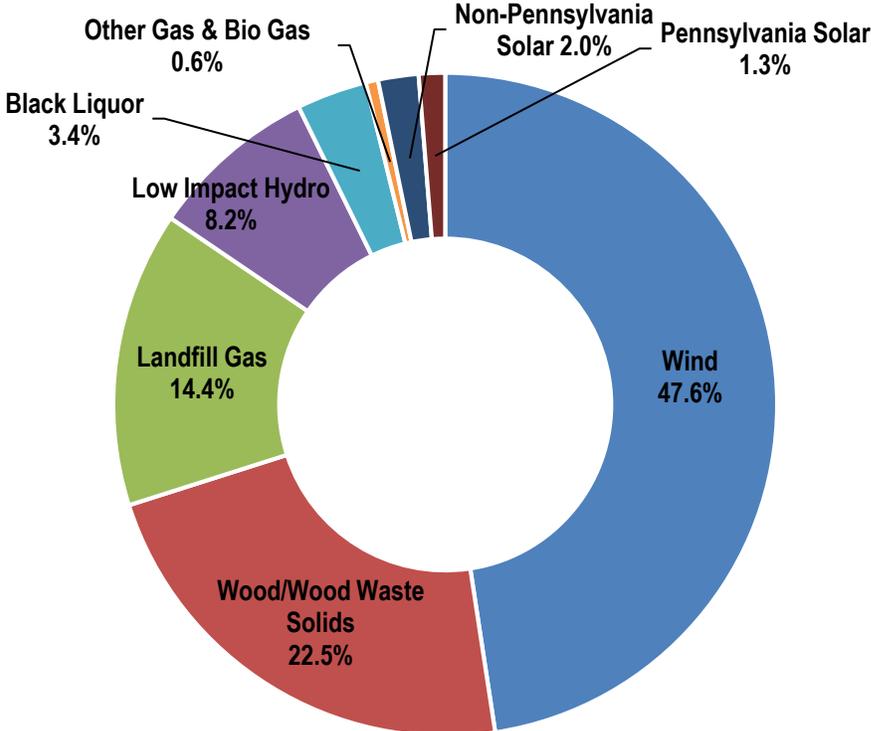
Aspurity Energy, LLC abruptly left the market after they filed for bankruptcy on June 30, 2017 and sent a notice to customers on August 4, 2017, informing them that their accounts had been reassigned to another EGS. Due to the bankruptcy, Aspurity Energy, LLC did not meet its AEPS obligations nor pay the \$17,843.58 ACP imposed by the Commission. Aspurity Energy's unmet obligations were 9 Solar AECs, 171 Tier I AECs and 213 Tier II AECs.

Table 3 in Appendix A presents details of the compliance obligations in each EDC territory and the compliance status for the reporting year 2018. The table presents reporting year data on the number of AECs retired by tier in the EDC territories. Several EGSs retired excess credits beyond the required AEPS obligations, as noted by the overages reported in Table 3. EGS sales information is considered proprietary, therefore, their AEPS credit retirement data are combined and shown in the appropriate EDC service territory. It is important to note that many EGSs provide service in more than one EDC territory. When an EGS retires too few or too many AECs, the excess or deficiency is not always connected to a specific EDC service area. Therefore, Table 3 shows some EDCs having a deficiency or excess of credits.

A. Tier I Compliance

Chart 2 shows the resource percentage of Tier 1 AECs retired in the 2018 reporting year. Wind energy produced almost half of the retired Tier 1 AECs, followed by Wood/Wood Waste Solids (biomass energy) and Landfill Gas (biologically derived methane) electricity generation.

Chart 2: Percentage of sources of Tier I AECs Retired in Pennsylvania for the 2018 Reporting Year



a. Solar Compliance

For the 2018 reporting year, the Solar PV obligation was 0.3400 percent. All EDCs and all but two EGSs retired the requisite number of Solar AECs. One of the two EGSs paid the ACP for their Solar PV obligation. The other EGS, Aspirity Energy, did not pay ACPs for its Solar PV obligation and failed to comply. The number of Solar AECs that were not retired represented 0.0021% of the total Solar AEC obligation.

b. Non-Solar Compliance

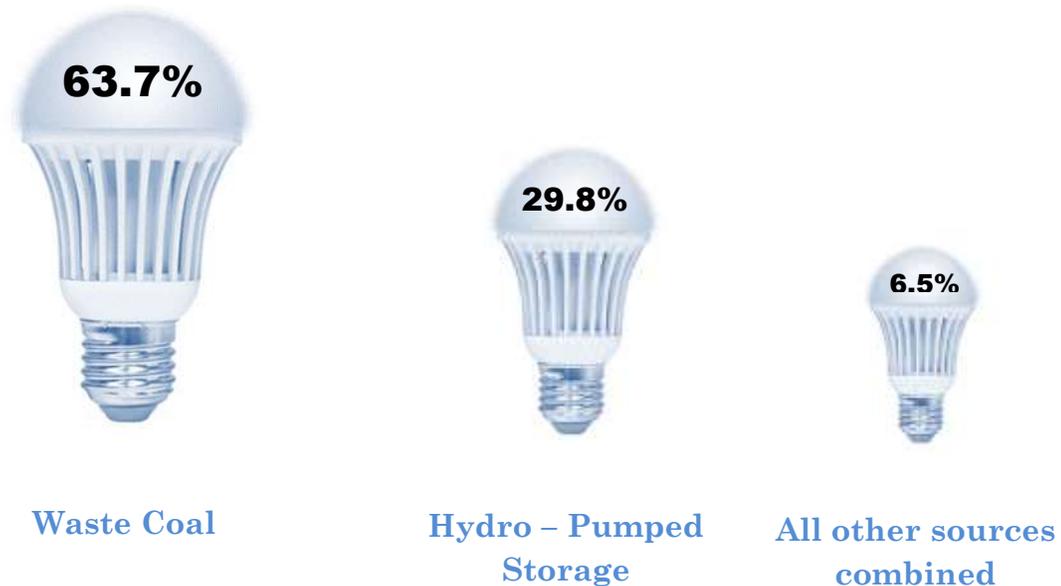
For the 2018 reporting year, the base obligation for non-solar Tier I was 6.16 percent. The Tier I quarterly adjustment, impacting only non-solar Tier I, added a quarterly increase of 0.3566 percent, 0.3571 percent, 0.3906 percent, and 0.5009 percent, for quarters one through four, respectively. This resulted in 570,464 AECs added to the base obligation of 8,730,242. All EDCs and all but four EGSs achieved

compliance by retiring the requisite number of Tier I AECs. Three of the four EGSs paid ACPs for their non-solar Tier I obligations. Aspiry Energy did not pay ACPs for its non-solar Tier I obligation and failed to comply. The number of Tier I AECs that were not retired represented 0.0023% of the total Tier I AEC obligation.

B. Tier II Compliance

For the 2018 reporting year, the base obligation for Tier II was 8.2 percent. All EDCs and all but three EGSs achieved compliance in the reporting year by retiring the requisite number of AECs. Two of the three EGSs paid ACPs for their Tier II obligations. Aspiry Energy did not pay ACPs for its Tier II obligation and failed to comply. The number of Tier II AECs that were not retired represented 0.0020% of the total Tier II AEC obligation. Chart 3 shows sources and percentages of Tier II AECs retired in Pennsylvania in the 2018 reporting year.

Chart 3: Sources and Percentages of Tier II AECs Retired in Pennsylvania for the 2018 Reporting Year





3. Costs and Benefits of Alternative Energy Generation

A. Current Estimated Costs of Future Alternative Energy Generation

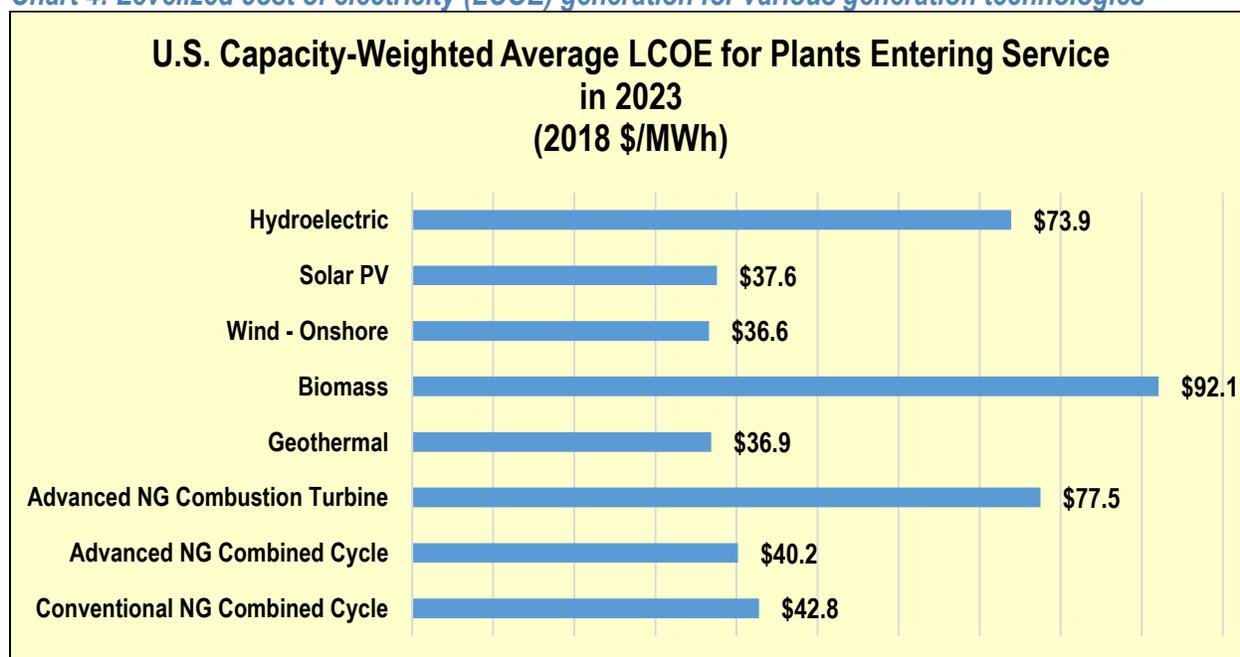
The United States Energy Information Administration (EIA) provided estimated cost data for the construction and operation of utility-scale generation plants that may be brought online in 2023.⁵ The EIA data is used as the most consistently reliable information available. In using this data, 2023 was selected to account for the lead time needed by some technologies to be brought online. EIA uses average data, including capacity factors, from across the country. Chart 4 compares these levelized costs, in 2018 dollars, for differing generation technologies on a dollar per megawatt-hour (\$/MWh) basis over an assumed financial life of the plant.

Levelized cost components include overnight capital costs, construction, operation and maintenance (O&M) costs, and an assumed utilization rate for each plant type. O&M costs include items such as fuel costs, maintenance, insurance, taxes and federal tax incentives, but do not include state or local incentives.⁶ EIA notes actual plant investment decisions are affected by the specific technological and regional characteristics of a project and levelized costs are a convenient summary measure of overall competitiveness of generation technologies.

⁵ U.S. Energy Information Administration document titled *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2019*, February 2019. Available at https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf.

⁶ The [IRS Investment Tax Credit \(ITC\) credit for commercial solar](#) decreases to 10% for projects that start construction in 2022 and remains at this level until or unless changed by an act of Congress.

Chart 4: Levelized cost of electricity (LCOE) generation for various generation technologies



B. Future Estimated Statewide AEPS Cost of Compliance

For analytical purposes, the Commission has estimated the statewide costs of AEPS Act compliance for 2021, the year of maturation for this standard.

These cost projections shown in Appendix A, Table 5, are presented in 2019 dollars, using a six percent discount rate and projected AEC costs. While projected total compliance costs are expected to increase each year as the percentage requirements of alternative energy increase, an update of the methodology used to calculate future credit requirements and changes to predicted credit prices resulted in a cost decrease for 2021. A key variable shown to have a demonstrable beneficial impact on containing AEPS compliance costs is Pennsylvania's energy efficiency and conservation (EE&C) program, known as Act 129. The EE&C program, coupled with higher energy efficiency standards for appliances, has curtailed the rate of energy consumption and therefore lowered the number of AECs required for annual compliance.

Electricity consumption, as reported by Pennsylvania’s EDCs, decreased from 145,022 gigawatt hours (GWh) in 2016 to 142,740 GWh in 2017, a 1.57% reduction.⁷ The passage of Act 40 of 2017 has decreased the amount of solar credits available for use in Pennsylvania which has increased the cost of solar credits, and may contribute to the increase in anticipated solar compliance costs.

As shown in Table 5 in Appendix A, the estimated cost of AEPS compliance in 2021 is approximately \$101.4 million. This represents a slight decrease from estimated costs reported in the 2017 AEPS annual report. This decrease results from lower Tier I credit price estimates and a decrease in the estimated number of credits needed for compliance. These annual estimates are based on monitored market trends and realized credit transactions. To put these figures in perspective, the annual statewide customer expenditure on electric service, across all sectors, was approximately \$14.5 billion in 2017.⁸ Therefore, approximately \$0.007 (seven-tenths of one cent) of every electric service related dollar is spent on AEPS compliance. The cost estimates were broken down by the types of AECs (Solar, Tier I (non-solar) and Tier II). The AEC prices used in this analysis are based on historical pricing as reported by the AEPS Program Administrator (available on the AEPS page of the PUC’s website), as well as the results of EDC default service solicitations. Preferential weighting is given to more recent solicitation results, and some assumptions are made as to the potential credit pricing into the near future.

C. Renewable Energy Economic Benefit – Jobs, Exports, Wages

Economic benefits associated with the development and deployment of renewable and alternative energy sources was a significant consideration in the passage of the AEPS Act. Since its inception, the AEPS Act has been instrumental in sustaining and creating thousands of jobs and business ventures associated with all aspects of renewable and alternative energy generation.

⁷ *Electric Power Outlook for Pennsylvania, 2017-2022*, http://www.puc.pa.gov/General/publications_reports/pdf/EPO_2018.pdf

⁸ See U.S. Energy Information Association – *Electric Power Annual 2017*, published October, 2018, Table 2.9 <http://www.eia.gov/electricity/annual/>

The *Clean Jobs Pennsylvania 2018* report cites that Pennsylvania has a renewable energy workforce of more than 8,500. The companies supporting these jobs are typically small businesses of 25 or fewer employees. The report also states that Pennsylvania has a workforce of more than 65,000 employed in the energy efficiency sector, a Tier II resource of the AEPS.⁹

In reporting year 2018, approximately 47 megawatts (MW) of solar-electric generating capacity was installed in PA, which brought the in-state total capacity to 342 MW.¹⁰ These installations at private residences, businesses, and institutions, across Pennsylvania, help sustain a workforce of slightly more than 4,219 that are engaged in all aspects of the solar industry, including manufacturing, sales, distribution and installation of solar power components and systems and related support services.¹¹ Nationally, average hourly wages for the solar industry are reported to be above the national median wage for all occupations. For those engaged fulltime in the installation of solar energy systems, the median entry-level wage for solar PV electricians was \$24.32/hour and was \$18.92/hour for non-electricians; wages are higher still for those involved in the installation of utility-scale solar farms.¹² Beyond rooftop solar, Pennsylvania has abundant opportunities for solar development that exclude green spaces, including locations such as abandoned mine lands, closed landfills and parking lot/garage canopies.

As of the end of 2017, Pennsylvania ranked 18th in the country for installed wind capacity (1,369 MW)¹³ and 18th in the country for the number of wind turbines (726 installed); enough generation to power about 314,000 homes.¹⁴ Additionally, Pennsylvania supports a number of wind energy jobs. For 2018, the total number of direct and indirect jobs supporting the wind industry in Pennsylvania was approximately 2,677.¹⁵ More information about the Pennsylvania wind generation

⁹ *Clean Jobs Pennsylvania 2018* - <https://www.e2.org/wp-content/uploads/2018/06/Clean-Jobs-Pennsylvania-2018.pdf>

¹⁰ The *2017 Annual Report Alternative Energy Portfolio Standards Act of 2004* provided an incorrect total for in-state solar-electric generating capacity of 285 MW, the correct in-state capacity for reporting year 2017 was 294.8.

¹¹ *Pennsylvania Solar Jobs Census 2018* <https://www.thesolarfoundation.org/solar-jobs-census/factsheet-2018-pa/>

¹² *National Solar Jobs Census 2018*, The Solar Foundation, available at: <https://www.thesolarfoundation.org/national/>

¹³ The wind capacity installed in Pennsylvania reported by AWEA (1369 MW) differs from the capacity of certified wind reported by Pennsylvania's AEPS Administrator (1329.5 MW).

¹⁴ American Wind Energy Association, *Wind Energy in Pennsylvania 2018* Fact Sheet

¹⁵ *Clean Jobs Pennsylvania 2018* - <https://www.e2.org/wp-content/uploads/2018/06/Clean-Jobs-Pennsylvania-2018.pdf>

facilities can be found on AWEA's new [wind industry map](#).¹⁶ Additionally, wind farm development employs hundreds of people and each wind farm typically requires a small, permanent crew of up to 15 people to oversee the maintenance and continued operation of the turbines. Per AWEA, the total capital investment in Pennsylvania associated with wind power development is nearly \$3 billion.¹⁷

As of the end of the 2018 AEPS Act compliance year, Pennsylvania has approximately 2,635 MW of FERC-licensed, operating hydropower generating capacity with nearly half of that total coming from two pumped storage hydropower projects. Another 137 MW of hydropower generating capacity has been licensed by FERC but is not yet built or operating. Supporting the growth of hydropower in Pennsylvania and globally are two of the world's largest turbine manufacturers, Voith Hydro and Weir American Hydro, both headquartered in Pennsylvania. According to the National Hydropower Association, approximately 325 Pennsylvania businesses are part of the hydropower supply chain. The largest of these businesses is Voith Hydro whose York County manufacturing facility employs more than 550 people. Given the attention to large-scale hydropower, it is important to note that there is interest in the significant potential to develop low-impact hydropower resources, many of which can take advantage of existing infrastructure. A Navigant Consulting study indicates that for every 10 MW of hydropower generating capacity developed, the equivalent of 5.3 full-time jobs is created.¹⁸ The passage of the federal Hydropower Regulatory Efficiency Act of 2013 helps to streamline some of the FERC permitting/licensing requirements for smaller hydropower projects and may help facilitate the development of smaller projects in Pennsylvania.

Pennsylvania continues to invest in renewable and alternative energy projects. In the 2018 reporting year, the Commonwealth Financing Authority approved more than \$14 million in loans and grants to ten alternative and renewable energy projects. The relevant project types funded included hydropower, anaerobic digesters, and CHP projects. Funding was not available from the Pennsylvania

¹⁶ American Wind Energy Association, <http://gis.awea.org/arcgisportal/apps/webappviewer/index.html?id=eed1ec3b624742f8b18280e6aa73e8ec>

¹⁷ American Wind Energy Association, *Wind Energy in Pennsylvania 2018 Fact Sheet*

¹⁸ *Job Creation Opportunities in Hydropower, 2009*, found at: <http://www.hydro.org/waterpower/why-hydro/job-creation/navigant-study/>

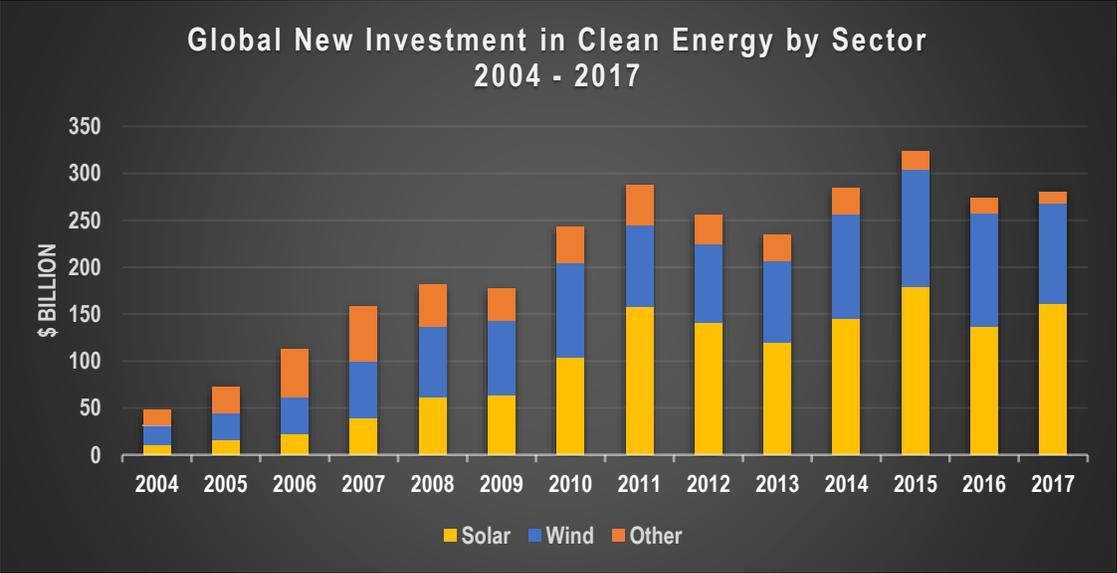
Energy Development Authority (PEDA) during this time. However, 19 of 21 approved projects from 2014 are now in full operation; the two remaining projects are currently under construction. For the 21 projects from 2014, the total anticipated savings / generation benefits equal 85,843,883 kWh/yr. Projected carbon dioxide emissions reductions from the projects are approximately 37,342 tons each year.



4. Market Trends

The renewable energy industry is becoming one of the most transformative sectors of the global economy. Through technology improvements, cost declines, new financing structures, and regulatory policy, the sector has driven economic growth around the world including in the United States. Chart 5 shows the new global investments in clean energy from 2004 through 2017. Investments in clean energy projects totaled \$279.8 billion in 2017, which was higher than 2016 but significantly lower than the record investment in 2015.

Chart 5: Global New Investment in Clean Energy by Sector (2004-2017)



Source: Global Trends in Renewable Energy Investment 2018

Globally, in 2017, 157 gigawatts (GW) of renewable energy production capacity came online. Solar alone accounted for 98 GW of new capacity in 2017.¹⁹

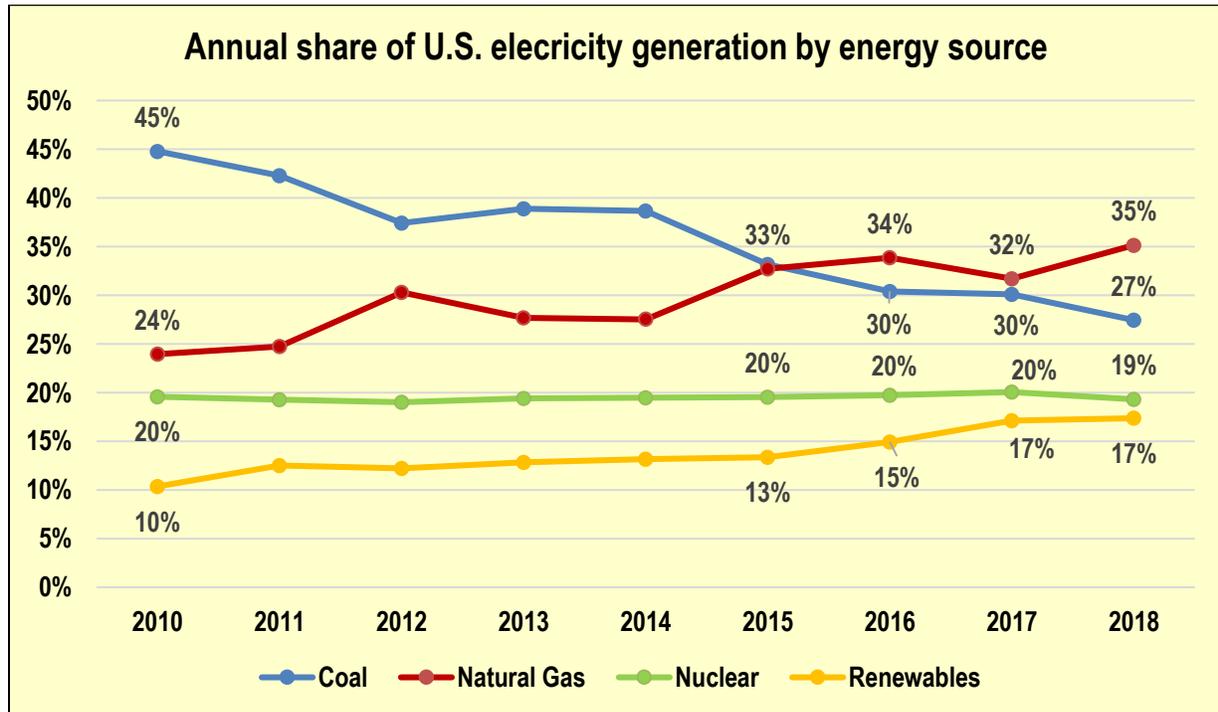
The United States ranks second in the world for renewable energy capacity (230.0 GW), behind China (618.7 GW)²⁰. Wind power generating capacity now slightly edges out conventional hydropower generating capacity as the largest renewable

¹⁹ Frankfurt School-UNEP Centre/BNEF. 2018. *Global Trends in Renewable Energy Investment 2018*, http://fs-unep-centre.org/fileadmin/gtr/Global_Trends_Report_2018.pdf

²⁰ IRENA - *Renewable Energy Capacity Statistics 2018*, page 2-6 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jul/IRENA_Renewable_Energy_Statistics_2018.pdf

resource in the U.S. Chart 6 shows the average yearly U.S. electricity generation by energy source.

Chart 6: U.S. Electricity Generation by Energy Source

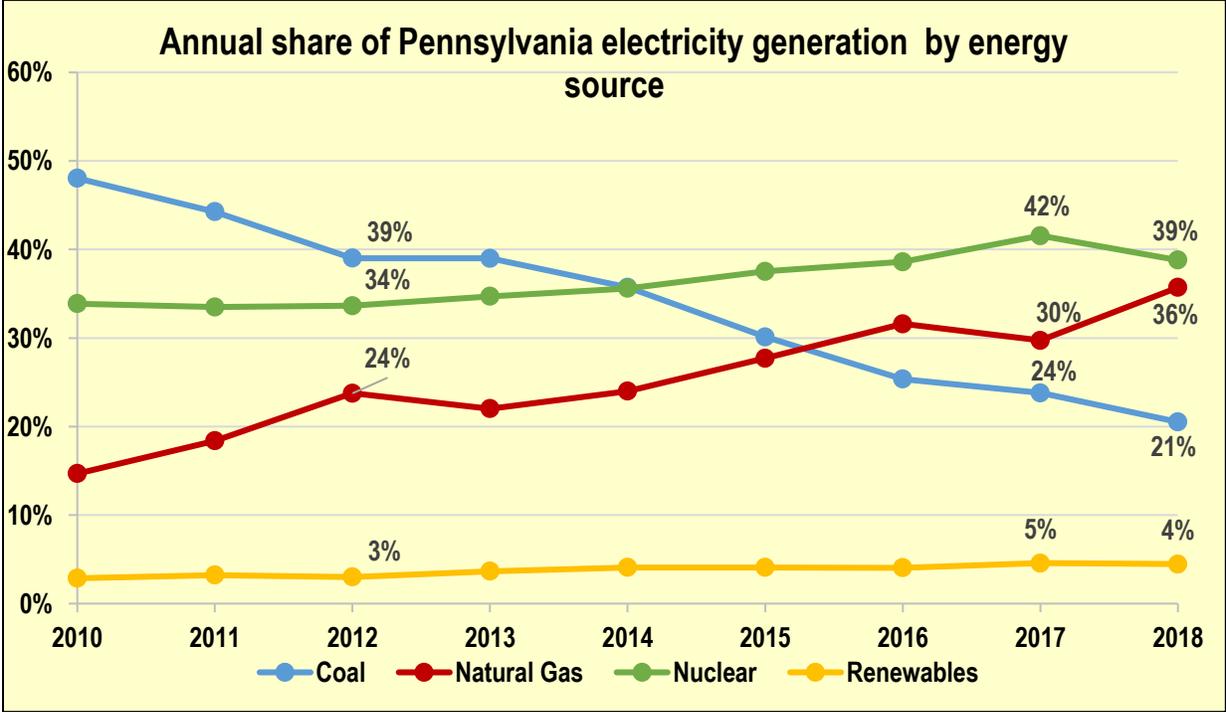


Source: Energy Information Administration Electricity Data Browser

Pennsylvania’s AEPS Act, which requires that, by 2021, 18% of electric power sold in the state come from alternative energy sources like wind, solar and hydropower, has helped to grow the renewable energy industry, while providing cleaner energy options to the state’s businesses and homeowners. More than 1,300 megawatts of wind power at 24 wind farms have been installed as of the end of 2018. These installations brought over \$2.9 billion in capital investment into the state.²¹

²¹ <https://www.awea.org/resources/fact-sheets/state-facts-sheets>

Chart 7: Pennsylvania Annual Electric Generation by Energy Source



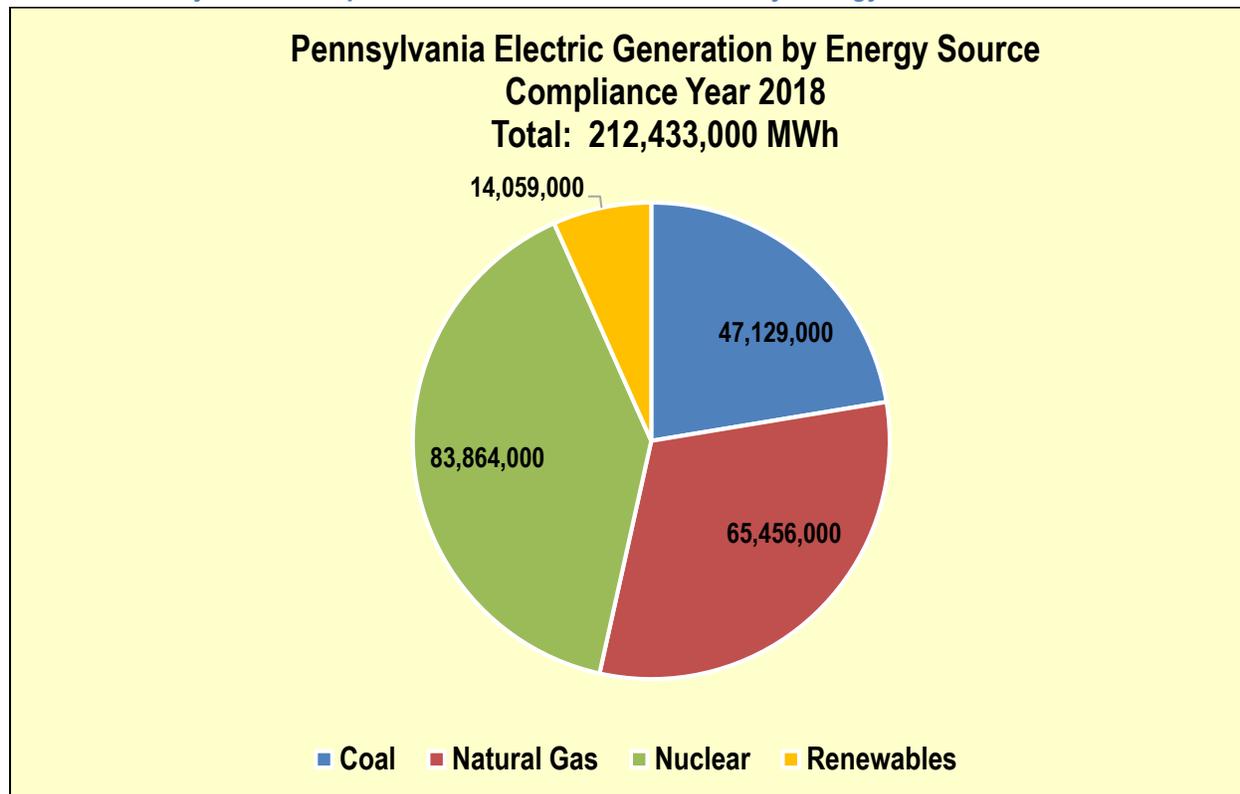
Source: Energy Information Administration Electricity Data Browser

Chart 7 shows annual Pennsylvania electric generation by energy source. In 2018, approximately 4% of the state’s electricity generation was from renewable energy sources.²² The chart mimics the general trend in U.S. electricity generation (Chart 6), where electricity generation from coal is steadily decreasing and natural gas electricity generation is steadily increasing. While U.S. electricity generation from renewable sources has grown, Pennsylvania’s electricity generation from renewable sources has not kept pace with the U.S. growth. A major reason for this is that the broad geographic scope of the AEPS Act allows compliance to come from credits generated from out-of-state resources, with the exception of the Tier 1 Solar obligation.

²² Energy Information Administration Electricity Data Browser

Chart 8 shows the breakdown of total electricity generation in Pennsylvania by source for the compliance year 2018. This information is obtained from EIA using their Electricity Data browser tool.

Chart 8: Pennsylvania Compliance Year Electric Generation by Energy Source



Alternative energy policy and federal policies such as the Business Energy Investment Tax Credit (ITC) and the Renewable Electricity Production Tax Credit (PTC) helped accelerate renewable energy investments and developments in the United States. The PTC for wind and the ITC for solar were extended at the end of 2015. The tax credits include an eventual decline in value for both technologies with the PTC for wind expiring in 2020 and the ITC for large-scale solar declining from 30% to a permanent 10% and expiring for residential projects in 2022.²³ Any policy changes affecting the incentive programs, either positively or negatively, may have

²³ <http://www.eia.gov/todayinenergy/detail.php?id=29492&src=email>

an almost immediate impact on the market’s attractiveness and AEC prices for solar and wind.

Chart 9 shows a historical view of the renewable energy generation capacity available in Pennsylvania. As of the end of 2018 compliance year, Pennsylvania had approximately 6,770 MW of installed renewable electricity generation capacity.

Chart 9: PA Installed Nameplate Renewable Capacity – 2006-2018 (MW)

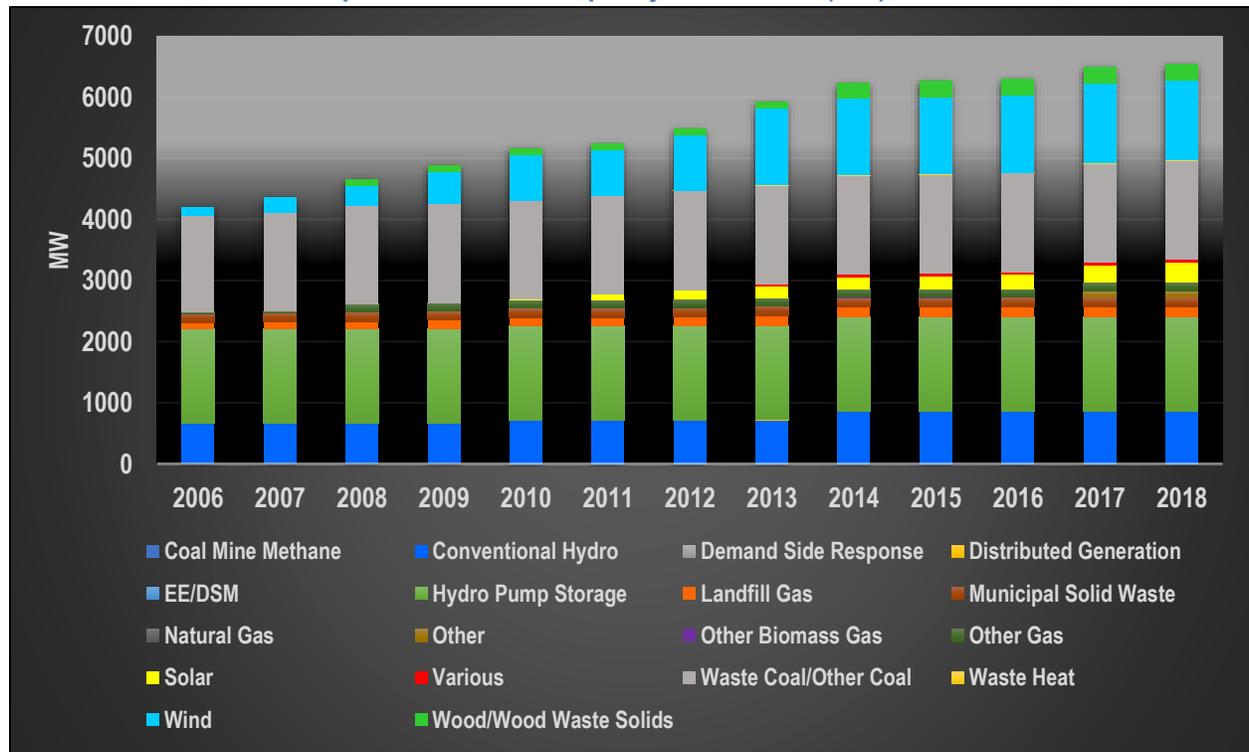
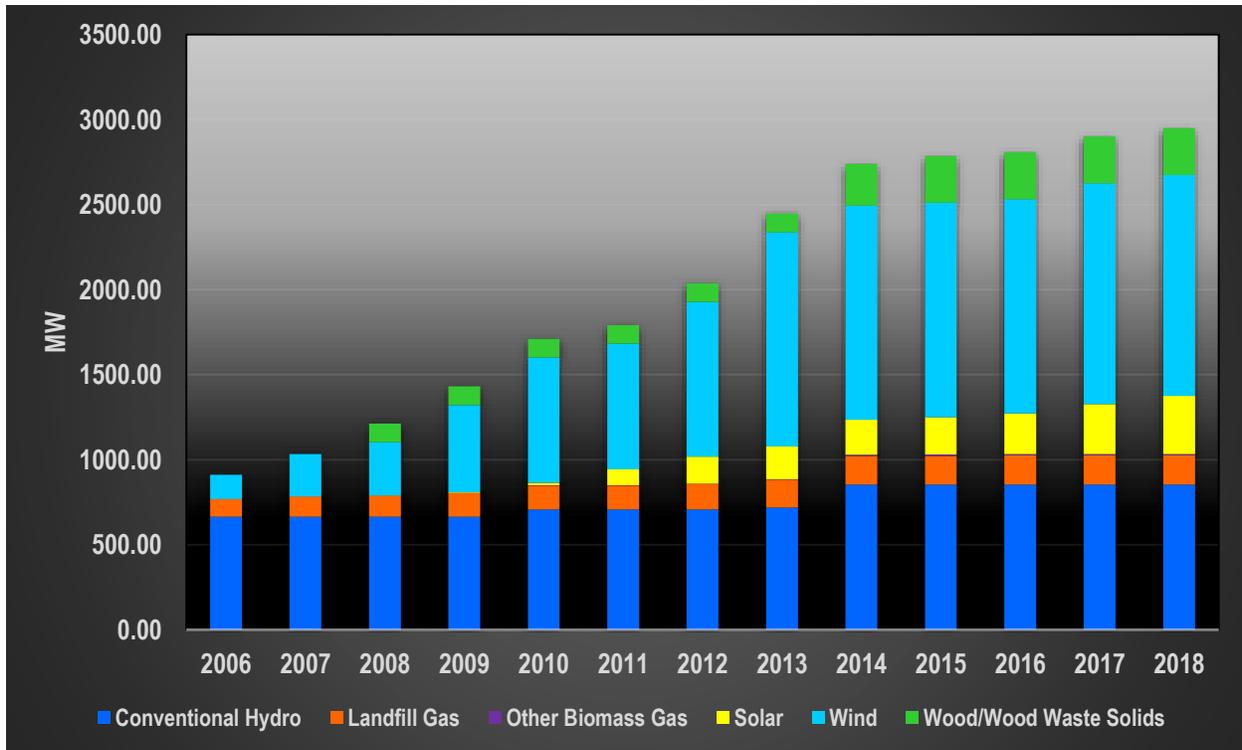


Chart 10 shows a few select renewable energy resources that have grown over the years.

Chart 10: PA Installed Nameplate Renewable Capacity by Resource – 2006-2018 (MW)



A. Solar

In the first half of 2018, approximately 4,700 MWdc (direct current megawatts) of solar PV was installed in the U.S. This is a 9% decrease over the same period in the previous year. The installed capacity is expected to more than double over the next five years.²⁴

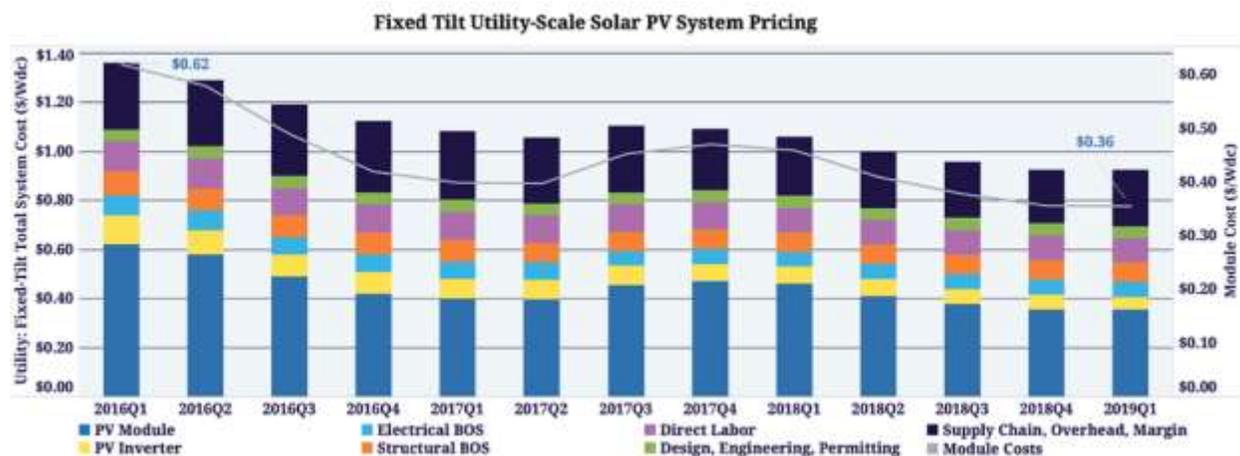
Chart 11 shows the trend in the cost of utility scale fixed-tilt solar PV systems. The installed system cost for a utility-scale, fixed-tilt, solar PV system has dropped more than 70% over the last decade to less than \$1/Wdc.²⁵ Solar panels produce direct

²⁴ <https://www.seia.org/research-resources/solar-market-insight-report-2018-q3>

²⁵ <https://www.seia.org/solar-industry-research-data>

current (DC) and are rated in terms of the power output expressed in watts (W). In many cases, system cost is expressed as \$/Wdc (direct current watts).

Chart 11: Utility-Scale Fixed Tilt Solar PV System Cost Trend



Source: Wood Mackenzie Power & Renewables and SEIA (Solar Energy Industries Association)
<https://www.seia.org/sites/default/files/inline-images/SIDP-2019Q2-Fig6-UtilityPrices.png>

As of the end of 2018, the United States had a total of 62.5 GW of cumulative operating solar PV capacity.²⁶ It is important to note that technologies such as solar and wind are generally non-dispatchable and generate power only when the respective resources are available (sun shining or wind blowing). Therefore, the capacity factors²⁷ for these resources are typically lower than those of the other resources.²⁸ Per EIA data, in 2017 the nationwide capacity factor for utility scale solar was 27.0%.²⁹ In Pennsylvania, 15% is a more realistic capacity factor. Adding energy storage to these resources does not increase the capacity factor, but it does allow for more consistent and reliable dispatching of these resources.

In Pennsylvania, 342 MW of solar electric capacity had been installed as of the end of the compliance year 2018. \$141.19 million was invested in Pennsylvania in 2018

²⁶ <https://www.nrel.gov/docs/fy19osti/73992.pdf>

²⁷ A ratio of the actual power output for a time period to the maximum possible power output if the plant was operating at full name plate capacity for the same time period.

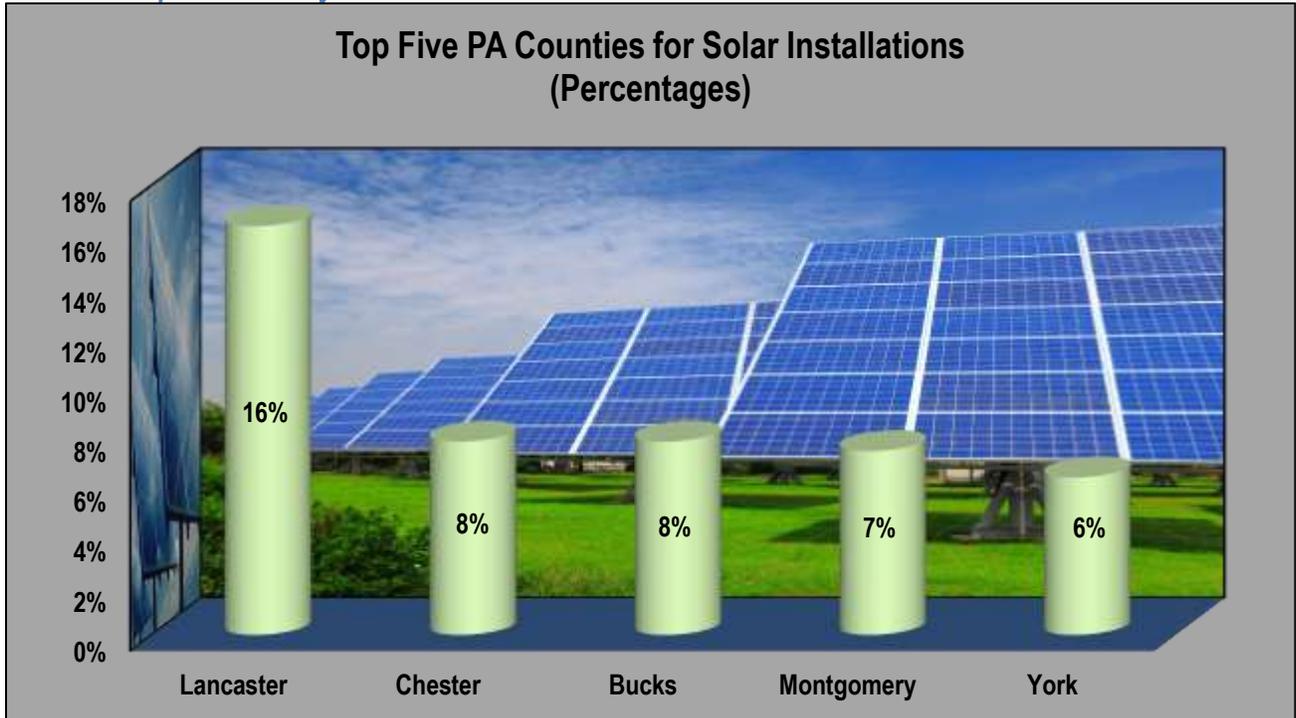
²⁸ U.S. Energy Information Administration, Electric Generators Report - 2016

²⁹ <https://www.eia.gov/electricity/monthly/archive/june2018.pdf>

for solar installations, and approximately 36,000 homes are powered by some amount of electricity from solar energy.³⁰

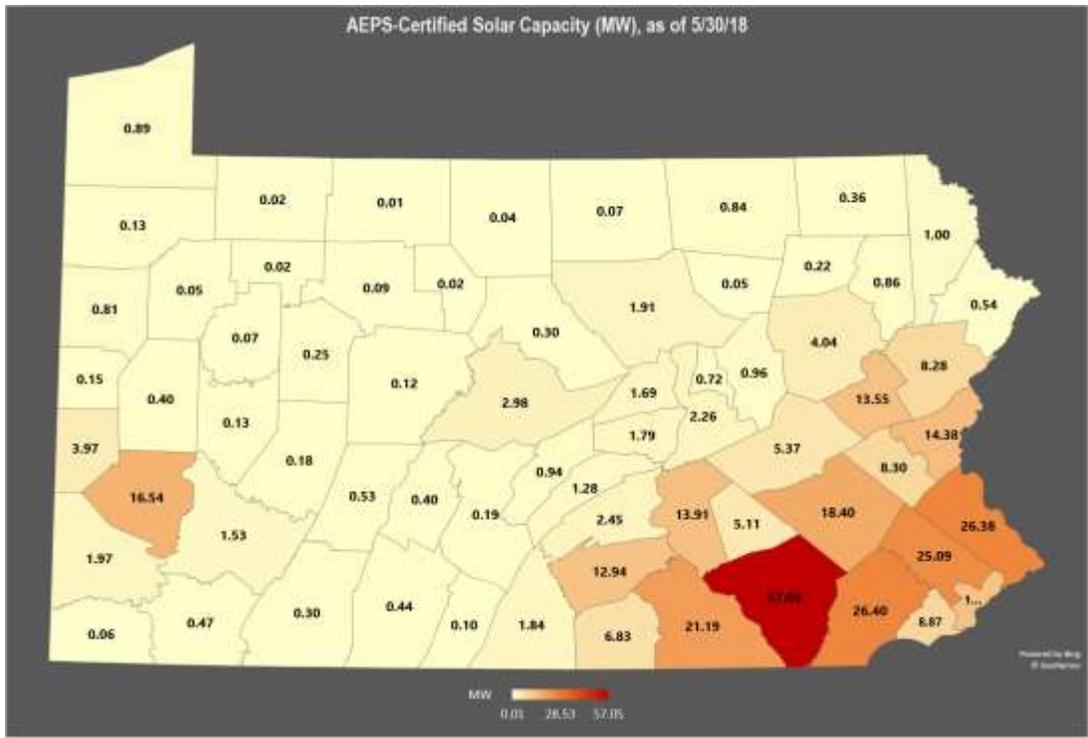
Chart 12 shows the top five Pennsylvania counties for solar installations, as of the end of the compliance year.

Chart 12: Top Five Pennsylvania Counties for Solar Installations



The following two maps show the AEPS certified solar PV capacity and the number of facilities across various counties in Pennsylvania, as of the end of the compliance year.

³⁰ Solar Energy Industry Association (SEIA) - <http://www.seia.org/state-solar-policy/pennsylvania>. The installed capacity reported by SEIA, which is included here for reference, is higher than the number reported by the state AEPS administrator.



Note: Philadelphia county has 764 AEPS certified solar generation facilities with a total capacity of 13.11 MW.

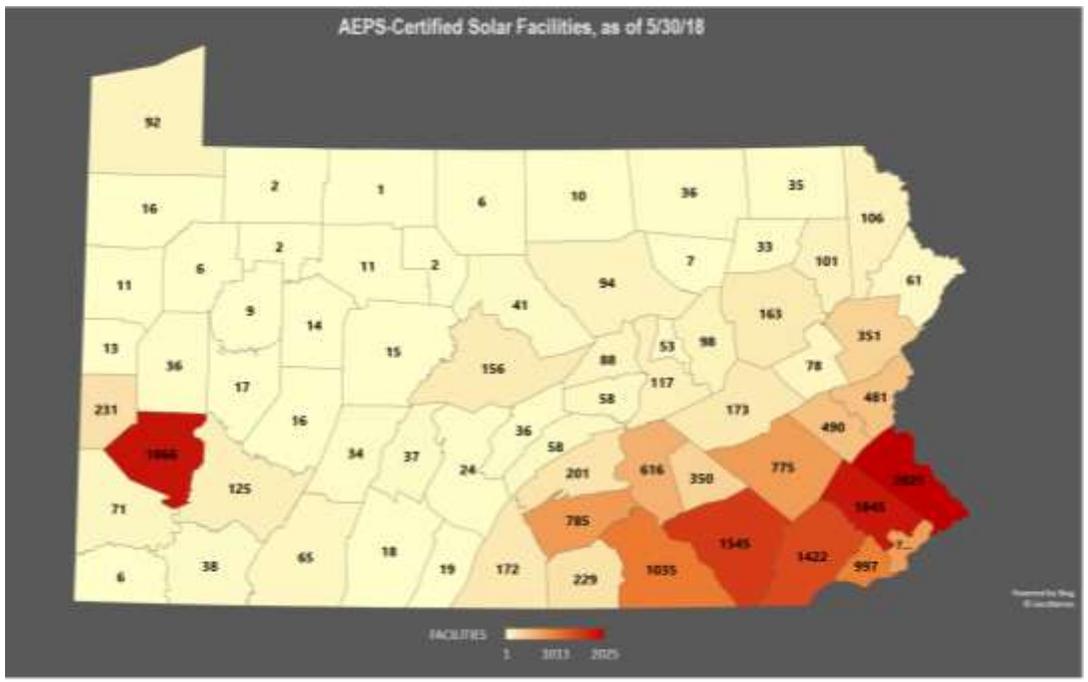
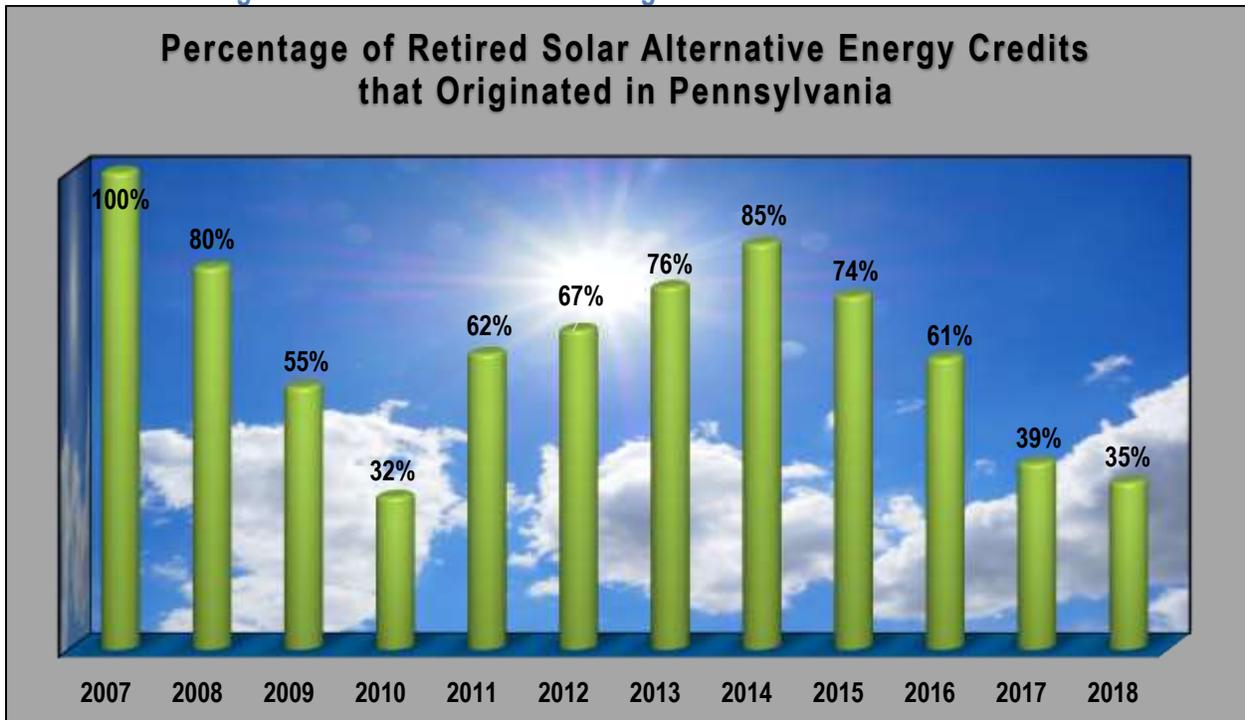


Chart 13 shows the percentage of retired solar AECs used for AEPS Act compliance that originated in Pennsylvania.³¹ 2017 and 2018 data show a significant reduction in the number of retired solar AECs that originated in Pennsylvania. This trend is expected to reverse due to the implementation of Act 40 of 2017 that requires compliance with the Tier I Solar PV requirements of the AEPS Act to be met by using solar AECs generated from within Pennsylvania.

Chart 13: Percentage of Retired Solar AECs that originated in PA



In January 2017, the DEP began a 30-month stakeholder engagement and modeling initiative, “Finding Pennsylvania’s Solar Future,” aimed at finding ways to increase Pennsylvania’s in-state solar generation to 10% of PA retail sales by 2030. This initiative involved the input of more than 600 stakeholders with varied interests and backgrounds. The draft plan was released in July 2018 with a public comment period that ended in August. The draft plan identified that, to meet the 10% goal, approximately 11 GW of solar generation capacity needs to be installed in Pennsylvania over the next 12 years. The final plan: Pennsylvania’s Solar Future

³¹ This report contains the corrected percentage for 2017, last year’s report inadvertently recorded the percentage as 29%.

Plan was released November 2018 and includes 15 core strategies in support of utility-scale and distributed, net-metered solar generation.³² The plan was provided to the public, the legislature, and the Governor for use as a guide for policy making.

B. Wind

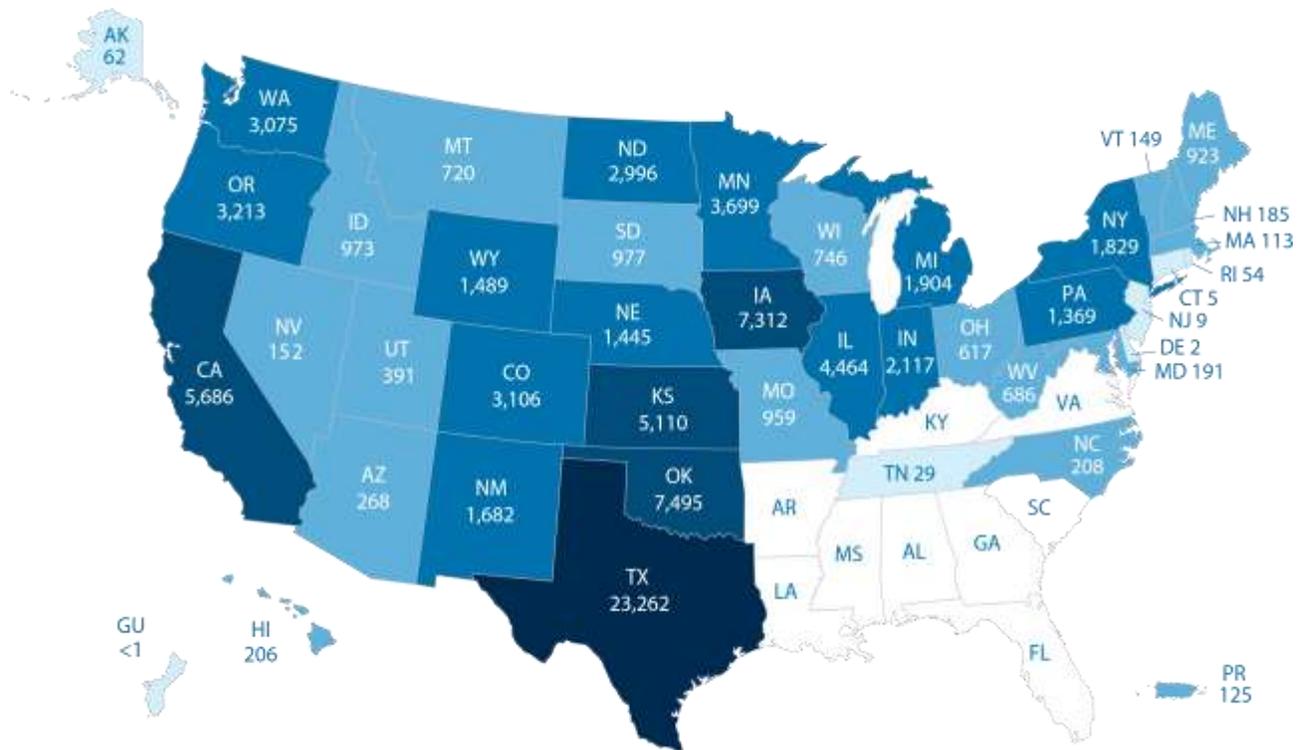
In calendar year 2017, the United States saw a total of 7,017 MW of wind electricity generation capacity installed. This brings the cumulative installed capacity to 88,973 MW. Wind energy supplied 254 million MWh of electricity to the US grid, supplying 6.3% of total all electricity produced.³³

The average wind capacity factor has been increasing over the years. In 2016, the average capacity factor for wind turbines installed in 2014 and 2015 was 42.6%, an increase from an average of 32.1% for wind turbines installed from 2004 to 2011. Technological improvements, particularly, increased blade length, contributed to the increased capacity factor.³⁴

³² <https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx>

³³ American Wind Energy Association, Annual Market Report, 2017 Market Report

³⁴ US Department of Energy, 2016 Wind Technologies Market Report



American Wind Energy Association | U.S. Wind Industry Second Quarter 2018 Market Report | Public Version

During 2017, wind energy provided 1.7% of all in-state electricity production, enough electricity to power over 300,000 average American homes.³⁵

Per the Department of Energy’s Wind Vision projections, Pennsylvania has the potential to generate enough wind electricity to power the equivalent of 1.6 million average American homes. The report estimates an electricity generation potential of 878 MW at a hub height of approximately 260 feet (80 meters) and 43,565 MW at a hub height of approximately 360 feet (110 meters).

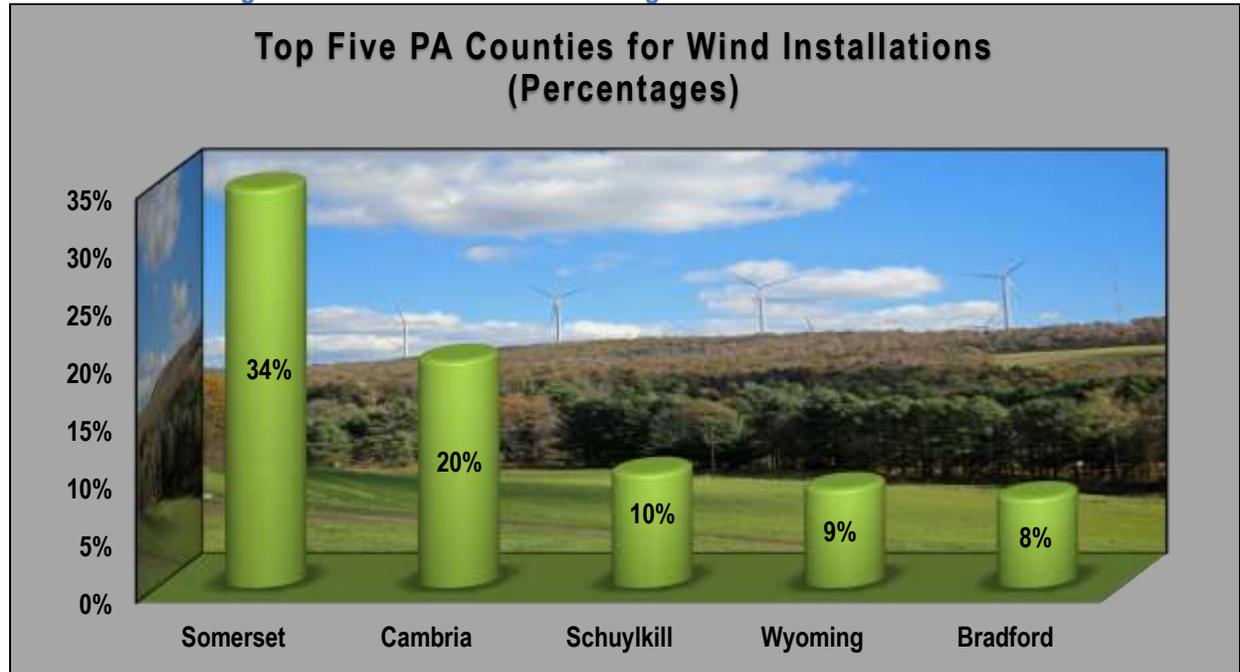
As of May 31, 2018, Pennsylvania’s installed wind capacity, which accounts for roughly 3% of the potential wind electric generating capacity, supports between 1,000 and 2,000 direct and indirect jobs, respectively.³⁶

³⁵ American Wind Energy Association, Statewide Facts, Pennsylvania

³⁶ American Wind Energy Association, Statewide Facts, Pennsylvania

Chart 14 shows the top five counties for Wind installations in Pennsylvania.

Chart 14: Percentage of Retired Solar AECs that originated in PA



C. Hydropower

The United States has almost 103 GW of installed hydropower capacity; the second largest installed capacity in the world, behind China. Hydropower had been the second largest source of non-fossil fuel generation, behind nuclear power, but has recently been eclipsed by the growth of wind power. Since the 1960s, major hydropower development has essentially stopped. Only three percent of domestic hydropower capacity has been installed since 1990, with just one GW of new capacity added since 2000. Most future domestic capacity growth is expected to occur in the form of efficiency improvements at existing dams and the installation of power generating equipment at small dams that were constructed for some other purpose, *i.e.*, river navigation, flood control, etc.³⁷ A study conducted by the U.S.

³⁷ 2016 International Trade Administration (ITA) Energy Top Markets Report

Department of Energy's Oak Ridge National Laboratory has concluded that Pennsylvania has the potential for more than 600 MW of incremental hydropower capacity by using existing water control infrastructure.³⁸ In 2018, with 83,000 miles of streams and rivers, hydropower accounted for 2.0% of Pennsylvania's total electricity generation of 215,385,830 MWh.³⁹

³⁸ 2014 *New Stream-reach Development: A comprehensive Assessment of Hydropower Energy Potential in the United States*.

³⁹ Energy Information Administration data. *Low Impact Hydropower in Pennsylvania: Financial Feasibility Assessment September 2015*, prepared by PALOALTO partners for Pennsylvania Environmental Council



5. Status of Pennsylvania's Alternative Energy Portfolio Standards Marketplace

This section discusses renewable and alternative energy data trends and generation capacity both in Pennsylvania and in the PJM region.

Specifically, this section compares the amount of renewable and alternative energy generation available and to the amount of renewable and alternative energy generation which will be needed to meet future AEPS Act requirements.

The following graphs illustrate the growth of AEPS resources, within Pennsylvania, from 2011 through May 31, 2018, and the AEC price trend through this same time-period, as presented in the PUC’s “Net Metering & Interconnection Report”. Chart 15 provides the cumulative number of AEPS-certified solar PV and Tier I systems, inclusive of solar PV, located in Pennsylvania. Chart 16 provides the cumulative number of AEPS-certified Tier II systems located in Pennsylvania. Charts 17 and 18 show the cumulative nameplate electric generating capacities for Solar, Tier I non-solar, and Tier II installations.

Chart 15: Cumulative Number of Tier I and Solar PV Systems, by Year

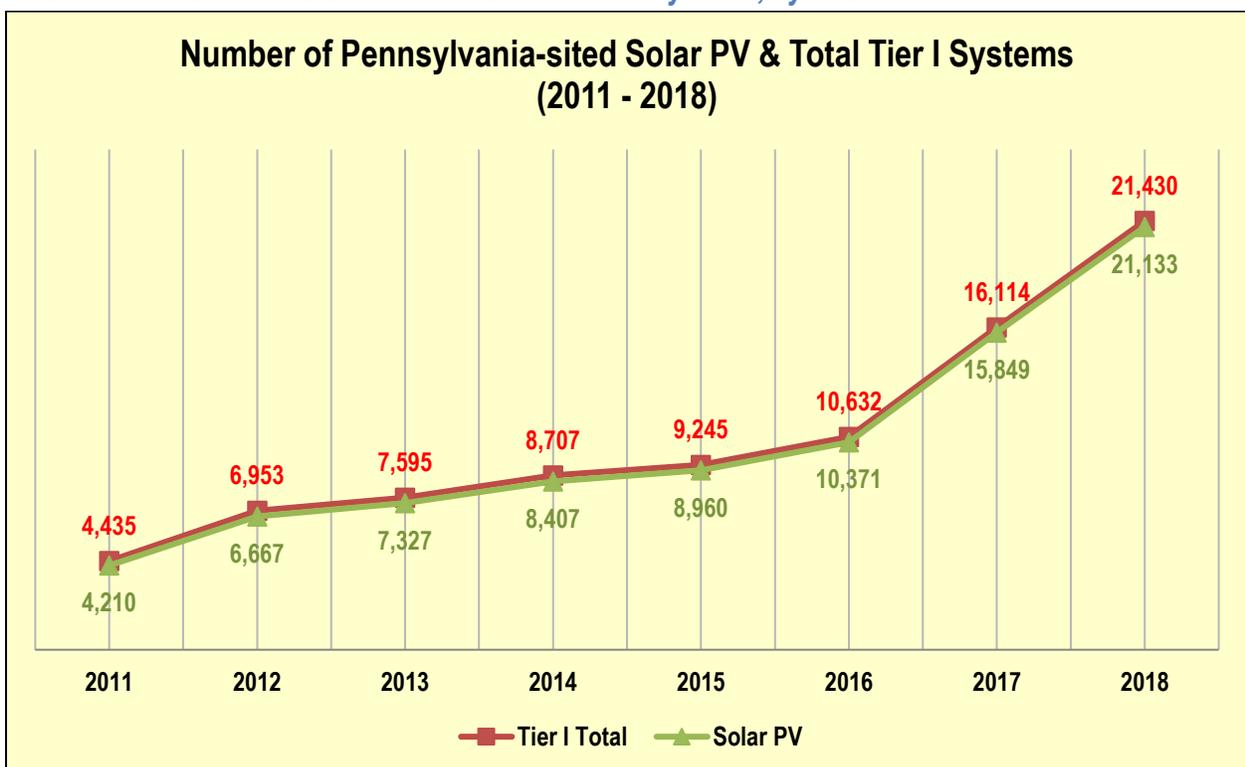


Chart 16: Cumulative Number of Tier II Systems, by Year

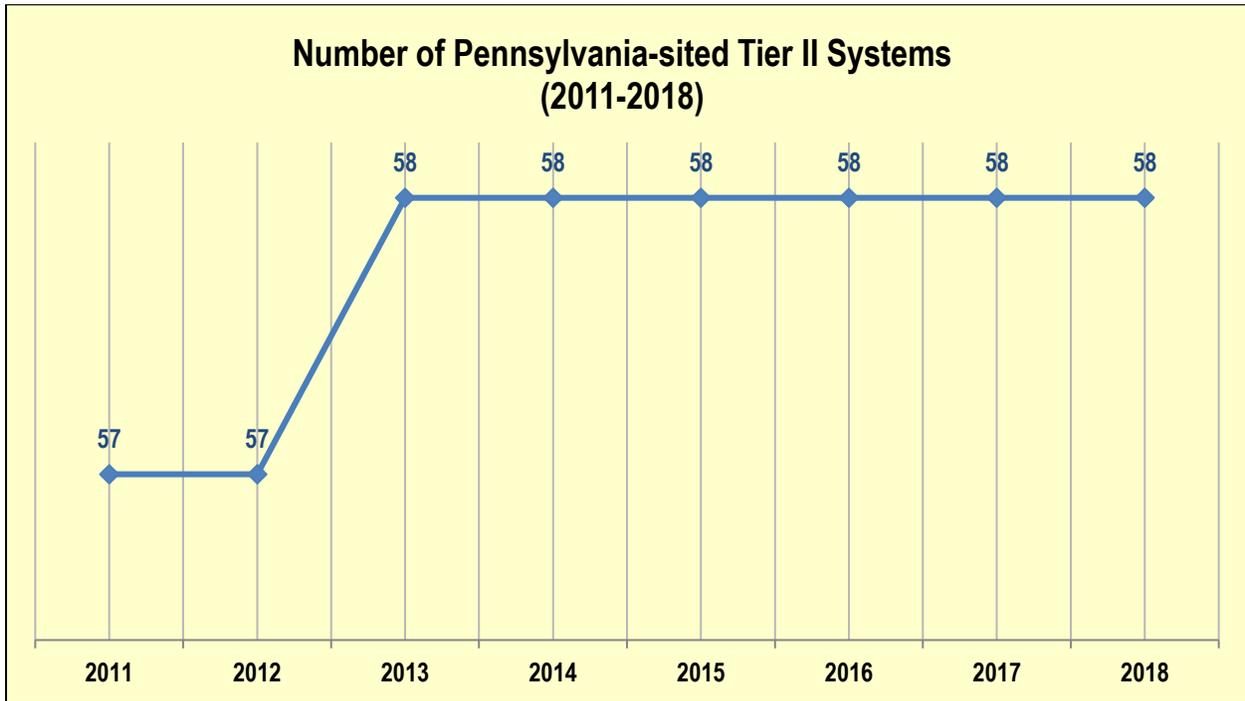


Chart 17: Cumulative Tier I and Solar Nameplate Capacity Installed by Year

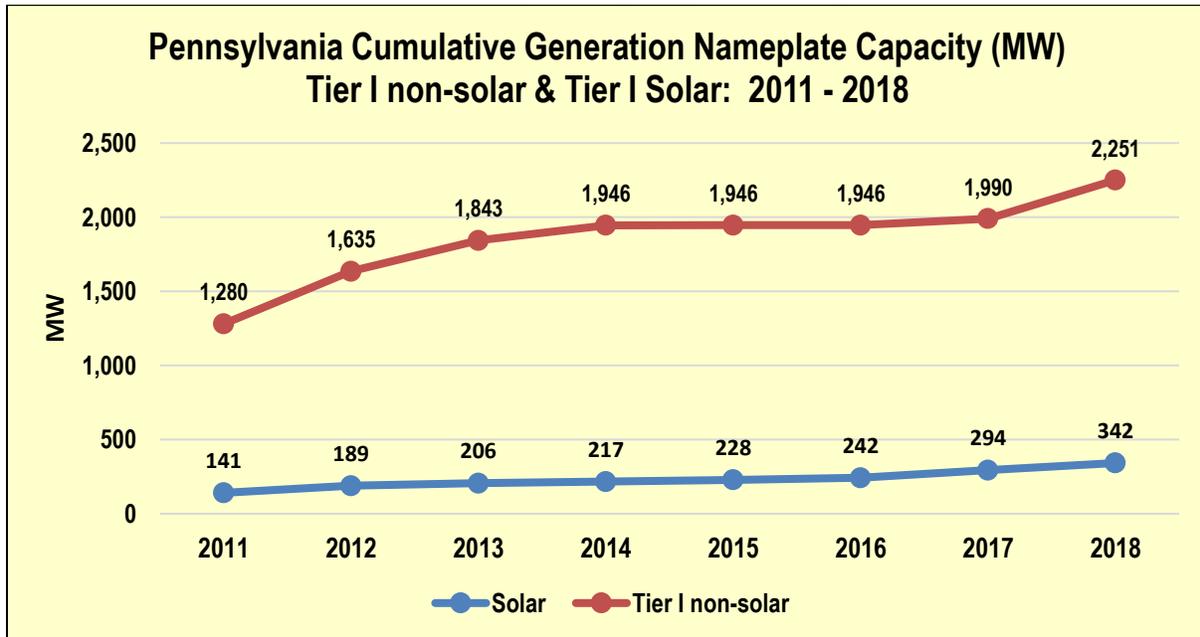
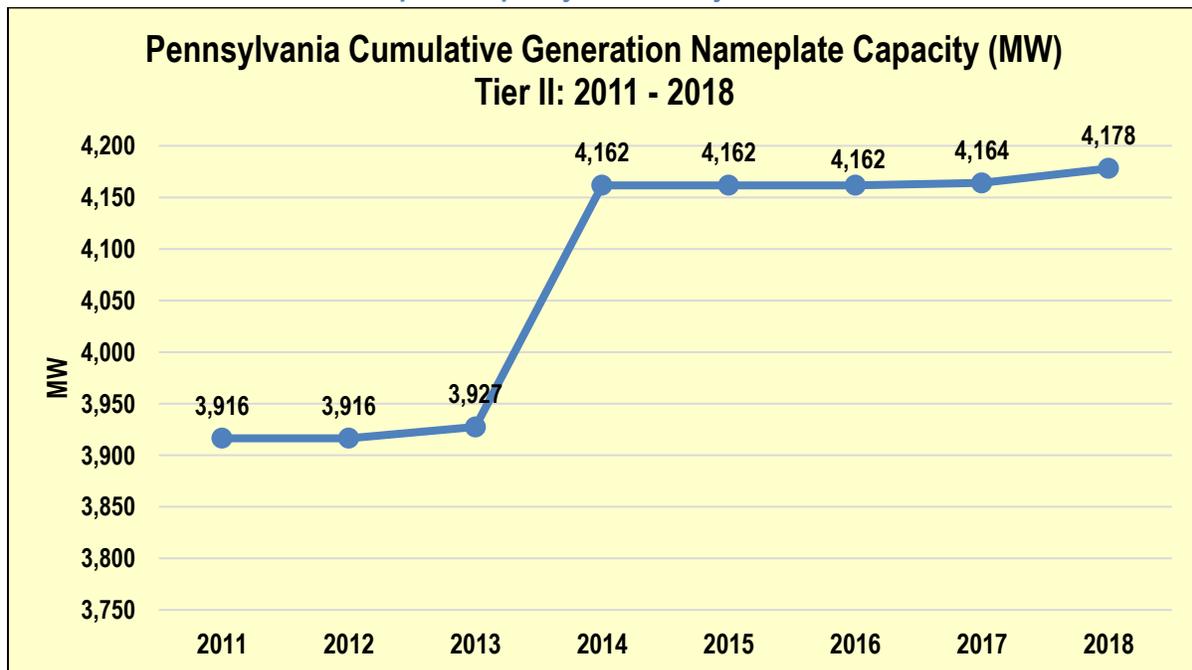
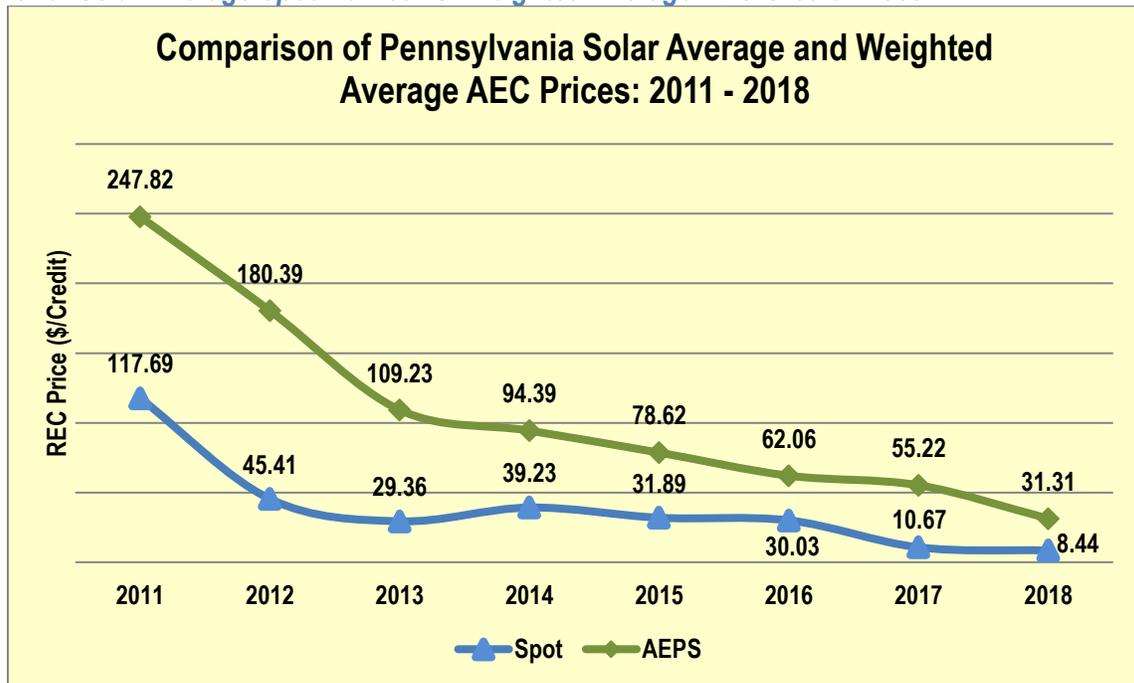


Chart 18: Cumulative Tier II Nameplate Capacity Installed by Year



Charts 19, 20 and 21, on the following pages, provide a comparison of the average annual (compliance year) spot market prices⁴⁰ for the given AEPS tiers, as compared to the weighted average credit prices that have been retired for AEPS compliance. These graphs illustrate the differences between average spot market prices that most readers may be accustomed to seeing and the weighted average price of credits retired for AEPS compliance. This difference is due to the relatively significant volume of credits retired for AEPS compliance that are purchased as part of multi-year procurement processes.

Chart 19: Solar Average Spot Market VS. Weighted Average AEC Credit Prices



⁴⁰ Spot prices from S&P Global Market Intelligence

Chart 20: Tier I Average Spot Market vs. Weighted Average AEC Credit Prices

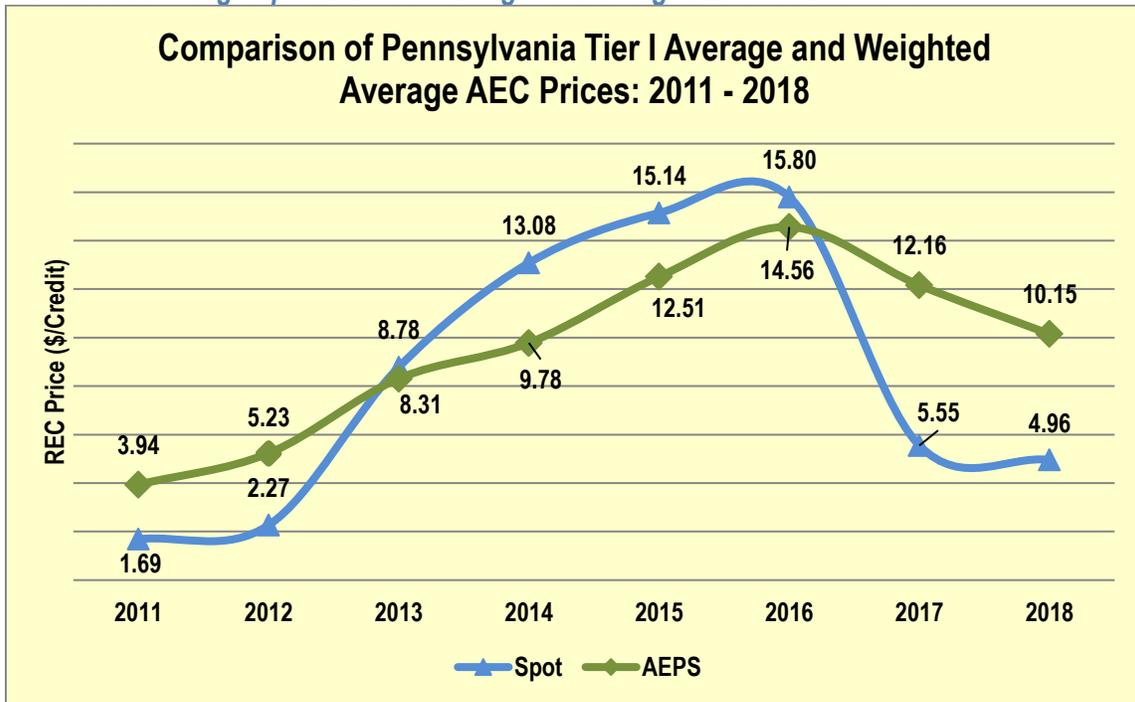
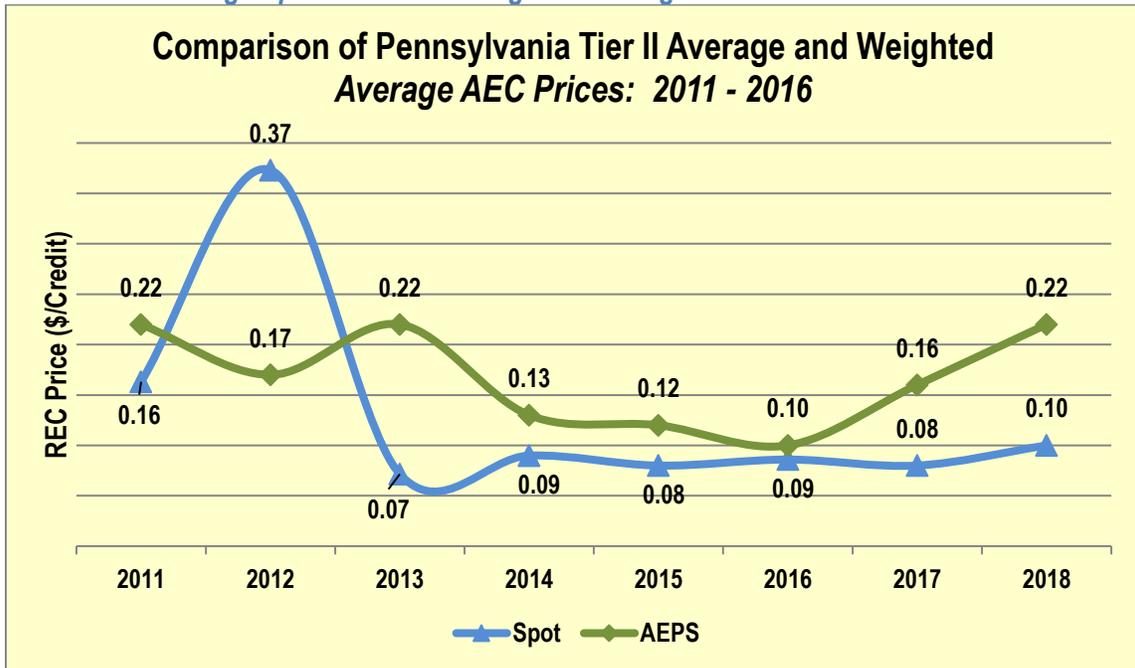


Chart 21: Tier II Average Spot Market vs. Weighted Average AEC Credit Prices



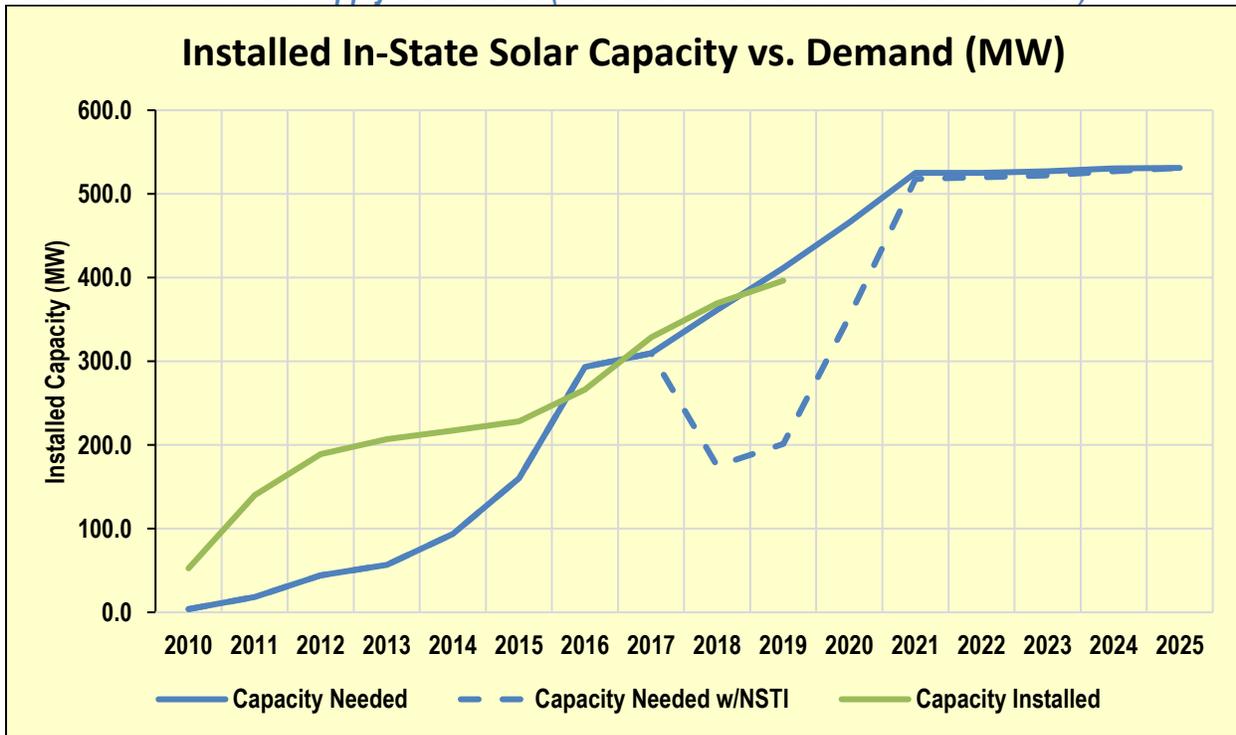
Impact of Act 40 Implementation

Pursuant to the passage of Act 40 and consistent with its Implementation Order⁴¹, the Commission is continuing its review of petitions and associated contracts that seek approval of the use of credits from out-of-state solar facilities, referred to as NSTI credits, for use by Pennsylvania EDCs and EGSs for use towards their Solar PV compliance obligations.

As noted in previous AEPS annual reports, a significant volume of out-of-state credits have been used for solar compliance, which has had a notable impact on the price of solar AECS generated in Pennsylvania, as well as the economic viability to develop in-state solar capacity. Based on the latest analysis of the approved and pending petitions, as well as anticipated growth of in-state solar, Commission staff believe that the most significant impact to the demand for in-state solar will occur in 2020 and should significantly decline thereafter. Chart 22 shows the magnitude that out-of-state solar resources were and are having on the potential buildout of in-state solar needed to comply with the AEPS Tier I Solar requirement. Analysis of this chart also demonstrates that sufficient solar AECs are reasonably expected to be available for Solar PV compliance, out to 2020, if new solar electricity generation facilities are developed in Pennsylvania at the current pace, coupled with the addition of the approved out-of-state solar credits (NSTI credits). Beyond 2020, the pace of solar development in Pennsylvania will need to increase to provide sufficient credits for Solar PV compliance.

⁴¹<http://www.puc.pa.gov/pdocs/1565100.docx>

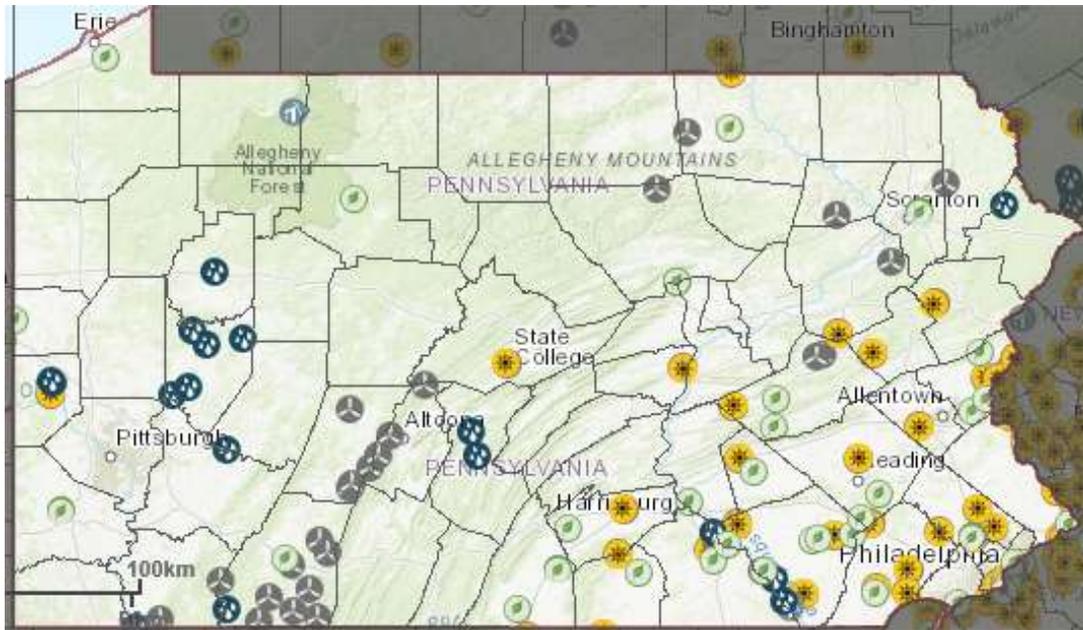
Chart 22: In-State Solar Supply vs. Demand (with and without out-of-state/NSTI Credits)





6. Renewable and Alternative Energy Generation Capacity in Pennsylvania and PJM

The following map shows utility scale (nameplate capacity of 1 MW or greater) alternative energy resources in Pennsylvania, primarily solar PV, wind, biomass, hydroelectric, and pumped storage hydropower plants.⁴²



★ Solar PV 🌀 Wind 🌿 Biomass ⚡ Hydroelectric 1 Pumped Storage

The Pennsylvania AEPS website⁴³ maintains a summary of all AEPS-certified generation facilities and certified energy efficiency and demand-side management (EE/DSM) resources. There were 24,539 certified generation facilities as of May 31, 2018. Of those certified generation facilities, 18,095 facilities (74 percent) are located in Pennsylvania and 6,444 facilities are located outside of Pennsylvania.

Statistics for AEPS-certified generators, as of May 31, 2018, include:

- 18,095 generators located in Pennsylvania with a total nameplate generating capacity of 6,770 MW
- 6,444 generators located outside of Pennsylvania with a total nameplate generating capacity of 16,079 MW

⁴² <https://www.eia.gov/state/?sid=PA#tabs-4>

⁴³ <http://www.pennaeps.com/reports/>

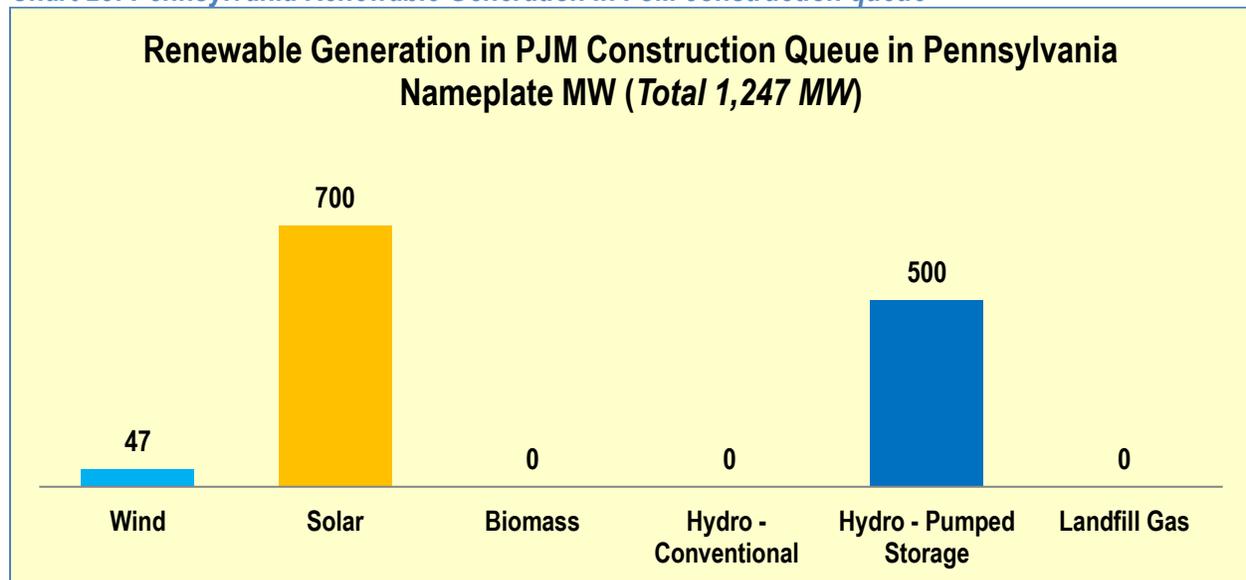
- 17,926 solar facilities in Pennsylvania with a total nameplate generating capacity of 342 MW
- 6,258 solar facilities outside of Pennsylvania with a total nameplate generating capacity of 1,732 MW

Table 6 in Appendix A summarizes the active, AEPS-certified, alternative energy resources by type, as defined within the AEPS, and the capacity of each type inside and outside of Pennsylvania. Generation facilities using biomass are further disaggregated by those using cellulosic or woody biomass and those using black liquor, a by-product of the wood pulping industry. Similarly, biologically derived methane gas is separated into anaerobic digester gas and landfill gas. In some instances, a qualifying AEPS fuel may not be the primary fuel used at a facility for generating electricity. In such cases, listing the nameplate capacity of the generation facility can cause confusion so we have indicated when an AEPS fuel resource is not the primary fuel used in electricity generation.

PJM manages grid interconnection requests in construction queues. Not all projects submitted to PJM for interconnection are constructed. Chart 23 summarizes the proposed renewable generation projects in the queue for Pennsylvania as of the end of the compliance year, with expected completion dates through fourth quarter of 2021.⁴⁴ Withdrawn projects and projects that are in service are not included.

⁴⁴ <http://www.pjm.com/planning/generation-interconnection/generation-queue-active.aspx>

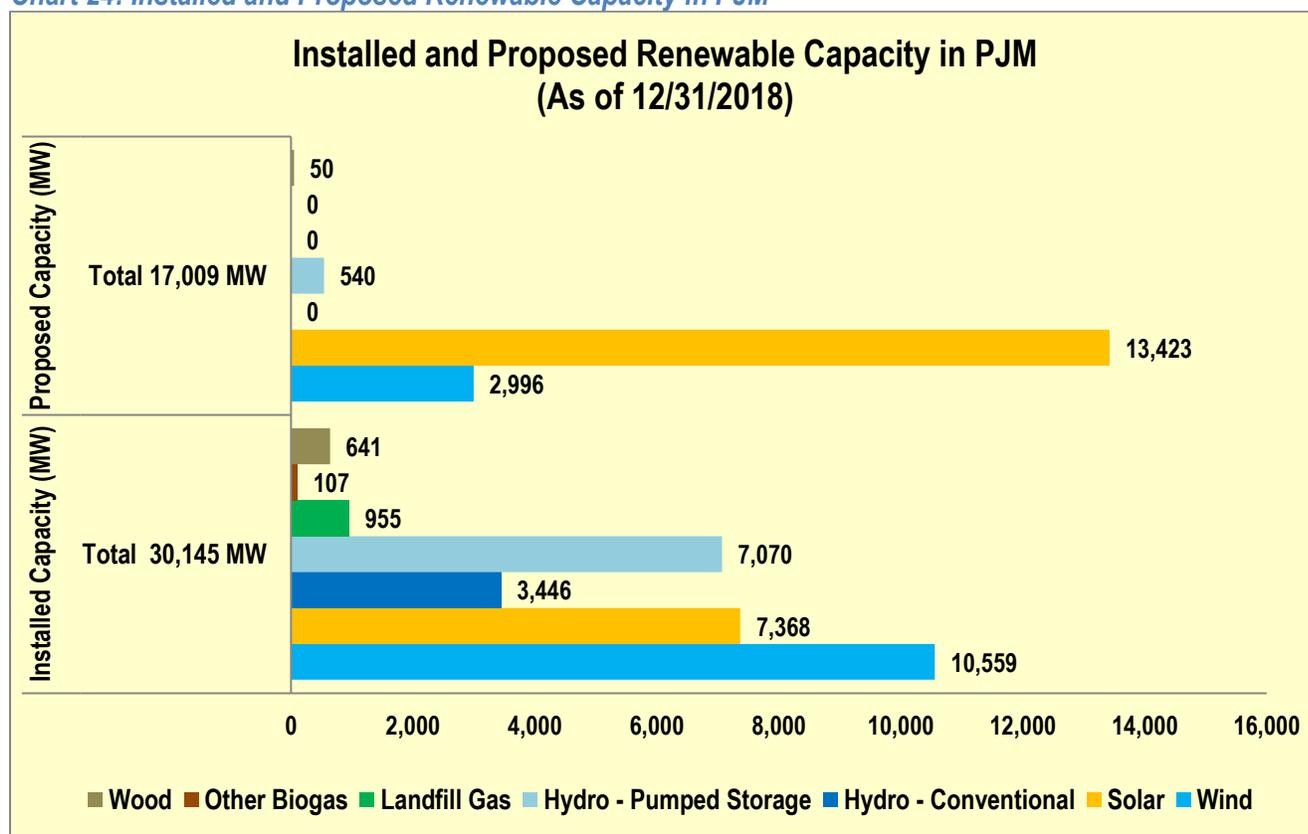
Chart 23: Pennsylvania Renewable Generation in PJM construction queue



As previously discussed in Chapter 5 of this report, since the implementation of Act 40 of 2017, the AEPS Act allows Pennsylvania EDCs and EGSs to purchase Tier I Solar AECs only from facilities located within the borders of Pennsylvania, unless the contracts for out-of-state solar credits (NSTI credits) have been approved by the Commission. Tier I non-solar and Tier II AECs may be purchased from anywhere within the PJM region. PJM has substantial existing and proposed renewable generation capacity, as detailed in Chart 24, that may be eligible for use in complying with the AEPS requirements.⁴⁵

⁴⁵ PJM-EIS Public Reports, Renewable Generators Registered in GATS and PJM queue. Includes “Active” and projects “Under Construction”

Chart 24: Installed and Proposed Renewable Capacity in PJM



Note: Solar PV supply includes existing supply and 25 percent of the new capacity in the PJM construction queues. It does not account for small, behind the meter systems.

PJM states with renewable portfolio standards (RPS) include Pennsylvania, Michigan, Ohio, North Carolina, Illinois, Delaware, District of Columbia, Maryland, and New Jersey. Virginia and Indiana have RPS goals and West Virginia, Tennessee and Kentucky do not yet have a final RPS. In states with RPS requirements, the final requirements range from 10 percent of electricity sales by 2025 in Indiana to 50 percent of sales by 2032 in the District of Columbia.⁴⁶

The RPS requirements of the PJM states and the District of Columbia vary considerably regarding the generation resources that are eligible to meet the requirements. Differences are found in the types of renewable and/or alternative

⁴⁶ [Comparison of Renewable Portfolio Standards \(RPS\) Program in PJM States](#) – Published June 26, 2018

energy generation resources that qualify. Some states allow resources that are not permitted by other states. Also, some states use credit multipliers for certain generation resources, allowing certain resources to earn double or triple the amount of credits per MWh of generation. Generation facility location for compliance purposes is another matter where the states differ. Some states require that qualifying generation facilities be located within that state. Other states allow resources originating from anywhere within the PJM service area and still others allow resources outside of PJM to qualify. Also, within some states, EDCs, EGSs and municipal utilities have different requirements under their RPS.

The AEPS marketplace for Pennsylvania is quite complex due to numerous factors which must be considered, such as those previously referenced. To meet the Tier I Solar AEPS obligations, EDCs and EGSs must purchase solar AECs from resources located within the geographic boundaries of Pennsylvania. To meet their Tier I non-solar and Tier II AEPS obligations, they can purchase AECs from anywhere within the PJM region. Based on existing resources within PJM, staff estimates that adequate Tier I non-solar and Tier II supply exists through 2021. The development of Tier I solar resources is lagging slightly. Several large solar farms are planned for development in Pennsylvania, but it is uncertain how much of this planned capacity may be online and generating credits for use in the AEPS marketplace by 2021.

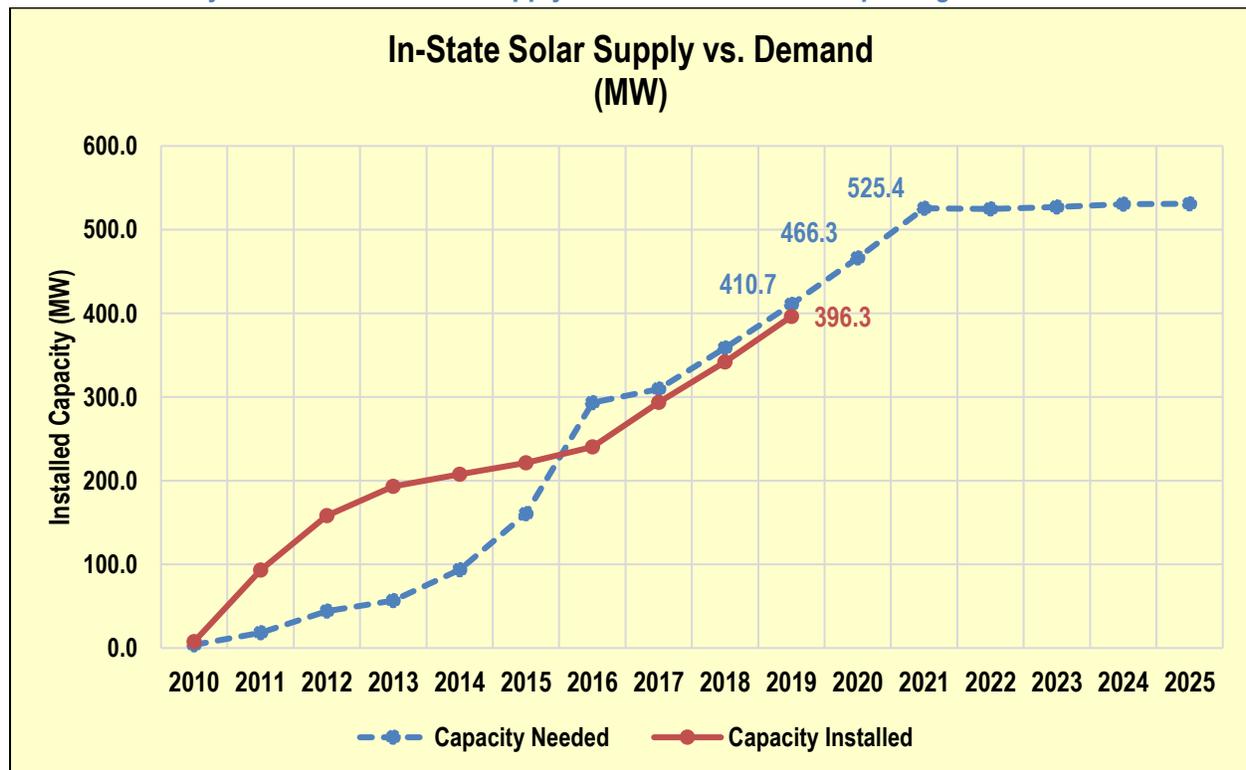
Chart 25 provides a comparison of Pennsylvania's solar requirement to in-state installed capacity. The graph shows that Pennsylvania will require a modest increase in the rate of solar development growth to be able to meet its solar requirement without consideration of NSTI credits that the Commission may have approved from legacy contracts. If all the solar projects proposed for Pennsylvania in the PJM planning queue came to fruition, it would add an additional 700 MW of installed capacity between 2017 and January 2022. The PJM queue, however, is not a good indicator of solar development given that most solar development tends to be small, distributed and behind-the-meter projects that are not tracked by the queue. In addition, only a small percentage of the proposed projects in the queue have historically come into service. The chart illustrates that a significant and increasing amount of in-state solar credits would be necessary if compliance with the annual

solar obligations of the AEPS Act was based on solar AECs from only in-state resources.

Similar to Pennsylvania, many of the PJM states have “closed their borders”, not allowing the use of NSTI (out-of-state solar credits) for use in complying with their state RPS solar requirements. For this reason, it is likely that most of the solar AECs currently available in GATS, that originated in Pennsylvania, will be available for use in Pennsylvania.

Projected solar demand is summarized in Table 7 in Appendix A. Please note that in estimating the needed capacity, a capacity factor of 13 percent had been applied for years prior to 2016. A capacity factor of 15 percent is used for years 2016 and later, which is more reflective of the current systems being installed in Pennsylvania.⁴⁷

Chart 25: Pennsylvania In-State Solar Supply vs. Demand in Each Reporting Year



⁴⁷ The relative percentage of time a generator actually produces electricity



7. Recent Activity Since End of Compliance Year

Pennsylvania House Bill 118 was signed into law as Act 40 of 2017 on October 30, 2017. Act 40 among other things, modifies the AEPS Act. Section 11.1 of Act 40 of 2017 amends the Administrative Code (Adm. Code), 71 P.S. §§ 1 *et seq.*, by adding Section 2804 to the Adm. Code, 71 P.S. § 714, that amends the Alternative Energy Portfolio Standards Act (AEPS Act), 73 P.S. §§ 1648.1 – 1648.8, 66 Pa. C.S. § 2814, by establishing geographical limits on solar photovoltaic (solar PV) systems that qualify for the solar PV share requirement in Section 3 of the AEPS Act, 73 P.S. § 1648.3(b)(2).

On December 21, 2017, the Commission adopted a Tentative Implementation Order (TIO) at the above referenced Docket seeking comments on proposed interpretations and implementation of Section 2804 of the Adm. Code.⁴⁸ In addition to the TIO, Chairman Gladys M. Brown Dutrieuille and Vice Chairman Andrew G. Place issued a joint statement that presented supplemental interpretations of Section 2804(2)(i) and 2804(2)(ii) of the Adm. Code, as well as the status of banked solar PV alternative energy credits (SRECs) for comment. Written comments were to be submitted within 30 days of the publication of the TIO in the *Pennsylvania Bulletin*, February 5, 2018.⁴⁹

On April 19, 2018, upon consideration of the comments, the Commission adopted the Joint Motion of Chairman Gladys M. Brown Dutrieuille and Vice Chairman Andrew G. Place setting forth the Commission's interpretation and implementation of Act 40. On May 3, 2018, the Act 40 Final Implementation Order (FIO) was entered. On May 16, 2018, the Commission issued a Secretarial Letter providing additional procedural information regarding the Section 2804(2)(ii) of the Adm. Code, 71 P.S. § 714(2)(ii), contract approval process.

Various petitions for reconsideration/clarification and an application for stay were filed in response to the Act 40 FIO - some of which requested clarification regarding the Commission's implementation of Section 2804(2)(ii).⁵⁰ In response, the

⁴⁸ See *Implementation of Act 40 of 2017*, Tentative Implementation Order at Docket No. M-2017-2631527 (entered December 21, 2017).

⁴⁹ The TIO was published in the *Pennsylvania Bulletin* on January 6, 2018 at 48 Pa. B. 111.

⁵⁰ See, e.g., In the Matter of Implementation of Act 40 of 2017, Docket No. M-2017-2631527, Petition of Exelon Generation Company, LLC and Constellation New Energy, Inc. For Clarification And/or Reconsideration of the Commission's Final Implementation Order dated May 18, 2018 at 6-10.

Commission entered an Opinion and Order August 2, 2018 clarifying its interpretation and implementation of Section 2804(2) (“Act 40 Clarification Order”).⁵¹

Accordingly, the Commission provided the following clarification as to the Implementation of Section 2804(2)(ii) as set forth below.

In the FIO, the Commission stated the following regarding Sections 2804(2)(i) and (2)(ii):

For the reasons expressed in Section F.2. above, when reviewing the totality of comments described above, it becomes evident that Section 2804(1)(i), 2804(1)(ii), and 2804(1)(iii) explicitly describe the qualifications for Tier I Solar facilities after passage of Act 40; Section 2804(2)(i) clarifies that all Tier I Solar facilities certified before passage of Act 40 that are located within the geographic boundaries of Pennsylvania are to be held harmless from this legislation; and Section 2804(2)(ii) enjoins the legislation from breaching existing contracts from out of state Tier I Solar facilities which were entered into before passage to serve the AEPS Act needs of Pennsylvania entities.

The Commission went on to state that “we interpret this section to only permit out of state facilities that are (a) already certified as AEPS Tier I Solar Photovoltaic and that (b) have entered into a contract with a Pennsylvania EDC or EGS serving Pennsylvania customers, for the sale of solar credits, to maintain certification until the expiration of the contract.” The Commission further stated that “this maintained certification should only be applicable to the amount of credits contractually committed to by an out of state certified facility to an EDC or EGS.”

In the Act 40 Clarification Order, the Commission provided further clarification as to the implementation of Section 2804(2)(ii) as follows:

We clarify that all contracts with EGSs, EDCs and/or their wholesale suppliers, as well as any other entity holding contracts entered into prior to October 30, 2017, and within the chain of production of the solar AECs

⁵¹ Implementation of Act 40 of 2017, Petition of Community Energy, Inc. for Clarification and/or Reconsideration, et. al., Docket No. M-2017-2631527, Opinion and Order entered August 2, 2018 (“Act 40 Clarification Order”).

supplying those contracts may file a petition. Such Petitions may seek to have the AECs covered by the contracts with the EGS, EDC or their wholesale supplier certified for use by the EGS or EDC for compliance with the AEPS Act solar PV share requirement. We emphasize that only the AECs directly attributable to an EGS serving load in Pennsylvania, an EDC serving load in Pennsylvania or its wholesale supplier will be eligible to be used for the AEPS Act solar PV share requirement pursuant to Section 2804(2)(ii).



8. Appendix

Appendix A

Table 1: Overview of AEPS Percentage Sales Requirements

Year	Period	Tier I			Tier II
		Total	Solar PV	Non-Solar	
1	June 1, 2006 – May 31, 2007	1.50%	0.0013%	1.4987%	4.20%
2	June 1, 2007 – May 31, 2008	1.50%	0.0030%	1.4970%	4.20%
3	June 1, 2008 – May 31, 2009	2.00%	0.0063%	1.9937%	4.20%
4	June 1, 2009 – May 31, 2010	2.50%	0.0120%	2.4880%	4.20%
5	June 1, 2010 – May 31, 2011	3.00%	0.0203%	2.9797%	6.20%
6	June 1, 2011 – May 31, 2012	3.50%	0.0325%	3.4675%	6.20%
7	June 1, 2012 – May 31, 2013	4.00%	0.0510%	3.9490%	6.20%
8	June 1, 2013 – May 31, 2014	4.50%	0.0840%	4.4160%	6.20%
9	June 1, 2014 – May 31, 2015	5.00%	0.1440%	4.8560%	6.20%
10	June 1, 2015 – May 31, 2016	5.50%	0.2500%	5.2500%	8.20%
11	June 1, 2016 – May 31, 2017	6.00%	0.2933%	5.7067%	8.20%
12	June 1, 2017 – May 31, 2018	6.50%	0.3400%	6.1600%	8.20%
13	June 1, 2018 – May 31, 2019	7.00%	0.3900%	6.6100%	8.20%
14	June 1, 2019 – May 31, 2020	7.50%	0.4433%	7.0567%	8.20%
15	June 1, 2020 – May 31, 2021	8.00%	0.5000%	7.5000%	10.00%

Table 2: 2018 AEPS Compliance Report by Tier

MWhs	Alternative Energy Requirement		Number of Credits Reserved	Weighted Average Credit Price	Cost of Purchased Credits	Alternative Compliance Payments Required
	Tier	Percent of Total Energy Sold				
141,724,702	Solar	0.34	481,963	\$31.31	\$15,004,873.09	10
	I	6.16	9,301,679	\$10.15	\$92,922,771.66	211
	II	8.2	11,623,329	\$0.22	\$2,541,778.00	232
	Total	14.7	21,406,971	N/A	\$110,469,422.75	453

The weighted average credit prices reflected above are calculated using data for credits that have a known cost. Some credits that are retired to meet obligations are self-generated or purchased bundled with the electricity and a cost for those credits is not available. Therefore, dividing the cost of purchased credits by the number of credits reserved will not yield the weighted average credit price reflected in the table. The weighted average credit price is used to calculate the solar ACP. The solar ACP, as established in statute, is 200 percent of the sum of the weighted average credit price of solar AECs sold during the reporting year plus the value of any in-state and out-of-state solar rebates. The statutorily established ACP for Tier I and Tier II is \$45.

One EGS, Aspurity Energy, LLC did not pay the required ACPs as they are no longer in business. Aspurity Energy, LLC abruptly left the market after they filed for bankruptcy on June 30, 2017 and sent a notice to customers on August 4, 2017, informing them that their accounts had been reassigned to another EGS. Due to the bankruptcy, Aspurity Energy, LLC did not meet its AEPS obligations nor pay the ACPs.

Table 3: 2018 AEPS Compliance Report by EDC Service Territory

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired	Compliance Status
Citizens' Electric and EGS	175,857				
Solar		0.34%	598	598	In Compliance
Tier I (non-solar)		6.16%	11,541	11,540	In Compliance
Tier II		8.20%	14,420	14,420	In Compliance
Duquesne Light and EGSSs	13,001,861				
Solar		0.34%	44,206	44,220	In Compliance
Tier I (non-solar)		6.16%	853,249	853,233	In Compliance After ACP
Tier II		8.20%	1,066,153	1,066,159	In Compliance After ACP
Met Ed and EGSSs	14,347,239				
Solar		0.34%	48,781	48,779	In Compliance
Tier I (non-solar)		6.16%	941,540	941,558	In Compliance
Tier II		8.20%	1,176,474	1,176,526	In Compliance
PECO and EGSSs	37,827,945				
Solar		0.34%	128,615	128,657	In Compliance After ACP
Tier I (non-solar)		6.16%	2,482,465	2,482,946	In Compliance After ACP
Tier II		8.20%	3,101,892	3,102,902	In Compliance After ACP
Penelec and EGSSs	13,789,301				
Solar		0.34%	46,884	46,885	In Compliance
Tier I (non-solar)		6.16%	904,925	904,895	In Compliance
Tier II		8.20%	1,130,723	1,130,692	In Compliance
Penn Power and EGSSs	4,673,991				
Solar		0.34%	15,892	15,891	In Compliance
Tier I (non-solar)		6.16%	306,731	306,738	In Compliance
Tier II		8.20%	383,267	383,322	In Compliance
Pike County and EGSSs	75,679				
Solar		0.34%	257	257	In Compliance
Tier I (non-solar)		6.16%	4,966	4,967	In Compliance
Tier II		8.20%	6,206	6,205	In Compliance

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired	Compliance Status
PPL and EGSs	36,770,395				
Solar		0.34%	125,019	125,043	In Compliance After ACP
Tier I (non-solar)		6.16%	2,413,063	2,413,448	In Compliance After ACP
Tier II		8.20%	3,015,172	3,015,983	In Compliance After ACP
UGI Electric and EGSs	1,003,284				
Solar		0.34%	3,411	3,411	In Compliance
Tier I (non-solar)		6.16%	65,841	65,841	In Compliance
Tier II		8.20%	82,269	82,270	In Compliance
Wellsboro Electric and EGSs	124,912				
Solar		0.34%	425	425	In Compliance
Tier I (non-solar)		6.16%	8,197	8,197	In Compliance
Tier II		8.20%	10,243	10,243	In Compliance
West Penn Power and EGSs	19,934,238				
Solar		0.34%	67,776	67,797	In Compliance
Tier I (non-solar)		6.16%	1,308,188	1,308,316	In Compliance
Tier II		8.20%	1,634,607	1,634,607	In Compliance

The data reported for each Distribution Service Territory is aggregate for the EDC and all EGSs that served customers in that territory. The Credits Retired column shows an overage in some instances because numerous EGSs retired credits in excess of their required AEPS obligations. A few apparent shortages in the Retired Credits column occurred when EGSs retired AECs in another EDC territory. While these AEPS obligations show as a shortage in the Credits Retired column, these EGSs did meet their obligations on a statewide basis.

One EGS, Aspiry Energy, LLC did not pay the required ACPs as they are no longer in business. Aspiry Energy, LLC abruptly left the market after they filed for bankruptcy on June 30, 2017 and sent a notice to customers on August 4, 2017, informing them that their accounts had been reassigned to another EGS. Due to the bankruptcy, Aspiry Energy, LLC did not meet its AEPS obligations nor pay the ACPs.

Table 4: AEC State of Origin – Used for compliance in 2018

Tier	PA	NJ	MD	VA	WV	IL	OH	DE	NC	IN	MI	KY	TN
Solar	170,743	153	6,468	26,314	302	3,959	11,896	316	261,736	61	11	0	4
Tier I	2,680,847	91,054	85,876	2,373,182	236,770	2,653,982	356,381	14,978	195,737	575,953	3	36,897	19
Tier II	7,786,348	265,604	59,301	2,168,417	1,217,416	0	61,611	0	64,632	0	0	0	0
Total	10,637,938	356,811	151,645	4,567,913	1,454,488	2,657,941	429,888	15,294	522,105	576,014	14	36,897	23

Table 5: Estimated Statewide AEPS Cost of Compliance in 2021 (2019 Dollars) *

EDC	Solar Credits		Tier I Credits		Tier II Credits		Total Cost
	Credits Needed	Solar Credits @ \$42.50	Credits Needed	Tier I Credits @ \$7.20	Credits Needed	Tier II Credits @ \$0.525	
Duquesne	61,609	\$ 2,330,352	941,782	\$ 6,034,916	1,255,709	\$ 586,728	\$ 8,951,995
Met-Ed	67,787	\$ 2,564,049	1,065,538	\$ 6,827,943	1,420,718	\$ 663,828	\$ 10,055,820
Penelec	67,017	\$ 2,534,903	1,012,294	\$ 6,486,752	1,349,725	\$ 630,656	\$ 9,652,310
Penn Power	23,356	\$ 883,419	362,421	\$ 2,322,381	483,227	\$ 225,787	\$3,431,588
PECO	179,261	\$ 6,780,515	2,781,639	\$17,824,674	3,708,853	\$1,732,954	\$ 26,338,144
PPL	185,400	\$ 7,012,727	2,885,501	\$18,490,216	3,847,335	\$1,797,660	\$ 27,300,603
UGI	99110	\$ 3,748,805	1,557,958	\$ 9,983,358	2,077,278	\$ 970,604	\$ 14,702,767
West Penn	4,977	\$ 188,251	75,321	\$ 482,653	100,428	\$ 46,925	\$ 717,829
Citizens'	865	\$ 32,725	13,573	\$ 86,975	18,097	\$ 8,456	\$ 128,155
Pike County	399	\$ 15,096	6,230	\$ 39,922	8,307	\$ 3,881	\$ 58,900
Wellsboro	537	\$ 20,325	8,182	\$ 52,429	10,909	\$ 5,097	\$ 77,851
Totals	690,318	\$26,111,167	10,710,439	\$68,632,218	14,280,585	\$6,672,577	\$101,415,962

* Estimated costs reflect the application of a 6% discount rate

Table 6: AEPS Existing Capacities of Certified, Active Facilities

AEPS Tier	Alternative Energy Resource Types	Nameplate Capacity of PA Facilities (MWs)	Nameplate Capacity of Out-of-State Facilities (MWs)	Total Nameplate Capacity (MWs)
I	Biomass Energy			
	Cellulosic (woody) Biomass	339.3	1,198.9	1,538.1
	Black Liquor	163.7	0.0	163.7
I	Coal Mine Methane (primary fuel source)	0.8	0.0	0.8
I	Coal Mine Methane (secondary fuel source)	0.0	88.0	88.0
I	Fuel Cell*	0.6		0.6
I	Low-Impact Hydropower	178.7	2.2	180.9
I	Biologically Derived Methane Gas			
	Other Biomass Gas	3.3	0.0	3.3
	Anaerobic Digester Gas (primary fuel source)	12.8	6.6	19.4
	Anaerobic Digester Gas (secondary fuel source)	0.0	446.0	446.0
	Landfill Gas (primary fuel source)	222.0	439.3	661.3
	Landfill Gas (secondary fuel source)	0.0**	252.0	252.0
I	Solar PV	342.0	1,731.9	2,073.9
I	Wind	1,329.5	6,369.6	7,699.2
I	TOTAL of Tier I	2,592.6	10,534.5	13,127.2
II	Biomass Energy			
	Cellulosic (woody) Biomass	0.0	173.0	173.0
	Black Liquor	0.0	414.4***	414.4
II	Distributed Generation	4.8	0.0	4.8
II	Hydropower			
	Conventional, Non-Low Impact	712.3	1,066.8	1,779.1
	Pumped Storage	1,540.0	3,456.0	4,996.0
II	Municipal Solid Waste	149.7	202.2	351.9
II	Demand Side Management			
	Energy Efficiency	4.4	0.0	4.4
	Blast Furnace Gas	55.5	67.0	122.5
	Other Gases	85.5	0.0	85.5
	Waste Heat	5.0	0.0	5.0
	Industrial By-product	0.0	0.0	0.0
II	Waste Coal	1,620.4	165.0	1,785.4
II	TOTAL of Tier II	4,177.6	5,544.3	9,721.9
I & II	TOTAL of Tiers I & II	6,770.3	16,078.8	22,849.1

* New for 2018

** Nameplate capacity for some alternative energy resource types have decreased due to system decertification in the compliance year.

*** Several facilities have the capability of utilizing multiple fuel sources that may include a combination of Tier I, Tier II or even non-eligible AEPS fuels to generate electricity. For example, a facility may co-fire coal and biomass or blend landfill gas and natural gas. Methodologies are in place to ensure that only AEPS-certified generation is awarded AECs but it is not possible to designate a single, static AEPS nameplate capacity associated with these generators.

Table 7: Estimated In-state Solar Demand and Installed Capacity: 2015 – 2021

Year	Generation Requirement (MWh)	Capacity Required (MW)	Installed Capacity (MW)
2015	204,255	179	223
2016	364,442	320	232
2017	406,840	310	294
2018	471,061	359	342
2019	539,701	411	396
2020	612,745	466	
2021	690,318	525	

Table 8: Snapshot of the key chronology of events to date

Event	Date
Act 213 of 2004	Nov. 30, 2004
Act 213 of 2004 Effective Date	Feb.28, 2005
PUC Adopts Implementation Order I (M-00051865)	March 23, 2005
PUC Adopts Implementation Order II (M-00051865)	July 14, 2005
PUC Adopts Order: Standards for DSM Resources (M-00051865)	Sept. 25, 2005
PUC Adopts Order: Designates PJM GATS Registry (M-00051865)	Jan. 27, 2006
Final Net Metering/Interconnection Regulations in the <i>Pennsylvania Bulletin</i>	Dec. 16, 2006
PUC Contracts with Clean Power Markets as Program Administrator	March 28, 2007
Compliance Required for Pennsylvania Power Co. & UGI Utilities Inc.	May 31, 2007
Act 35 of 2007	July 19, 2007
Compliance Required for Citizens' Electric Co., Duquesne Light Co., Pike County Light & Power, and Wellsboro Electric Co.	Jan. 1, 2008
PUC Adopts Final Rulemaking Implementation Order (L-00060180)	Sept. 25, 2008
Act 129 of 2008	Oct. 15, 2008
Final Omitted Rulemaking Order (Net Metering) – Published in PA Bulletin (L00050174)	Nov. 29, 2008
PUC Adopts Act 129 Implementation Order – Relating to AEPS	May 28, 2009
Compliance Required for PPL Electric Utilities	Jan.1, 2010
PUC Adopts Solar Policy Statement	Sept. 16, 2010

Event	Date
Compliance Required for PECO Energy Co., Pennsylvania Electric Co., Metropolitan Edison Co., and West Penn Power Co.	Jan. 1, 2011
PUC Adopts Policy Statement, Net Metering – Use of Third-Party Operators	March 29, 2012
PUC Approves Selection of InClimate as Program Administrator	Sept.3 2015
PUC Adopts Second Amended Final Rulemaking Order (L-2014-2404361)	Oct. 27, 2016
Act 40 of 2017	Oct. 30, 2017
Final Implementation Order - Implementation of Act 40 of 2017 (Entered May 3, 2019)	April 19, 2018

Appendix B

Tier I Resources

Biologically Derived Methane Gas

Biologically derived methane gas is produced from the anaerobic digestion of organic materials from yard waste such as grass clippings and leaves, food waste, animal waste and sewage sludge. It also includes landfill methane gas. Biologically derived methane gas is used as fuel to power engines that drive generators to generate electricity.

Biomass Energy

Biomass energy electricity that is generated utilizing the following:

- A. Organic material from a plant that is grown for the purpose of being used to produce electricity or is protected by the Federal Conservation Reserve Program (CRP) and provided further that crop production on CRP lands does not prevent the achievement of the water quality protection, soil erosion prevention or wildlife enhancement purposes for which the land was primarily set aside.
- B. Solid nonhazardous, cellulosic waste material that is segregated from other waste materials, such as waste pallets, crates and landscape or right-of-way tree trimmings or agricultural sources, including orchard tree crops, vineyards, grain, legumes, sugar and other byproducts or residues.
- C. Generation of electricity utilizing by-products of the pulping process and wood manufacturing process, including bark, wood chips, sawdust and lignin in spent pulping liquors from alternative energy systems located in this Commonwealth.

Coal Mine Methane

Generation utilizing methane gas emitted and collected from abandoned or working coal mines.

Fuel Cells

Fuel cells are electrochemical devices that convert chemical energy in a hydrogen-rich fuel directly into electricity, heat, and water without combustion.

Geothermal Energy

Geothermal electricity generation extracts hot water or steam from geothermal reserves in the earth's crust and supplies it to steam turbines that drive generators to produce electricity. The three commercial types of conventional geothermal power plants are flash, dry steam, and binary.

In a geothermal flash power plant, high pressure geothermal water and steam are extracted, and the steam is separated and delivered to a turbine that drives a generator.

In a dry steam geothermal power plant, steam alone is extracted from a geothermal reservoir and is used to drive the turbine and generator.⁵²

In a binary plant, the geothermal fluid heats and vaporizes a separate working fluid with a lower boiling point than water, which drives a turbine for power generation. Each fluid cycle is closed, and the geothermal fluid is re-injected into the heat reservoir. The binary cycle allows an effective and efficient extraction of heat for power generation from relatively low-temperature geothermal fluids.⁵³

Low-Impact Hydropower

Low-impact hydropower consists of any technology that produces electric power and that harnesses the hydroelectric potential of moving water impoundments if one of the following applies:

- A. The hydropower source has a Federal Energy Regulatory Commission (FERC) licensed capacity of 21 MW or less and was issued its license by January 1, 1984, and was held on July 1, 2007, in whole or in part, by a municipality located wholly within this Commonwealth or by an electric cooperative incorporated in this Commonwealth.
- B. The incremental hydroelectric development:
 - i. Does not adversely change existing impacts to aquatic systems;
 - ii. Meets the certification standards established by the Low Impact Hydropower Institute and American Rivers, Inc., or their successors;

⁵² Geothermal Energy Association – Geothermal Basics Q&A, 2012

⁵³ Renewable Energy Policy Network (REN21) – Renewables 2016 Global Status Report

- iii. Provides an adequate water flow for protection of aquatic life and for safe and effective fish passage;
- iv. Protects against erosion;
- v. Protects cultural and historic resources;
- vi. Was completed after February 28, 2005.

Solar Photovoltaic (PV)

A solar PV System⁵⁴ generates electricity from sunlight. A solar photovoltaic cell is made of semiconductor material and can generate 1 to 2 watts of power. To increase the power output, multiple cells are connected together to form modules or panels. These modules or panels may be connected together to form arrays. A solar photovoltaic system consists of the PV panels, mounting structures, inverter that converts the direct current (DC) generated by the system to alternating current (AC).

Solar Thermal

Solar thermal power plant⁵⁵ technology uses heat from the sun's rays to generate electricity. The heat from the sun's rays is collected and used to heat a fluid to high temperatures. This high temperature fluid is used to heat water and generate steam. The steam is then used to spin a turbine that turns a generator attached to its drive shaft and generate electricity.

Wind Power

Wind power generation technology uses energy from the wind to turn large blades of a wind turbine which are connected to a drive shaft that turns a generator to generate electricity.

⁵⁴ Solar Photovoltaic Technology Basics at www.energy.gov

⁵⁵ Solar Thermal Power Plants at www.eia.gov

Tier II Resources

Distributed generation systems

Distributed generation systems are small-scale and generate electricity and useful thermal energy (*i.e.*, combined heat and power plants) from systems with a nameplate capacity not greater than 5 MW.

Demand-side management

Demand-side management consisting of the management of customer consumption of electricity or the demand for electricity through the implementation of:

- A. Energy efficient technologies, management practices or other strategies in residential, commercial, industrial, institutional and government customers that shift electric load from periods of higher demand to periods of lower demand.
- B. Load management or demand response technologies, management practices or other strategies in residential, commercial, industrial, institutional and government customers that shift electric load from periods of higher demand to periods of lower demand.
- C. Industrial by-product technologies consisting of the use of a by-product from an industrial process, including reuse of energy from exhaust gases or other manufacturing by-products that are used in the direct production of electricity at the facility of a customer.

Generation of Electricity Utilizing by-products of the Pulping Process and Wood Manufacturing Process at systems located outside this Commonwealth

In the wood pulping process, a liquid containing dissolved wood and spent chemicals is produced. This liquid is called black liquor. It is further concentrated and the organic compounds in the black liquor are used as a fuel to generate steam and produce electricity. Similarly, byproducts of the wood manufacturing process such as sawdust, wood chips and bark are used as fuel to generate steam and produce electricity.

Large-scale hydropower

Large-scale hydropower plants produce electricity by harnessing the hydroelectric potential of moving water impoundments that does not meet the requirements of low-impact hydropower. The term also applies to pumped storage hydropower which is electricity produced by the force of rushing water released from an upper reservoir. That water is temporarily stored in a lower elevation reservoir and later returned to the upper reservoir when electricity is least expensive.

Municipal solid waste

Municipal solid waste is burned at special waste-to-energy plants that use the heat to make steam to generate electricity or to heat buildings.

Waste Coal

Waste coal facilities generate electricity by combusting waste coal that was disposed or abandoned prior to July 31, 1982 or disposed of thereafter in permitted coal refuse disposal sites or other waste coal combustion meeting alternate eligibility requirements established by regulation.



9. Glossary

Alternative Compliance Payments (ACP): A payment made by non-complying EDCs and EGSs. These payments are made available to the sustainable energy funds established through the Commission's orders and are utilized solely for projects that increase the amount of electric energy generated from alternative energy resources.

Business Energy Investment Tax Credit (ITC): The Investment Tax Credit (ITC) reduces federal income taxes for qualified tax-paying owners based on capital investment in renewable energy projects.

Capacity Factor: A ratio of the actual power output for a time period to the maximum possible power output if the plant was operating at full name plate capacity for the same time period.

Demand Side Management: The process of managing the consumption of energy, generally to optimize available and planned generation resources.

Dispatchable Sources of Electricity: Power plants that can be turned on or off as needed; adjust their output supplied to the electrical grid based on demand. Conventional power plants using coal and natural gas can adjust their output to meet the always changing electricity demands of the consumers.

Non-Dispatchable Sources of Electricity: Power plants that use some renewable energy sources such as wind and solar cannot be turned on or off as needed or adjust their output supplied to the electrical grid based on demand.

Non-Solar Tier I (NSTI): Alternative energy credits originating from out-of-state solar generating facilities. All solar PV credits generated by out-of-state solar facilities on or after November 1, 2017, are designated as NSTI credits.

Renewable Electricity Production Tax Credit (PTC): The Production Tax Credit (PTC) reduces the federal income taxes of qualified tax-paying owners of renewable energy projects based on the electrical output, measured in kilowatt-hours, of grid-connected renewable energy facilities.

Utility-scale Wind Turbines: Individual turbines that exceed 100 kW in size.

Utility-scale Solar Plants: EIA defines utility scale solar plants as plants with a capacity of at least one megawatt.



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