

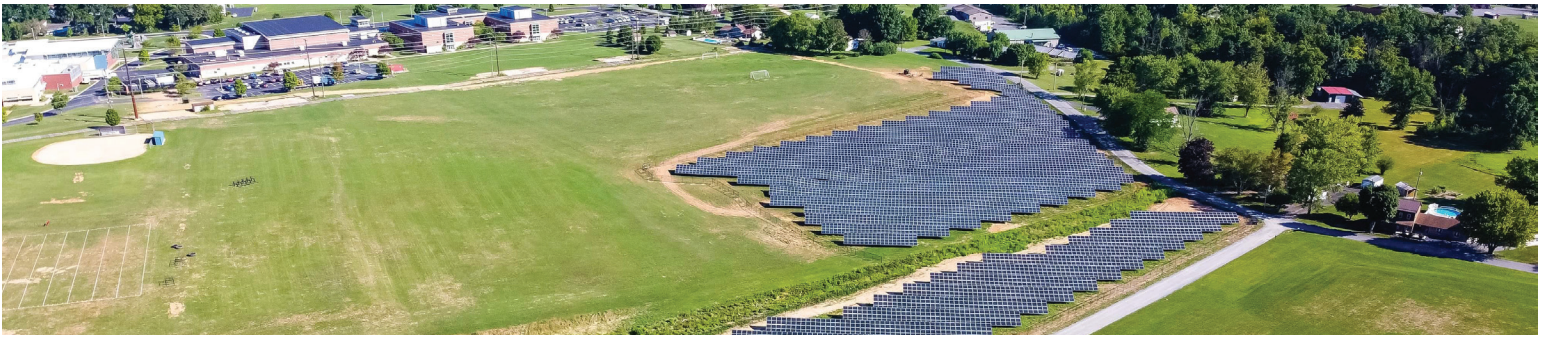


Alternative Energy Portfolio Standards Act Compliance for Reporting Year 2019

*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 2019

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Front and back covers: Lombardo Welcome Center, Millersville University, the first building in PA to receive the International Living Future Institute's zero energy certification.

Photo: TerraSol Energies, Inc.

Title page: Midd-West Elementary School

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Executive Summary

Alternative Energy Portfolio Standards Act

Compliance for Reporting Year 2019

Tier I Solar Compliance

- **All EDCs and all but two EGSs** met their requirements. Two EGSs paid the required ACPs to achieve compliance. Two EGSs reached settlements with the Commission regarding their compliance obligations.

Tier II Compliance

- **All EDCs and all but two EGSs** met their requirements. Two EGSs paid the required ACPs to achieve compliance. Two EGSs reached settlements with the Commission regarding their compliance obligations.

Tier I Non-Solar Compliance

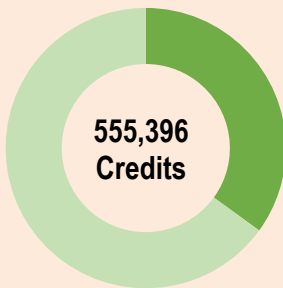
- **All EDCs and all but two EGSs** met their requirements. Four EGSs paid the required ACPs to achieve compliance. Two EGSs reached settlements with the Commission regarding their compliance obligations.

Total Number of Credits Retired

- **22,218,122** credits retired by **11 EDCs** and **119 EGSs**.

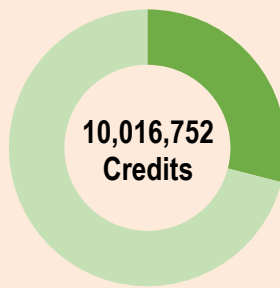
Source of Tier I Solar AECs Retired

- Pennsylvania – 35%
- Other States – 65%



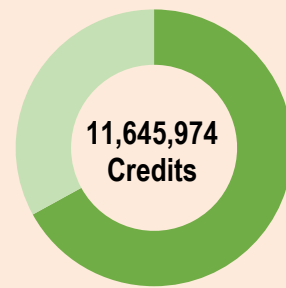
Source of Tier I Non-Solar AECs Retired

- Pennsylvania – 29%
- Other States – 71%



Source of Tier II AECs Retired

- Pennsylvania – 67%
- Other States – 33%



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 2019 reporting year (June 1, 2018 through May 31, 2019) the Tier I requirement was 7% of all retail sales, of which at least 0.39% 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 at the end of Section 1 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 0.4418% for a total Tier I requirement of 7.0518%.

For the 2019 reporting year, all the EDCs and all but six EGSs met their requirements by acquiring and retiring sufficient AECs. Four EGSs came into compliance through the submission or recovery of alternative compliance payments. Two EGSs, discussed later in this report, filed for bankruptcy. Of the total number of AECs retired, 48.9% of AECs were generated within Pennsylvania. A 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 Solar, Tier I non-solar, 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 Oct. 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, though there are exceptions for certain existing contracts that have been reviewed and approved for use by the Commission.¹

¹ *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 qualified and registered 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, LLC² (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 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.

² 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>.

The law provides for a three-month true-up period that runs from the conclusion of each reporting year, May 31, until Sept. 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, developing 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 Dec. 20, 2008, a PUC rulemaking based on the Act 35 changes became effective.³

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 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.

³ See, 38 Pa. B. 6908 at <https://www.pabulletin.com/secure/data/vol38/38-51/2286.html>

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 2019, a little more than 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, 48.9% were generated in Pennsylvania and the remaining 51.1% were generated from other states in the PJM service territory.

Chart 1 shows the percentage of AECs that were retired in Pennsylvania in the 2019 reporting year and their states of origin.

For the Solar PV requirement, 35.2% of retired AECs originated in Pennsylvania, 47.4% came from North Carolina, 11.3% came from Virginia, 3.2% came from Maryland and the other 3% came from six other states. Though Act 40 of 2017 created restrictions for Solar AECs generated outside of Pennsylvania, solar AECs generated prior to November 1, 2017, from facilities outside of Pennsylvania are still eligible for use as are credits from facilities with existing contracts.

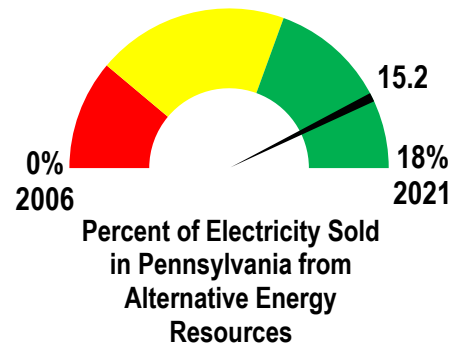
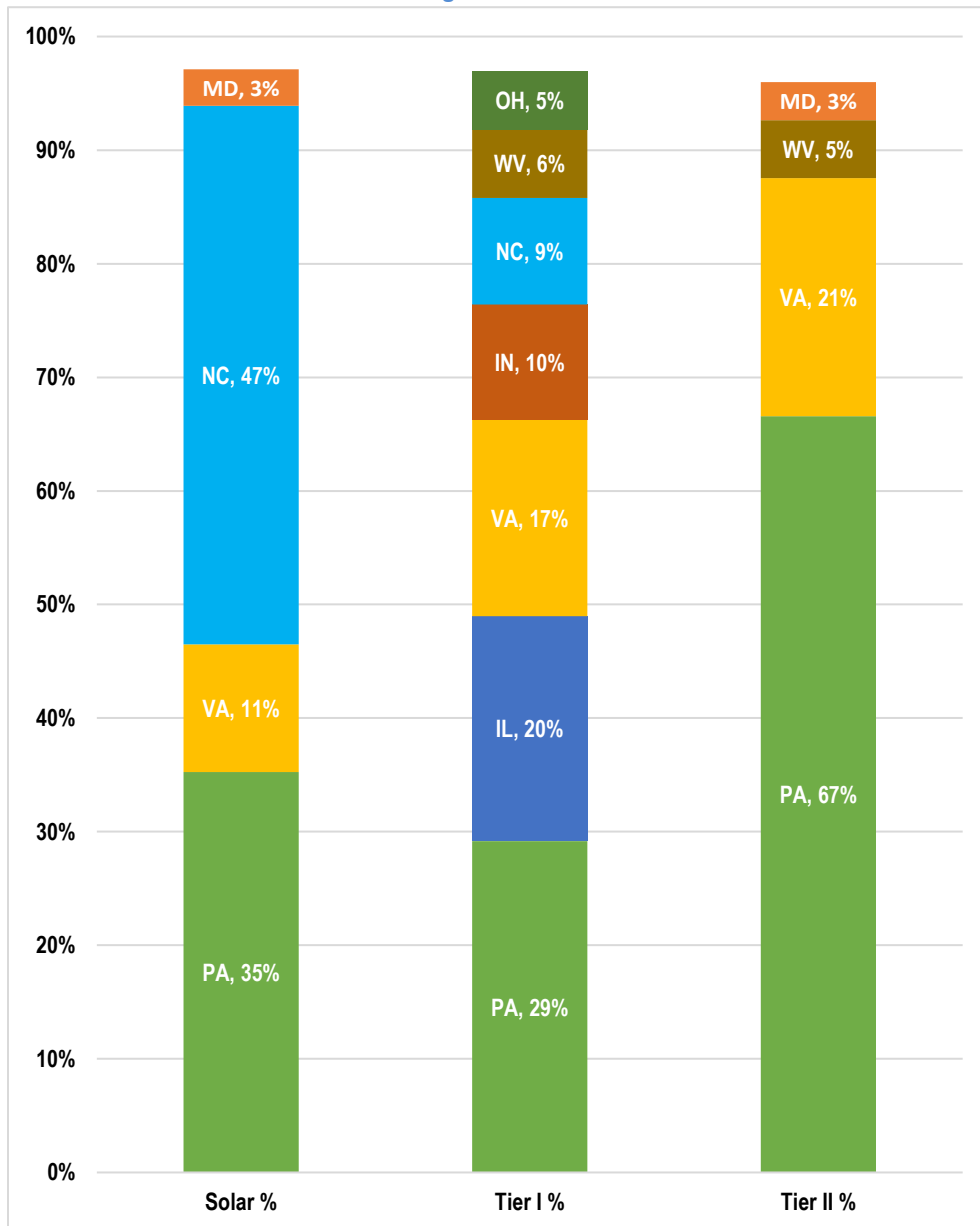


Chart 1: Percentage of AECs Retired in 2019



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, 29.2% of retired AECs came from Pennsylvania. Another 19.8% came from Illinois, 17.3% came from Virginia, 10.1% came from Indiana, 9.4% came from NC, 6% came from West Virginia, 5% came from Ohio and the remaining 3% came from six other states.

For the Tier II requirement, 66.6% of retired AECs came from Pennsylvania. Another 21% came from Virginia, 5.1% came from West Virginia, 3.3% came from Maryland 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.

The Commission extended the AEPS Act annual true-up compliance deadline to Oct. 1, 2019 after the quarterly adjustment calculations were changed to account for load misreported by PPL⁴. During the 2019 reporting year, 11 EDCs and 119 EGSs had compliance obligations. All EDCs achieved compliance in the reporting year by retiring the requisite number of AECs. Six EGSs did not retire sufficient AECs, three of the six EGSs achieved compliance by paying the required ACPs. One EGS, Amerigreen Energy Inc., came into compliance after a claim against Amerigreen's financial assurance was satisfied. Two EGSs, Agera Energy, LLC and energy.me Midwest, LLC did not pay the required ACPs as they are no longer in business and filed for bankruptcy. Subsequently, the Commission has taken steps to recover what it can against the obligations of Agera Energy and energy.me Midwest. Specifically, the Commission is seeking to recover the bond assurances posted by both companies and has filed a claim against a Letter of Credit posted by Agera Energy. Regarding bankruptcy, the Commission and these two EGSs have recently agreed to terms under a Chapter 11 bankruptcy settlement. Under the terms of the Chapter 11 bankruptcy agreement the Commission is authorized to seek recovery of funds amounting to slightly more than 50% of the more than six million dollars combined, in ACP obligations owed by these two companies, but is not permitted to seek any further remuneration regarding this or any other claims.⁵ As of Aug. 19, 2020, the Commission has been able to recover, in total, approximately \$1.4 million by securing the Letter of Credit and a portion of the allowable recovery via the bankruptcy proceedings. Unfortunately, both EGSs continued to serve load into the 2020 compliance year, even after filing for bankruptcy, but the terms of the Chapter 11 bankruptcy Order and agreement prohibit the Commission from seeking a claim to the estimated \$3.5 million in ACPs associated with serving this additional load, which would have been obligated after the annual true-up period in the fall of 2020.

⁴ See Secretarial Letter, issued to EDCs and EGSs on August 8, 2019, <http://www.puc.pa.gov/pcdocs/1630979.docx>

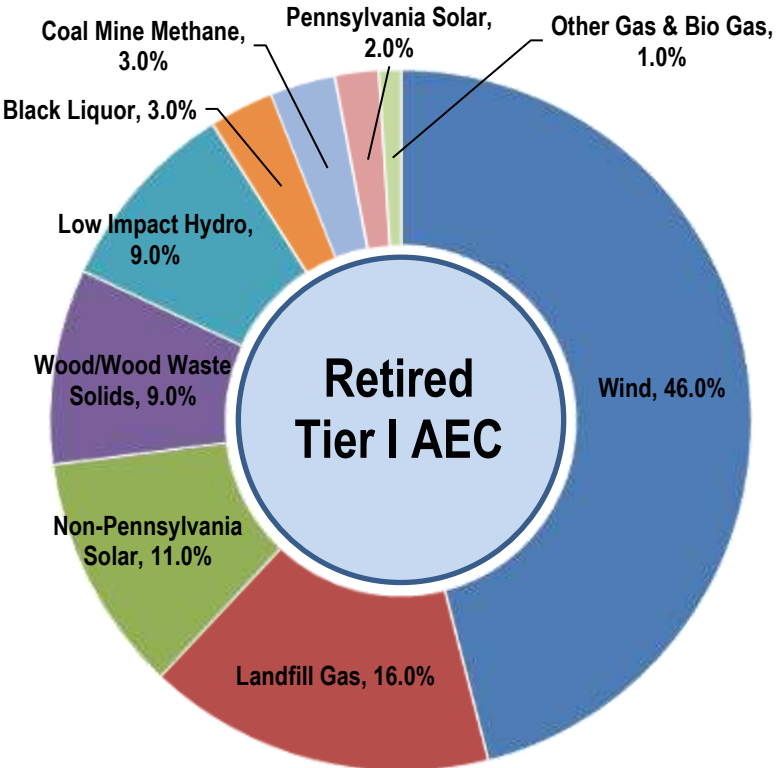
⁵ United States Bankruptcy Court Southern District of New York, Case No. 19-23802 (RDD), June 25, 2020

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. EGS compliance via ACP, securitization of bond assets or bankruptcy proceedings bears no reflection on EDC compliance but rather indicates the manner in which EGSs may have complied within those EDC service territories. 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 most EDC service territories as having a deficiency of credits.

A. Tier I Compliance

Chart 2 shows the resource percentage of Tier 1 AECs retired in the 2019 reporting year. Wind energy produced almost half of the retired Tier 1 AECs, followed by electricity generation from Landfill Gas (biologically derived methane) and Solar energy to round out the top three resource types.

Chart 2: Percentage of sources of Tier I AECs Retired for the 2019 Reporting Year



a. Solar Compliance

For the 2019 reporting year, the Solar PV obligation was 0.39%. All EDCs and all but four EGSs retired the requisite number of Solar AECs. Two of the four EGSs paid the ACP for their Solar PV obligation. Two EGSs, Agera Energy, LLC and energy.me Midwest, LLC have reached settlement with the Commission regarding their compliance obligations, via Chapter 11 bankruptcy proceedings. The number of Solar AECs that were not retired represented 0.40% of the total Solar AEC obligation.

b. Non-Solar Compliance

For the 2019 reporting year, the base obligation for non-solar Tier I was 6.1%. The Tier I quarterly adjustment, impacting only non-solar Tier I, added a quarterly increase of 0.3871%, 0.4983%, 0.4383%, and 0.4401%, for quarters one through four, respectively. This resulted in 631,629 AECs added to the base obligation of 9,450,791. All EDCs and all but six EGSs achieved compliance by retiring the requisite number of Tier I AECs. Four of the six EGSs paid ACPs for their non-solar

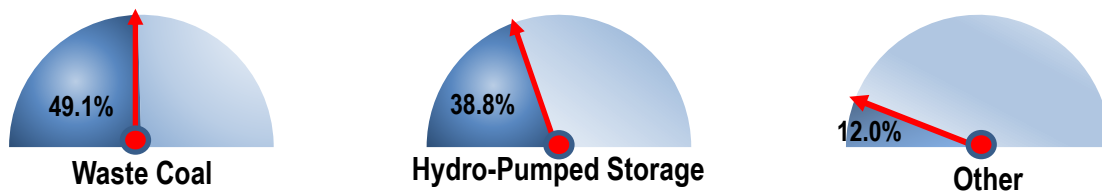
Tier I obligations. Agera Energy, LLC and energy.me Midwest, LLC reached settlement with the Commission regarding their compliance obligations, via Chapter 11 bankruptcy proceedings. The number of Tier I AECs that were not retired represented 0.670% of the total Tier I AEC obligation.

B. Tier II Compliance

For the 2019 reporting year, the base obligation for Tier II was 8.2%. All EDCs and all but four EGSs achieved compliance in the reporting year by retiring the requisite number of AECs. Two of the four EGSs paid ACPs for their Tier II obligations. Agera Energy, LLC and energy.me Midwest, LLC reached settlement with the Commission regarding their compliance obligations, via Chapter 11 bankruptcy proceedings. The number of Tier II AECs that were not retired represented 0.67% of the total Tier II AEC obligation.

Chart 3 shows sources and percentages of Tier II AECs retired in the 2019 reporting year.

Chart 3: Sources and Percentages of Tier II AECs Retired for the 2019 Reporting Year





3. Costs and Benefits of Alternative Energy Generation

A. Current Estimated Costs of Future Alternative Energy Generation

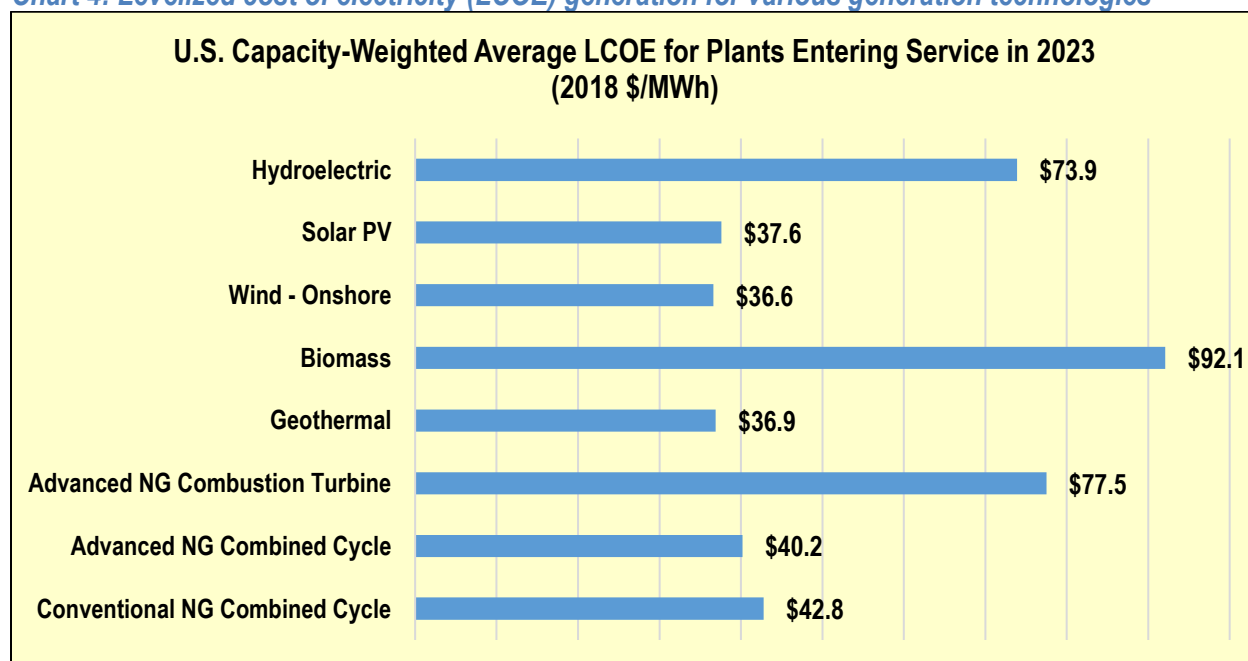
The United States Energy Information Administration (EIA) provided estimated cost data for the construction and operation of utility-scale generation plants that may be brought online in 2023.⁶ The EIA data is used as the most consistently reliable information available. In using this data, 2023 was 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.⁷ 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.

⁶ 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/electricity_generation.php

⁷ 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 endeavored to provide a best faith estimation of the potential statewide costs of AEPS Act compliance for 2021, the year of maturation for this standard. This has proven challenging given the variability of multiple parameters needed to make such an assessment. The first of these parameters needing assessed is a projection of future load (MWh) forecasts for each EDC. Load growth, overall, had been flat or declining for the past couple years but saw an increase of about 4% in 2018, the latest year that data is available. This growth is contrary to the previous and current five-year average growth projections provided by the EDCs. Growth in load results in a commensurate increase in the volume of AEPS credits needed for compliance. Second, there is a final step increase in the percentage requirements for each tier of the AEPS in 2021, which is further amplified by any increase in electric load. Additionally, Tier II credits, which comprise the largest volume of credits required for AEPS compliance, have realized an unprecedented ten-fold increase in spot market prices since January 2020, despite there being more than an adequate supply of Tier II credits available for AEPS compliance.

Noting the caveats above, Commission staff have estimated a cost of AEPS compliance of approximately \$191 million in 2021. To put these figures in perspective, annual statewide customer expenditures on electric service, across all sectors, were approximately \$15 billion in 2018.⁸ Therefore, approximately \$0.013 (1.3 cents) of every electric service-related dollar is spent on AEPS compliance. A more detailed assessment of these cost projections is provided in Appendix A, Table 5. A key variable that has 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 and lighting, has curtailed the rate of energy consumption and therefore lowered the number of AECs required for annual compliance.

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.

Jobs in the clean energy sector are numerous, varied in discipline, and well paying. As documented in the “2020 Pennsylvania Clean Energy Employment Report,” recently released by the PA DEP, nearly 100,000 Pennsylvanians are employed in the five broad areas defined as clean energy jobs: clean energy generation, clean grid and [energy] storage, energy efficiency, alternative transportation, and clean fuels. The report notes that job growth, between 2017 and 2019, was 4.5 times higher within the clean energy jobs sector, as compared to overall job growth within Pennsylvania, and that seventy-five percent of these employees earned higher wages than the statewide median. The report goes on to note that two-thirds of these jobs are full-time positions.⁹

⁸ See U.S. Energy Information Association – *Electric Power Annual 2018*, published October, 2019, Table 2.9 https://www.eia.gov/electricity/annual/html/epa_02_09.html

⁹ [2020 Pennsylvania Clean Energy Employment Report](#)

According to the report, roughly 74% of Pennsylvania’s clean energy jobs pertain to energy efficiency, including manufacturing, construction and installation of high efficiency appliances and products, high efficiency lighting, and energy efficient buildings and associated building materials. Energy efficiency is AEPS Tier II resource. The report also notes that the solar industry jobs made up the largest share of the clean energy generation subsector, at 35.4% (5,173 jobs), followed by jobs in the wind the industry with 2,937 Pennsylvanians employed.

In reporting year 2019, approximately 43.6 megawatts AC (MWac) of solar-electric generating capacity was installed in PA, which brought the in-state total capacity to 317 MWac. These installations at private residences, businesses, and institutions, across Pennsylvania, help sustain a workforce of slightly more than 4,846¹⁰ 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. 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 \$20/hour and was \$16/hour for non-electricians; wages are higher still for those involved in the installation of utility-scale solar farms.¹¹ 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 compliance year 2019, Pennsylvania ranked 18th in the country for installed wind capacity (1,369 MW)¹² and 18th in the country for the number of wind turbines (726 installed); enough generation to power about 347,600 homes.¹³ Additionally, Pennsylvania supports a number of wind energy jobs. For 2019, the total number of direct and indirect jobs supporting the wind industry in Pennsylvania was approximately 2,815.¹⁴ More information about the Pennsylvania wind generation facilities can be found on AWEA’s new [wind industry map](#).¹⁵ Additionally, wind farm development employs hundreds of people and each wind

¹⁰ *Clean Jobs Pennsylvania 2019* - <https://www.e2.org/reports/clean-jobs-pennsylvania-2019/>

¹¹ *National Solar Jobs Census 2019*, page 13. The Solar Foundation, available at: <https://www.thesolarfoundation.org/national/>

¹² 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).

¹³ American Wind Energy Association, *Wind Energy in Pennsylvania 2018 Fact Sheet*

¹⁴ *Clean Jobs Pennsylvania 2019* - <https://www.e2.org/reports/clean-jobs-pennsylvania-2019/>

¹⁵ American Wind Energy Association, <http://gis.awea.org/arcgisportal/apps/webappviewer/index.html?id=eed1ec3b624742f8b18280e6aa73e8ec>

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.¹⁶

As of the end of the 2019 AEPS Act compliance year, Pennsylvania has approximately 2,431 MW of certified operating hydropower generating capacity with 1,540 MW of that total coming from pumped storage hydropower projects. 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.¹⁷ 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 2019 reporting year, the Commonwealth Financing Authority approved \$14.03 million in loans and grants to twelve alternative and renewable energy projects. The project types funded include hydropower, anaerobic digesters, landfill gas and CHP projects.

Funding was not available from the Pennsylvania Energy Development Authority (PEDA) during this time. However, 20 of 21 approved projects from 2014 are now in full operation; the one remaining project is currently under construction. For the 21 projects from 2014, the total anticipated energy savings / generation is equal to 54,505 MWh/yr. Projected carbon dioxide emissions reductions from the projects are approximately 23,250 tons each year.

¹⁶ American Wind Energy Association, *Wind Energy in Pennsylvania 2018 Fact Sheet*

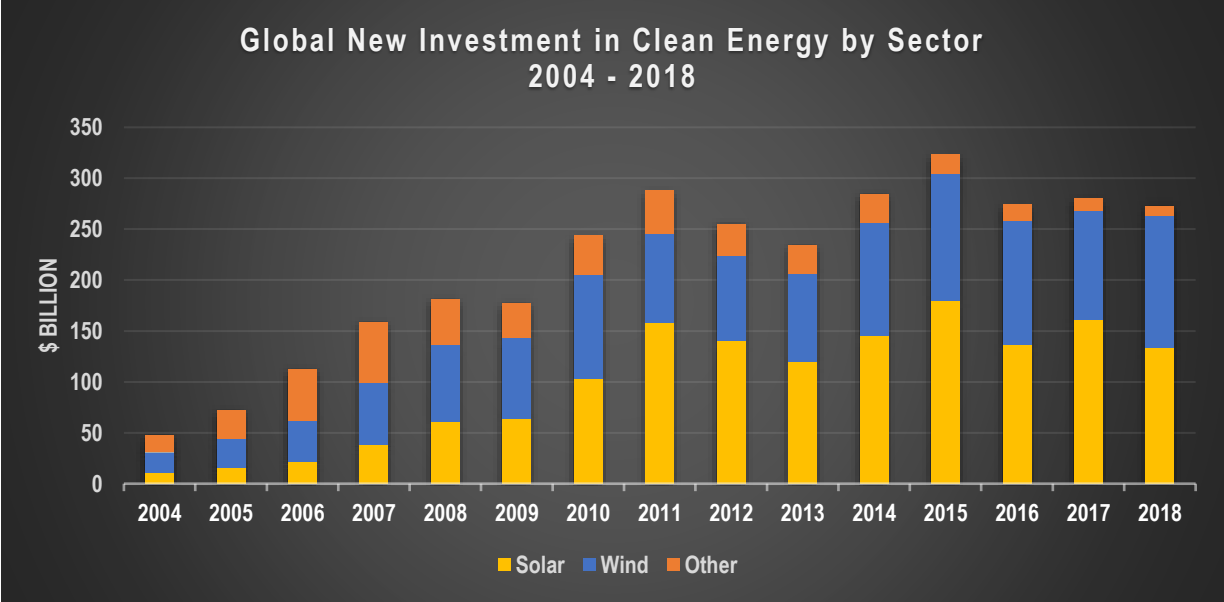
¹⁷ *Job Creation Opportunities in Hydropower, 2009*, found at: <http://www.hydro.org/waterpower/why-hydro/job-creation/navigant-study/>



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 2018. Investments in clean energy projects totaled \$273 billion in 2018, which was lower than 2017 and significantly lower than the record investment in 2015.

Chart 5: Global New Investment in Clean Energy by Sector (2004-2018)



Source: *Global Trends in Renewable Energy Investment 2019*

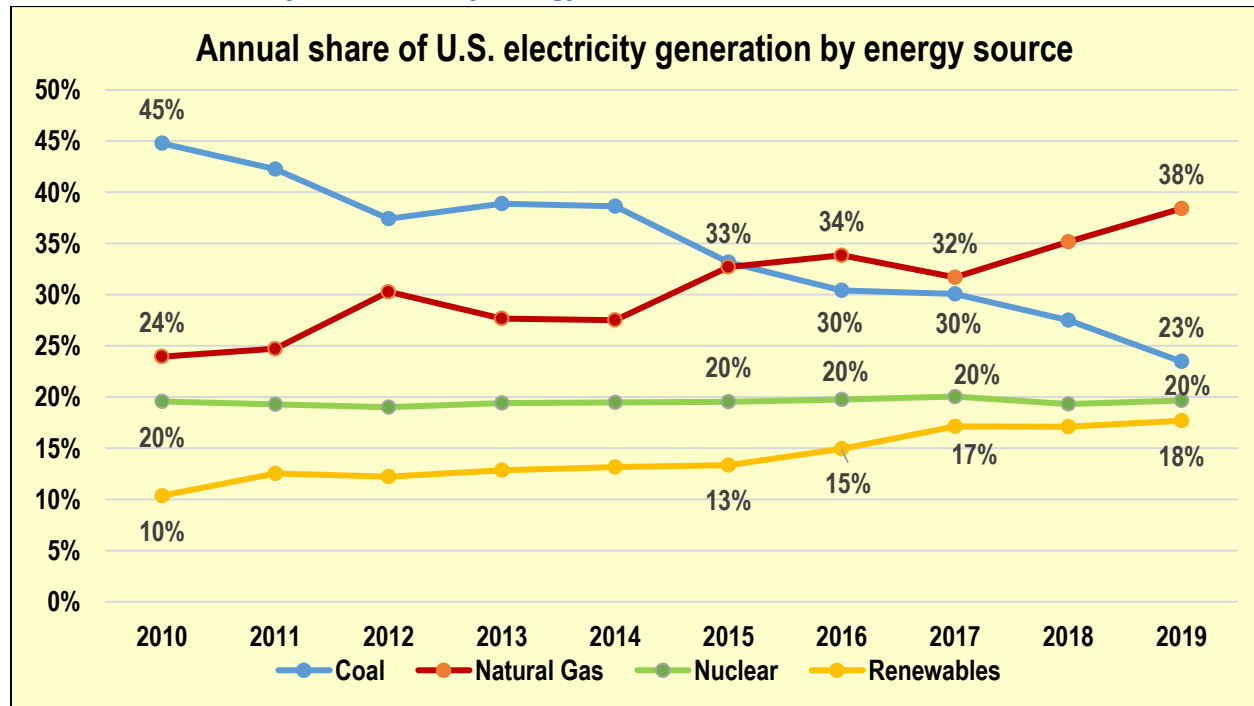
Globally, in 2018, 167 gigawatts (GW) of renewable energy production capacity (excluding large hydro) came online. Solar alone accounted for 108 GW of new capacity in 2018.¹⁸

The United States ranks second in the world for renewable energy capacity (230.0 GW), behind China (618.7 GW)¹⁹. Wind power generating capacity now slightly edges out conventional hydropower generating capacity as the largest renewable resource in the U.S. Chart 6 shows the average yearly U.S. electricity generation by energy source.

¹⁸ Frankfurt School-UNEP Centre/BNEF. 2019. *Global Trends in Renewable Energy Investment 2019*, page 11 <https://wedocs.unep.org/bitstream/handle/20.500.11822/29752/GTR2019.pdf?sequence=1&isAllowed=y>

¹⁹ 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

Chart 6: U.S. Electricity Generation by Energy Source, 2019 Calendar Year

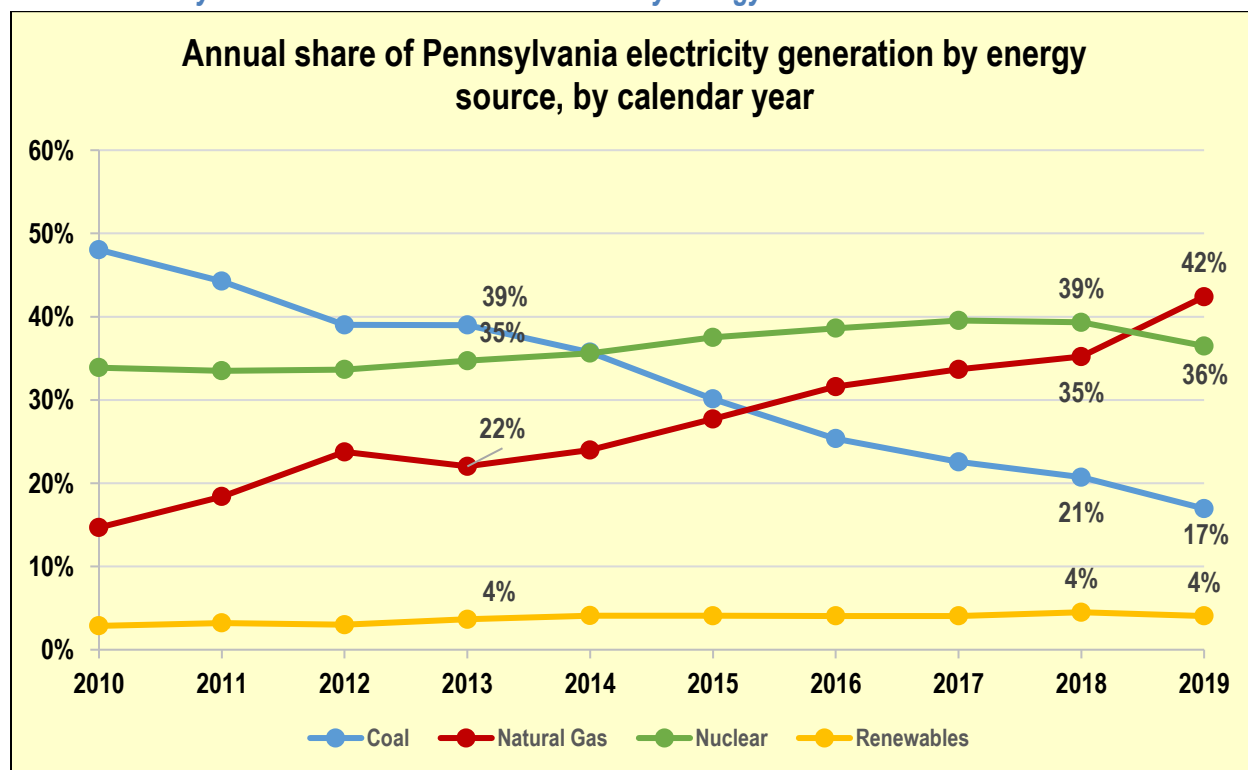


Source: Energy Information Administration Electricity Data Browser

Pennsylvania’s AEPS Act requires that, by 2021, alternative energy credits equivalent to 18% of all electric power sold in the state be obtained from qualifying resources and retired. This 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 2019. These installations brought over \$2.9 billion in capital investment into the state.²⁰

²⁰ <https://www.awea.org/resources/fact-sheets/state-facts-sheets>

Chart 7: Pennsylvania Annual Electric Generation by Energy Source



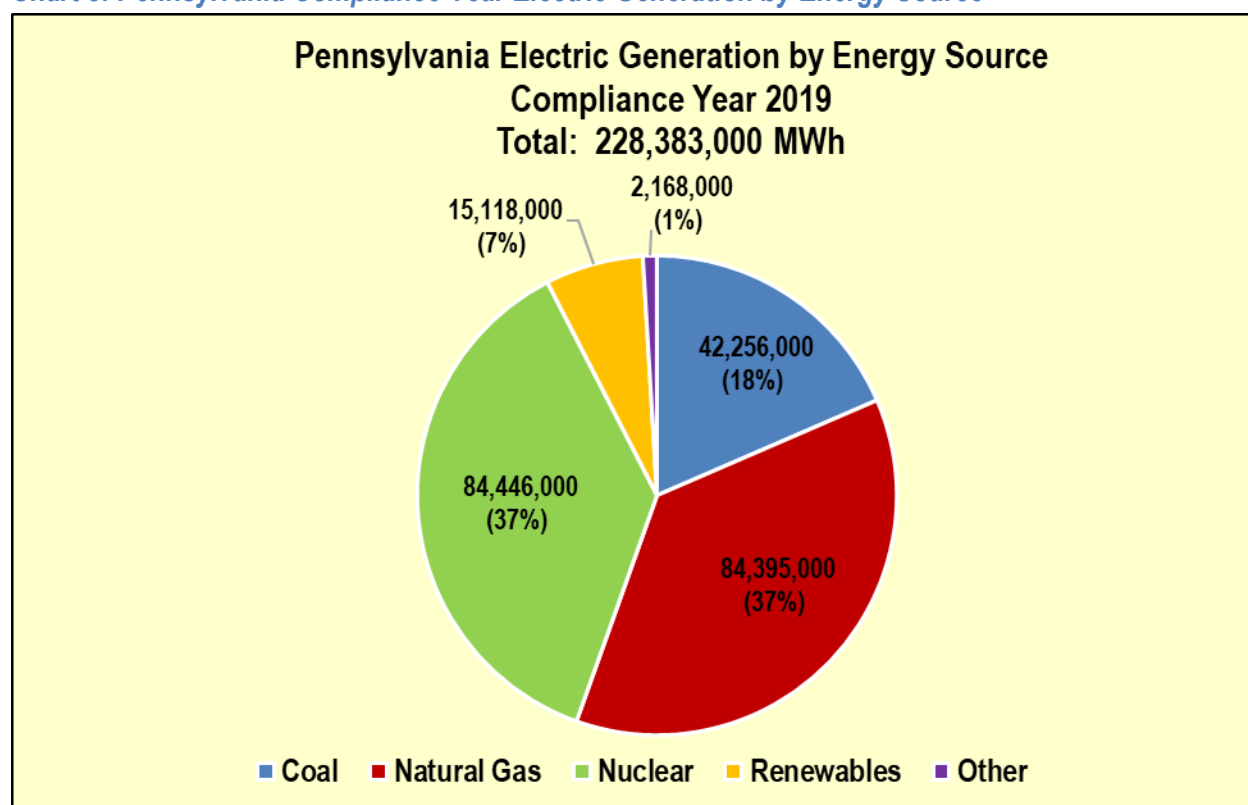
Source: Energy Information Administration Electricity Data Browser

Chart 7 shows annual Pennsylvania electric generation by energy source. In 2019, approximately 4% of the state’s electricity generation was from renewable energy sources.²¹ 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 recent exception of the Tier 1 Solar obligation.

Chart 8 shows the breakdown of total electricity generation in Pennsylvania by source for the compliance year 2019. This information is obtained from EIA using their Electricity Data Browser tool.

²¹ Energy Information Administration Electricity Data Browser

Chart 8: Pennsylvania Compliance Year Electric Generation by Energy Source



Source: Energy Information Administration Electricity Data Browser

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 2022.²² Any policy changes affecting the incentive programs, either positively or negatively, may have an almost immediate impact on the market's attractiveness and AEC prices for solar and wind.

Chart 9 shows a historical view of the Pennsylvania certified renewable energy generation capacity available in Pennsylvania. As of the end of 2019 compliance year, Pennsylvania had approximately 6,749.7 MWac of installed renewable electricity generation capacity.

²² <http://www.eia.gov/todayinenergy/detail.php?id=29492&src=email>

Chart 9: PA In-State AEPS-Certified Alternative Energy Capacity – 2006-2019 (MWac)

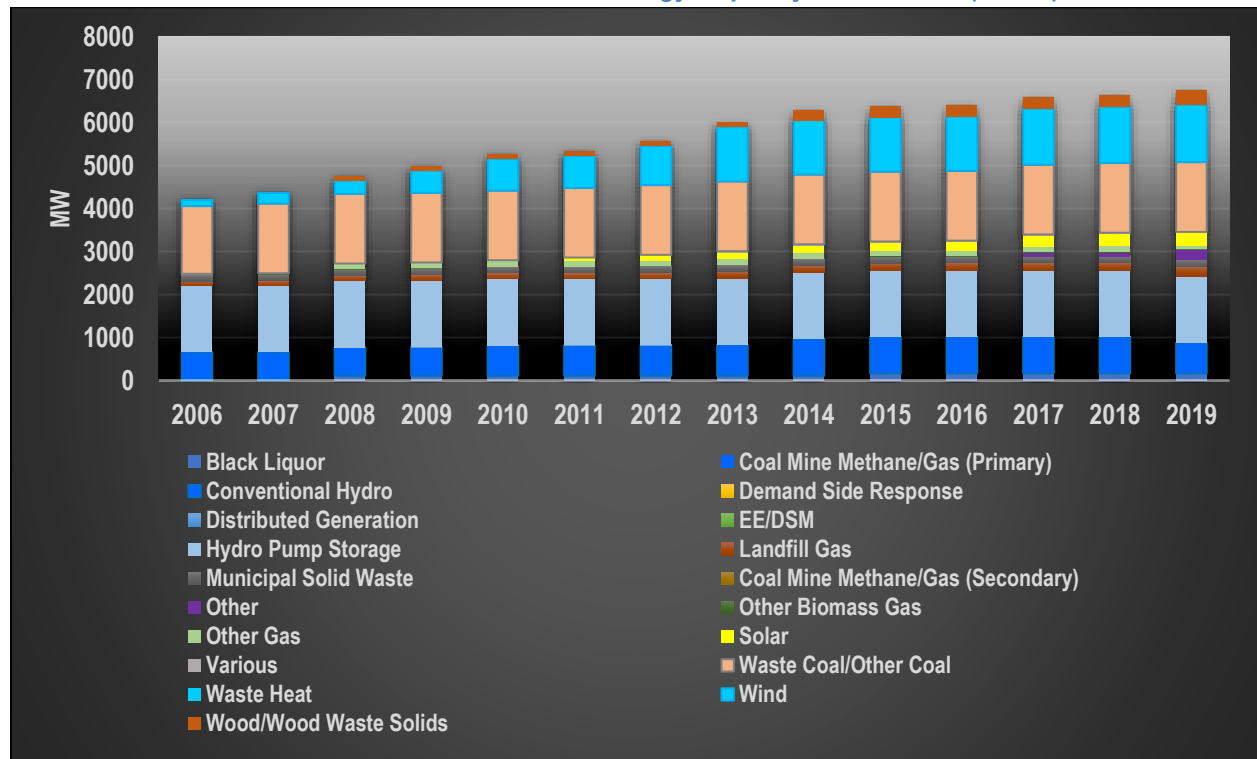
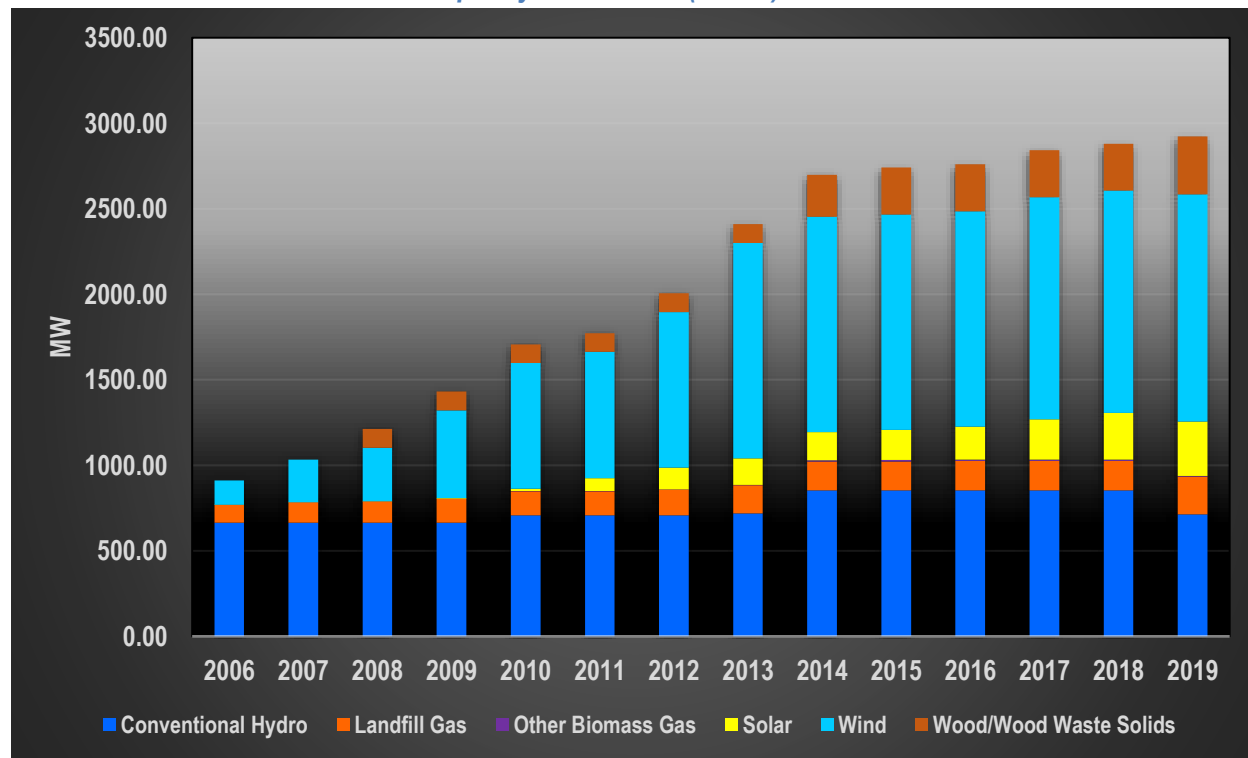


Chart 10 shows a few select Pennsylvania certified renewable energy resources that have grown over the years.

Chart 10: PA In-State Renewable Capacity– 2006-2019 (MWac)



A. Solar

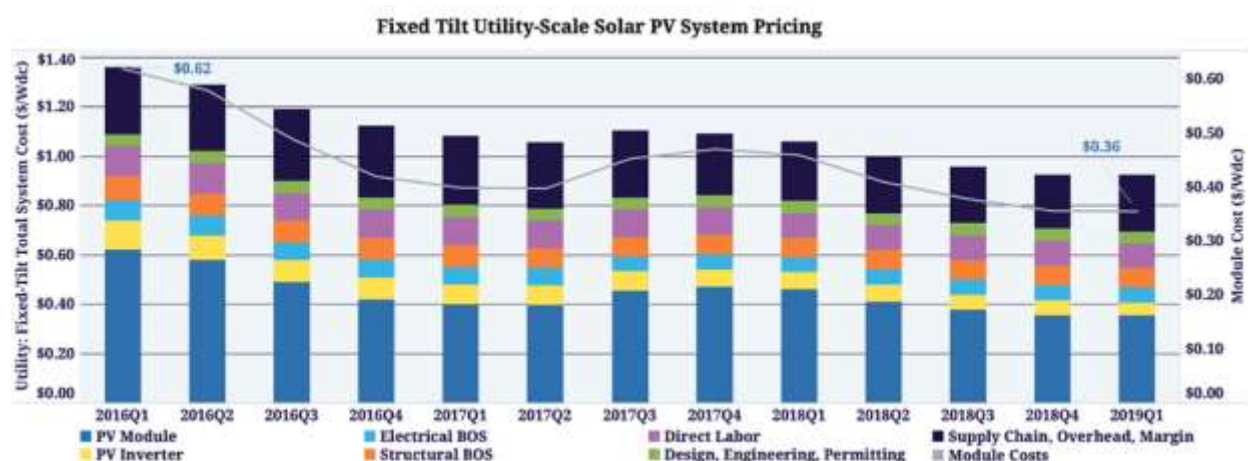
In the first half of 2019, approximately 4,800 MWdc (direct current megawatts) of solar PV was installed in the U.S. This is slightly more than 2% above for the same period in 2018. The installed capacity is expected to more than double over the next five years.²³

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.²⁴ Solar panels produce direct 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).

²³ <https://www.seia.org/research-resources/solar-market-insight-report-2019-q3>

²⁴ <https://www.seia.org/solar-industry-research-data>

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 2019, the United States had a total of 76 GWdc of cumulative operating solar PV capacity.²⁵ It is important to note that technologies such as solar and wind are non-dispatchable and generate power only when the respective resources are available (sun shining or wind blowing). Therefore, the capacity factors²⁶ for these resources are typically lower than those of the other resources.²⁷ Per EIA data, in 2017 the nationwide capacity factor for utility scale solar was 27.0%.²⁸ 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, approximately 353 MWac (442 MWdc) of solar electric capacity had been installed through the end of February 2020. \$1,826.98 million was invested in Pennsylvania, as of the 4th quarter of 2019, for solar installations, equivalent to powering 59,292 homes.²⁹

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

²⁵ <https://www.nrel.gov/docs/fy20osti/77010.pdf>

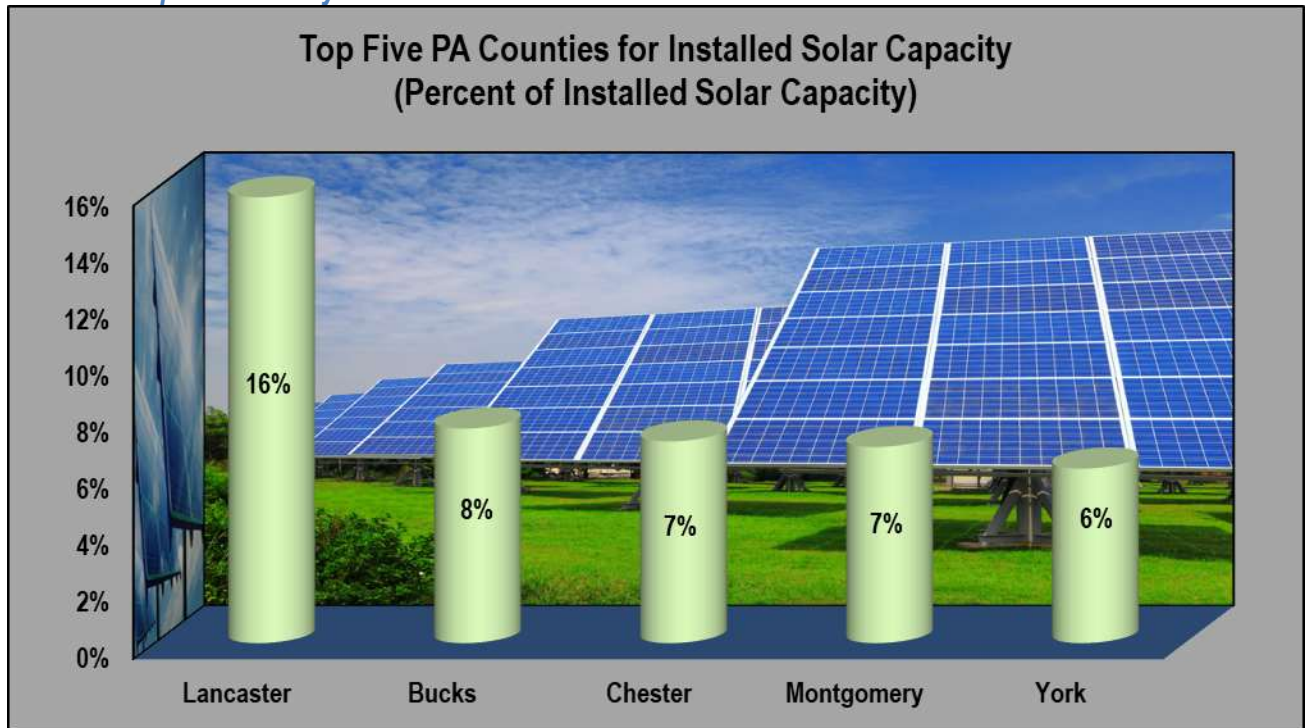
²⁶ A ratio of the actual power output for a time period to the maximum possible power output if the plant was operating at full name plate capacity for the same time period.

²⁷ U.S. Energy Information Administration, Electric Generators Report - 2016

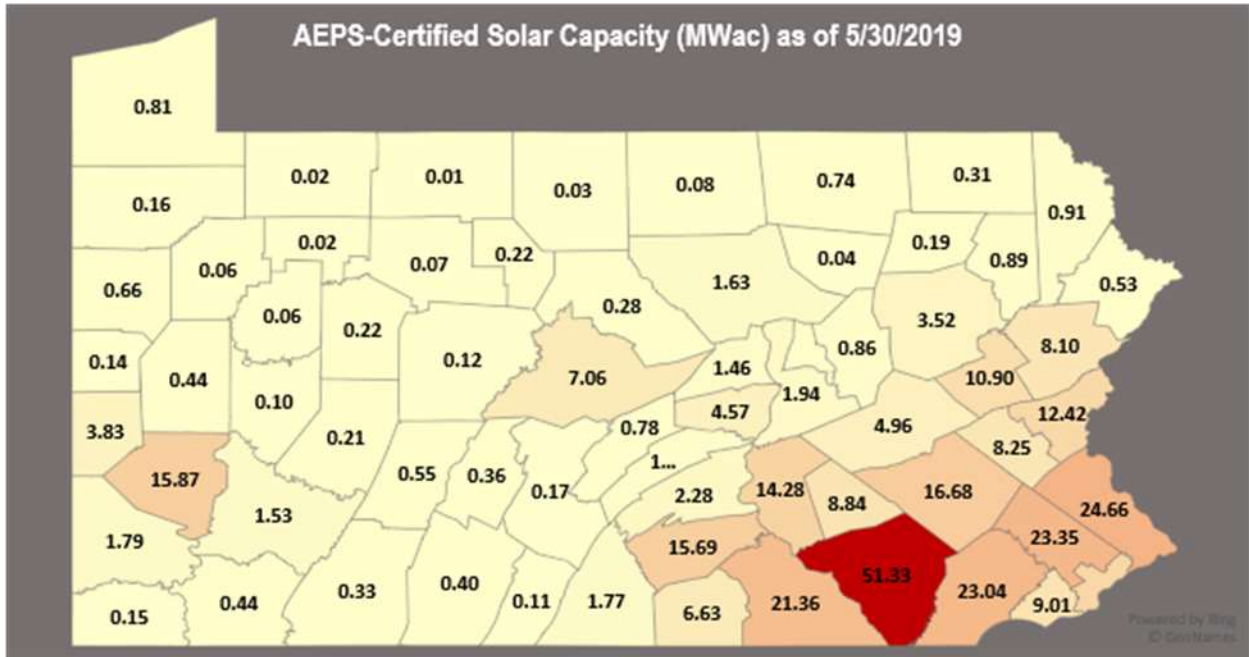
²⁸ <https://www.eia.gov/electricity/monthly/archive/june2018.pdf>

²⁹ 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.

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.



Note: As of 5/31,2019, Philadelphia county has 1,256 AEPS certified solar generation facilities with a total capacity of 13.24 MWac.

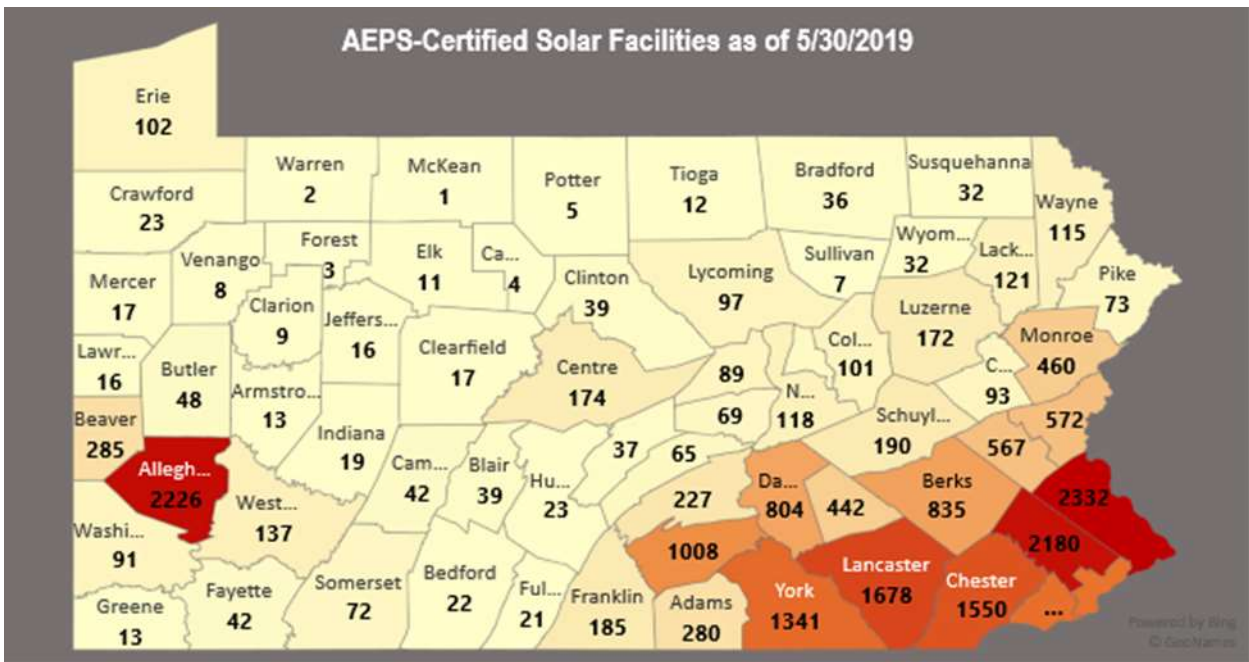
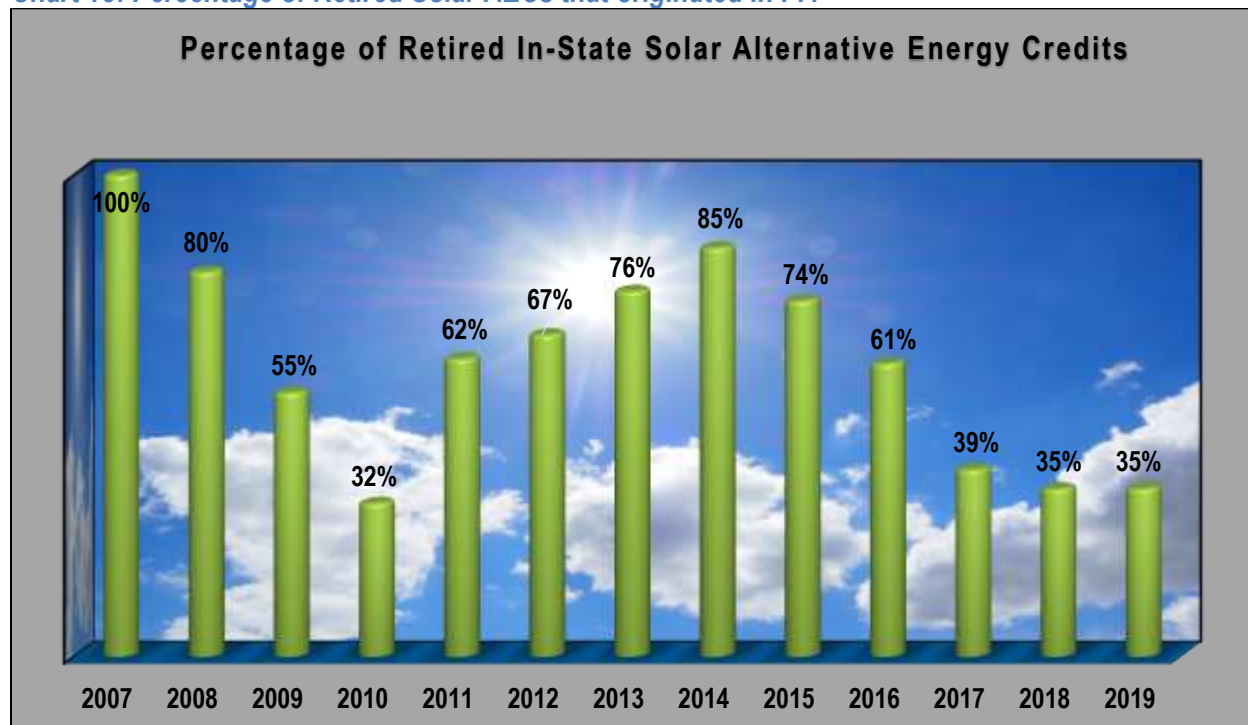


Chart 13 shows the percentage of retired in-state solar AECs used for AEPS Act compliance.³⁰ 2017, 2018 and 2019 data shows a significant reduction in the number of retired in-state solar AECs. This trend is expected to gradually reverse due to the

³⁰ This report contains the corrected percentage for 2017, last year's report inadvertently recorded the percentage as 29%.

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 in-state solar AECs, with an exception for previously issued contracts for out-of-state solar AECS (now tagged as NSTI credits, which stands for non-solar Tier I).

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



In January 2017, the Department of Environmental Protection 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.

The draft plan was released in July 2018 with a public comment period that ended one month later. The plan identifies 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 Plan was released November 2018.³¹ The plan was provided to the public, the legislature, and the Governor to be used as a guide for policy making. One strategy in the plan aimed at achieving this goal was to increase the AEPS solar PV carve-out to between 4% and 8% by 2030

³¹ <https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/SolarFuture/Pages/Pennsylvania's-Solar-Future-Plan.aspx>

and ensure creditable solar AECs are limited to those generated in Pennsylvania, as much as possible. Additionally, the Pennsylvania Climate Action Plan, authored by DEP and released in April 2019, also recommends increasing AEPS Tier 1 targets.

B. Wind

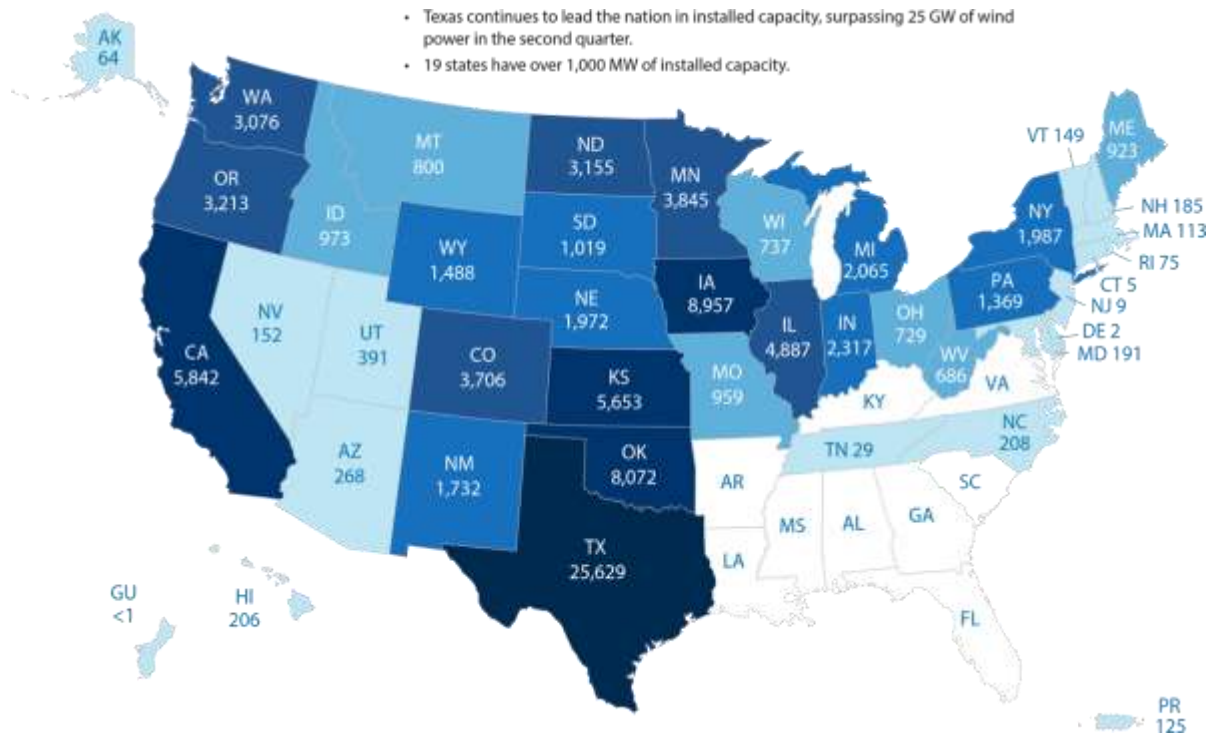
In calendar year 2019, the United States saw a total of 9,132 MW of wind electricity generation capacity installed. This brings the cumulative installed capacity in the U.S. to 105,622 MW. Wind energy generated 7.2% of the nation's electricity, enough to power 27.5 million homes.³²

The average wind capacity factor has been increasing over the years. In 2016, the national 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. While no Pennsylvania wind farms were brought online in 2014 or 2015, for comparison, the capacity factor for wind energy production in the Keystone State has historically been slightly lower than the national average.³³ Technological improvements, particularly, increased blade length, contributed to the increased capacity factor.³⁴

³² American Wind Energy Association, <https://www.awea.org/wind-101/basics-of-wind-energy/wind-facts-at-a-glance>

³³ US Department of Energy, WINDEXchange Database <https://windexchange.energy.gov/maps-data/332>

³⁴ US Department of Energy, 2016 Wind Technologies Market Report



American Wind Energy Association | U.S. Wind Industry Fourth Quarter 2019 Market Report | Public Version

During 2019, wind energy provided 1.50% of all in-state electricity production, enough electricity to power over 325,600 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). The most recent wind turbines to come online in Pennsylvania have a hub height of roughly 430 feet.

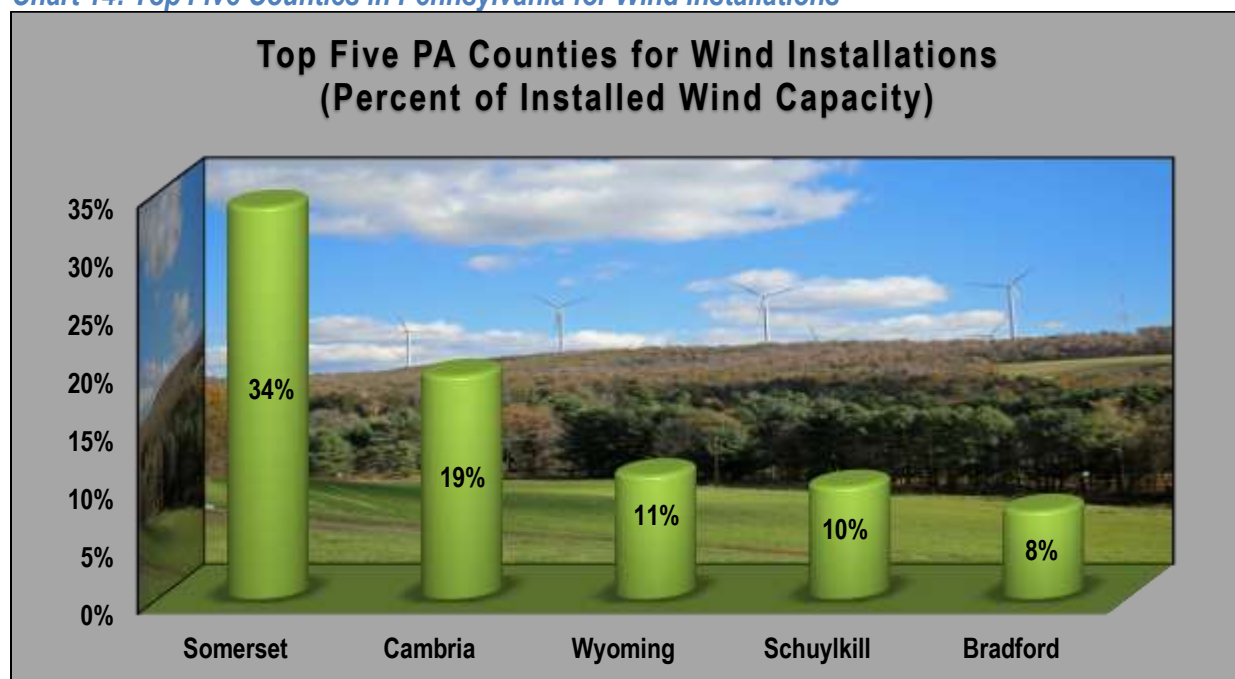
As of May 31, 2019, Pennsylvania’s certified installed wind capacity of 1,329.5 MW accounts for roughly 3% of the state’s potential wind electric generating capacity and supports between 2,000 and 3,000 direct and indirect jobs, respectively.³⁶

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

³⁵ American Wind Energy Association, Statewide Facts, Pennsylvania - <https://www.awea.org/Awea/media/Resources/StateFactSheets/Pennsylvania.pdf>

³⁶ American Wind Energy Association, Statewide Facts, Pennsylvania

Chart 14: Top Five Counties in Pennsylvania for Wind Installations



C. Hydropower

The United States has almost 103 GW of installed hydropower capacity; the third largest installed capacity in the world, behind China and Brazil.³⁷ 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 existing locks and dams that were constructed for some other purpose, *i.e.*, river navigation, flood control, etc.³⁸ A study conducted by the U.S. 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.³⁹ Projects such as these are

³⁷ International Hydropower Association 2019 Status Report, https://www.hydropower.org/sites/default/files/publications-docs/2019_hydropower_status_report.pdf

³⁸ 2016 International Trade Administration (ITA) Energy Top Markets Report

³⁹ 2014 New Stream-reach Development: A comprehensive Assessment of Hydropower Energy Potential in the United States.

beginning to take shape, such as the hydropower project at the Allegheny Lock and Dam No 2. The University of Pittsburgh has committed to purchasing 100% of the power output from this project.⁴⁰

⁴⁰ University of Pittsburgh, <http://www.news.pitt.edu/news/university-pittsburgh-purchase-local-hydropower>



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 reporting years 2011 through 2019, 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 Tier I systems, inclusive of solar PV, located in Pennsylvania. Solar PV systems account for 99% (25,685 systems) of all Tier I systems. 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. The fairly recent and notable changes in Tier II resources reflects the retirement and/or decertification of some waste coal and landfill gas facilities.

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

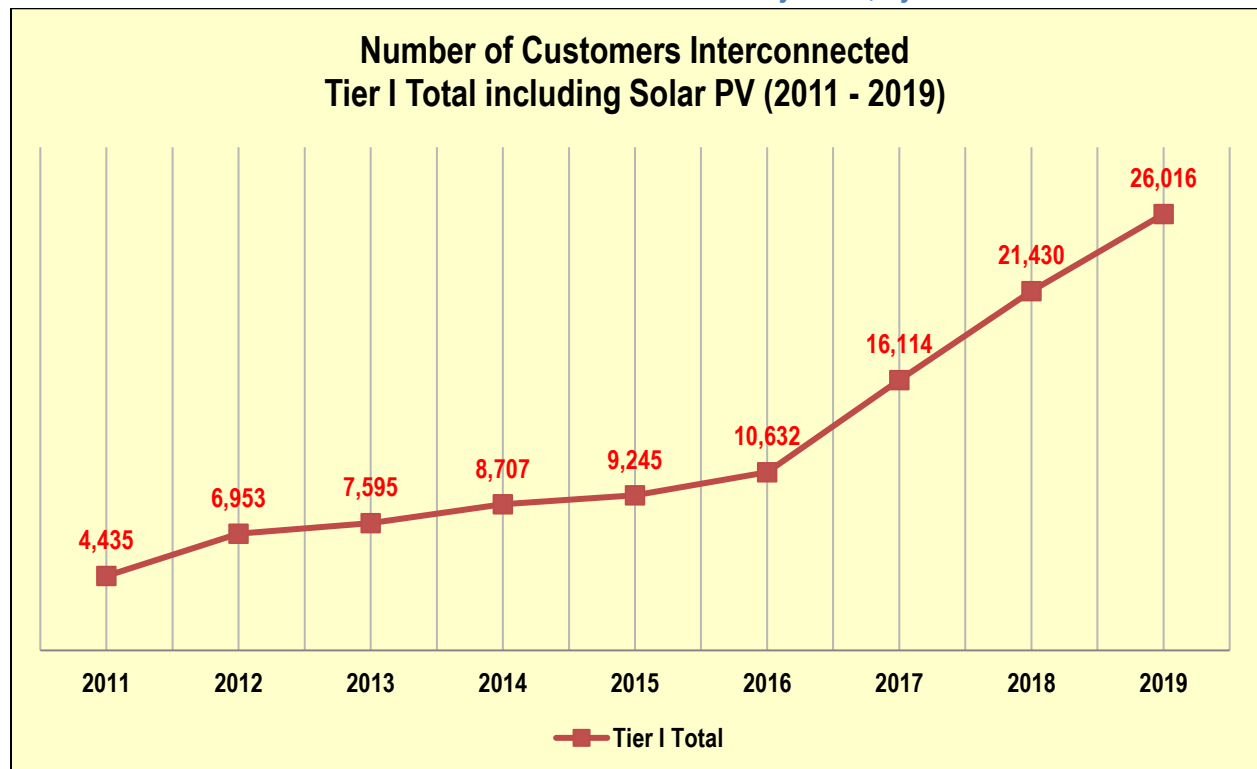


Chart 16: Cumulative Number of In-State Tier II Systems, by Year

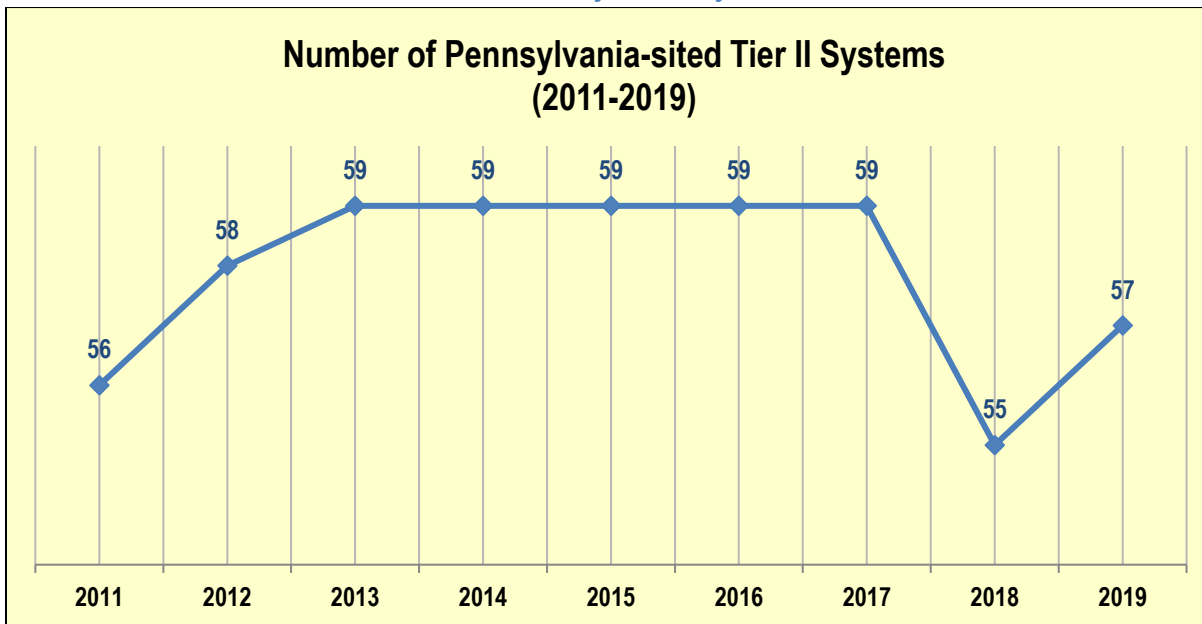


Chart 17: Cumulative In-State Tier I and Solar Nameplate Capacity Installed by Reporting Year

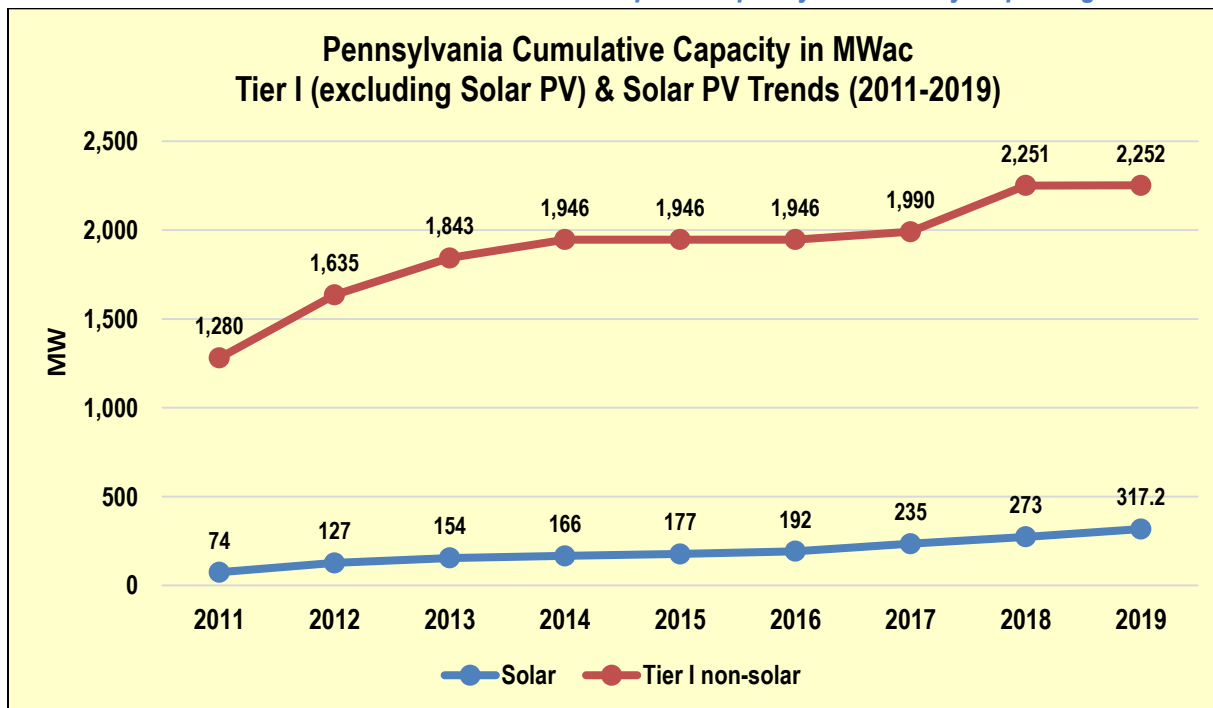
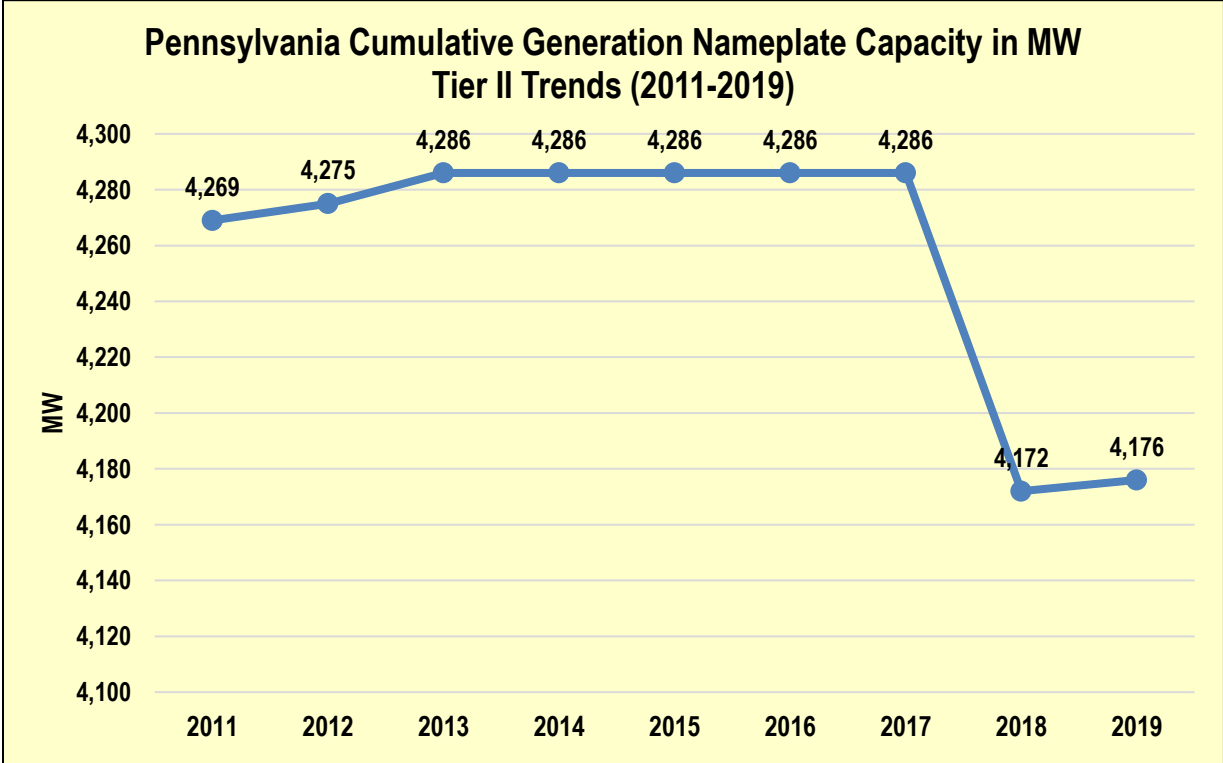


Chart 18: Cumulative Tier II Nameplate Capacity Installed by Year



Charts 19, 20 and 21, on the following pages, provide a comparison of the average annual (compliance year) spot market prices⁴¹ 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.

⁴¹ Spot prices from S&P Global Market Intelligence

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

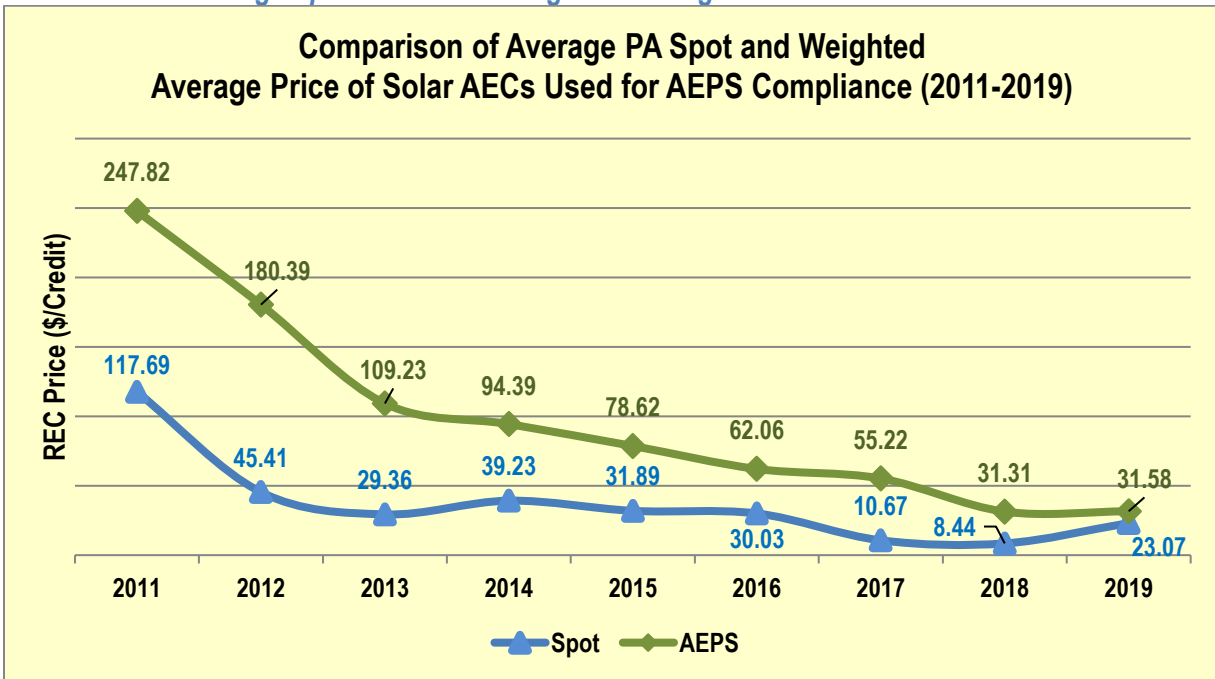


Chart 20: Tier I Average Spot Market vs. Weighted Average AEC Credit Prices

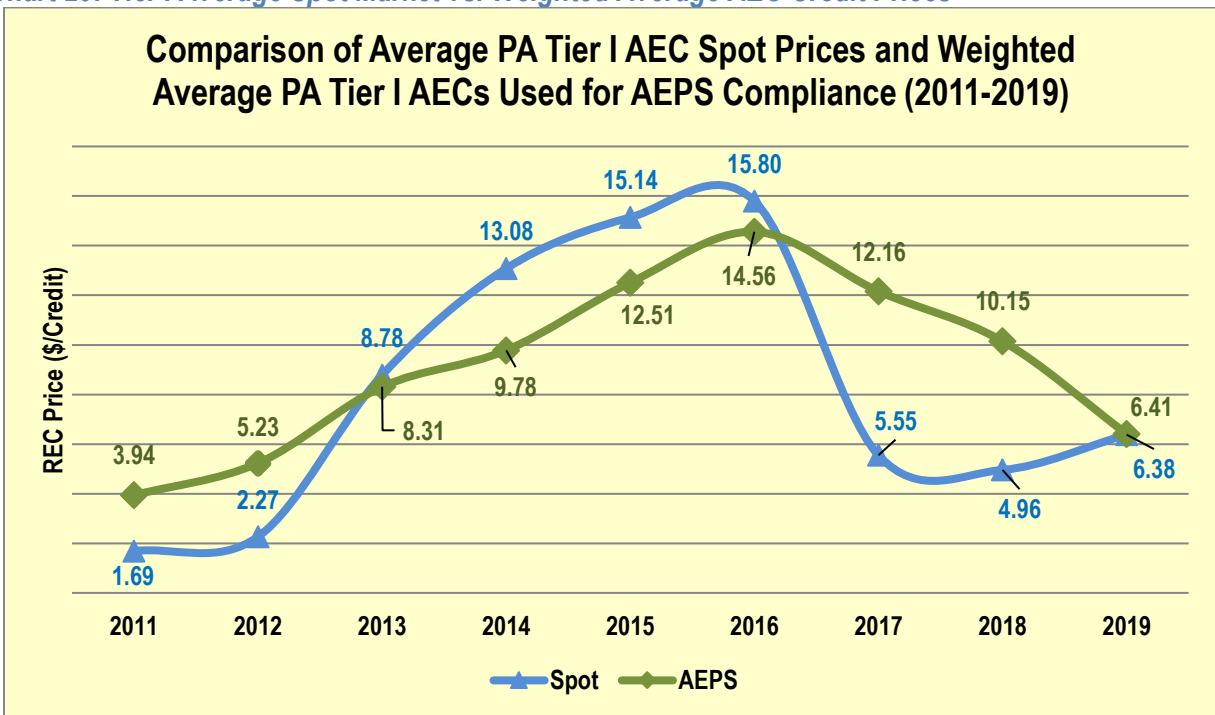
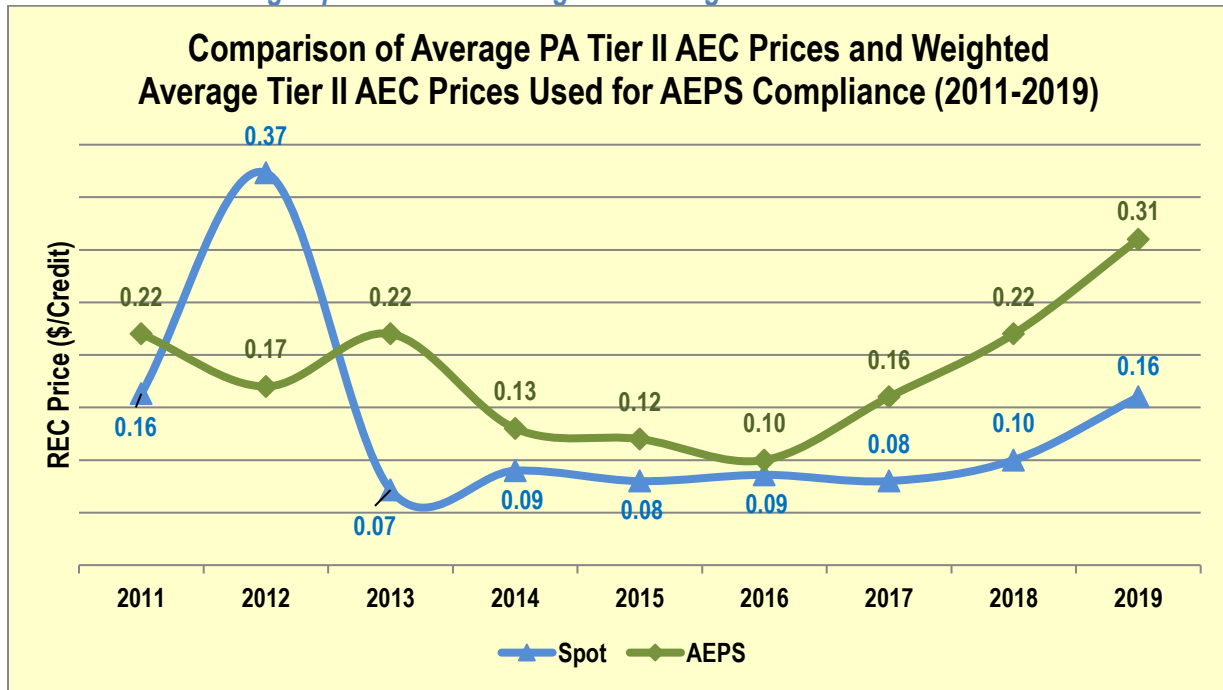


Chart 21: Tier II Average Spot Market vs. Weighted Average AEC Credit Prices



Impact of Act 40 Implementation

Pursuant to the passage of Act 40 and consistent with its Implementation Order⁴², 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 this report and 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 in-state solar AECs, and the associated economic viability to develop in-state solar capacity. Chart 22 shows the magnitude that out-of-state solar resources were and are having on the potential buildout of in-state solar capacity needed to comply with the AEPS Tier I Solar requirement. Chart 23 shows an estimate of the approved NSTI credits available for use in each compliance year.

⁴²<http://www.puc.pa.gov/pcdocs/1565100.docx>

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

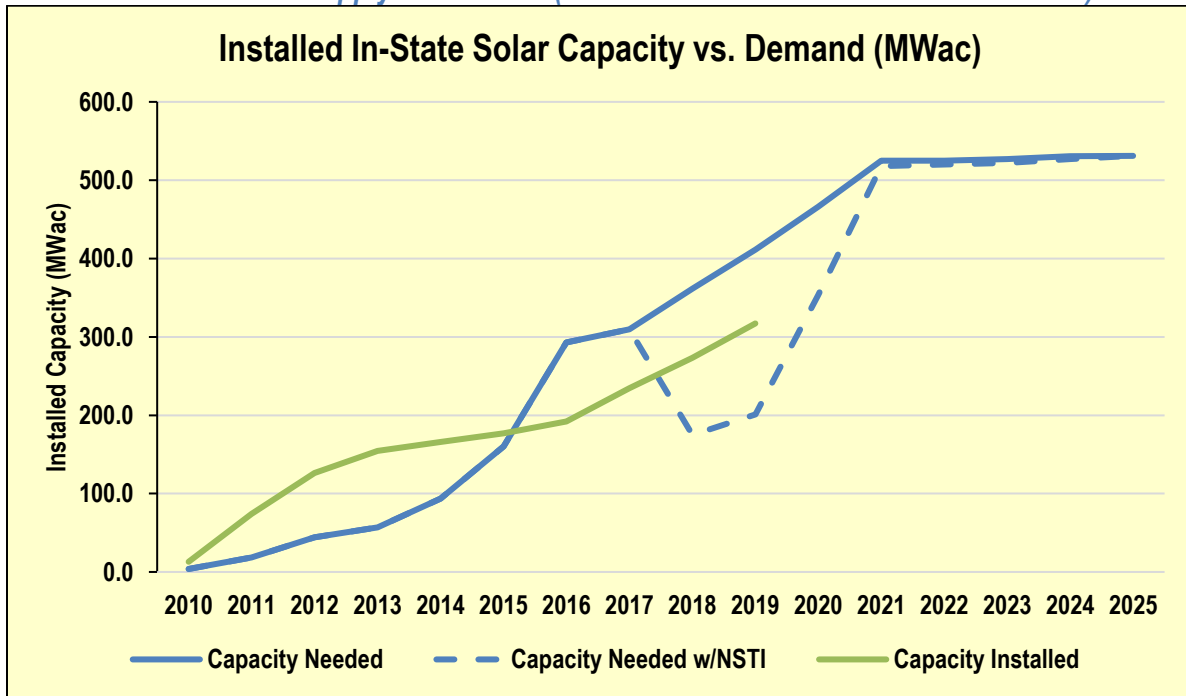
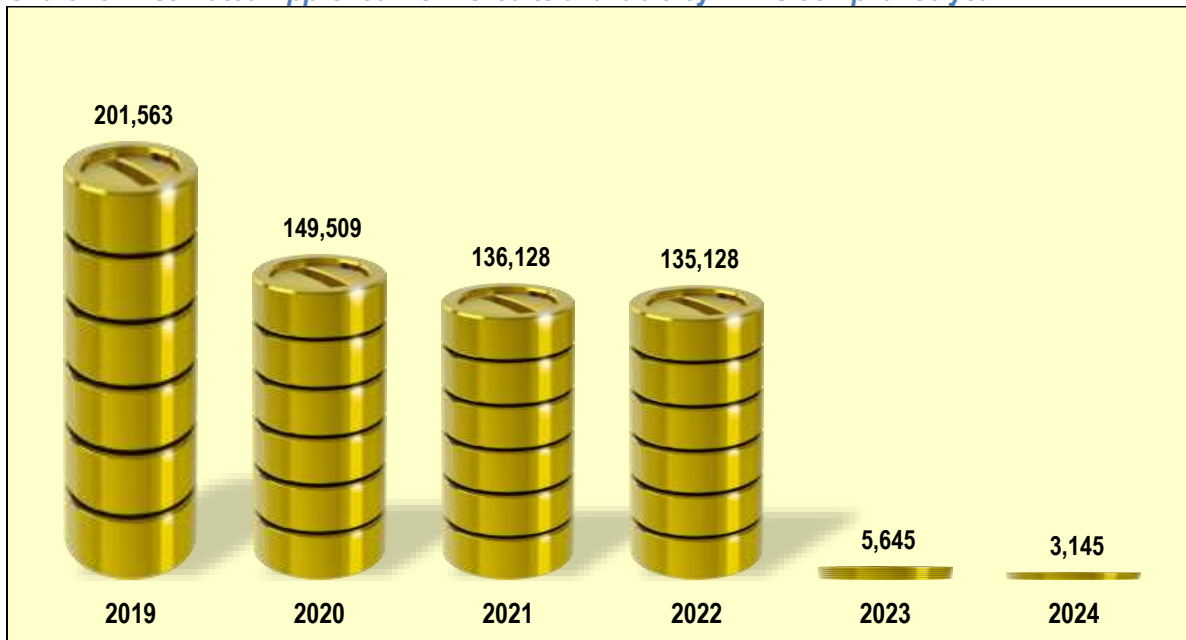


Chart 23: Estimated Approved NSTI Credits available by AEPS compliance year

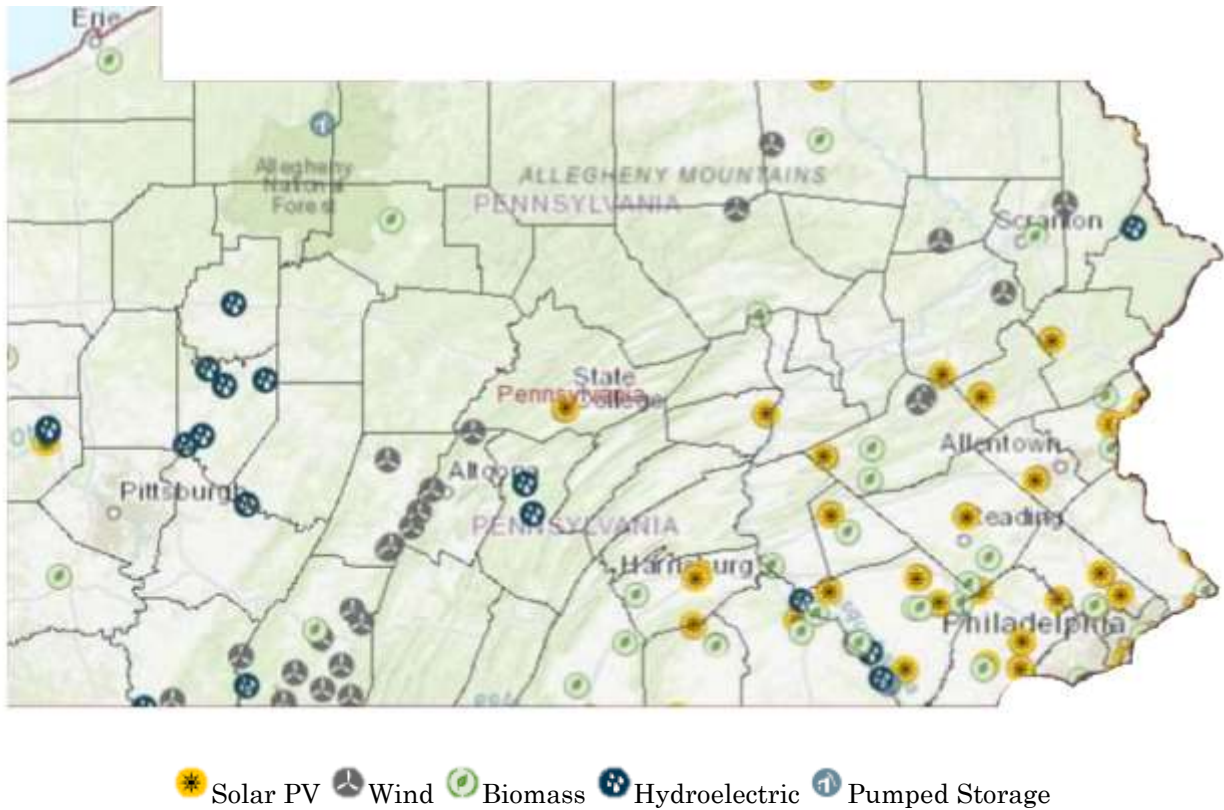


Due to nuances associated with the multitude of contracts, the numbers shown in the chart above are approximate.



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

The following map shows utility scale alternative energy resources in Pennsylvania, primarily solar PV, wind, biomass, hydroelectric, and pumped storage hydropower plants.⁴³



The Pennsylvania AEPS website⁴⁴ maintains a summary of all AEPS-certified generation facilities and certified energy efficiency and demand-side management (EE/DSM) resources. There were 28,042 certified generation facilities as of May 31, 2019.

Statistics for AEPS-certified generators, as of May 31, 2019, include:

- 21,518 generators (77%) are located in Pennsylvania with a total nameplate generating capacity of 6,750 MWac
- 6,524 generators are located outside of Pennsylvania with a total nameplate generating capacity of 15,677 MWac
- 21,333 solar facilities are located in Pennsylvania with a total nameplate generating capacity of 317.19 MWac. This represents 99% of all systems located in Pennsylvania but only 4.7% of nameplate generating capacity located in Pennsylvania.

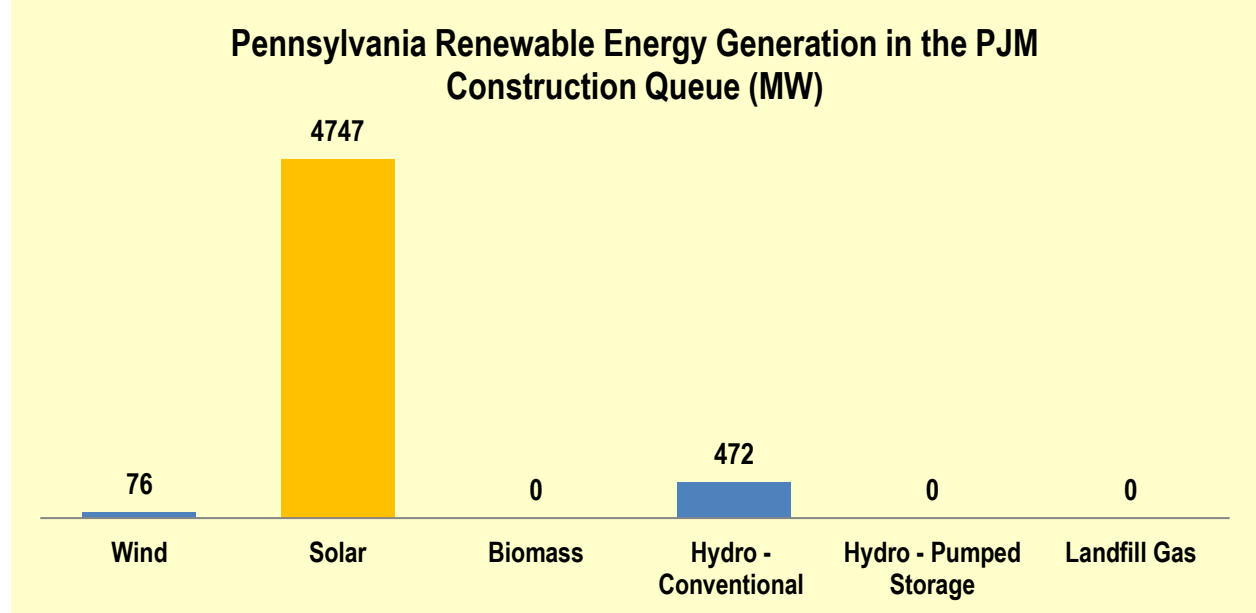
⁴³ <https://www.eia.gov/state/?sid=PA#tabs-4>

⁴⁴ <http://www.pennaeps.com/reports/>

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, attempting to make any conclusory statements by reviewing only the nameplate capacity of the generation facility can cause confusion so we have indicated if 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 24 summarizes the proposed renewable energy generation projects in the queue for Pennsylvania, as of July 7, 2020, with expected completion dates through third quarter of 2023.⁴⁵ Only active projects and projects under construction are included in this analysis, totaling 5,295 MW of generating capacity.

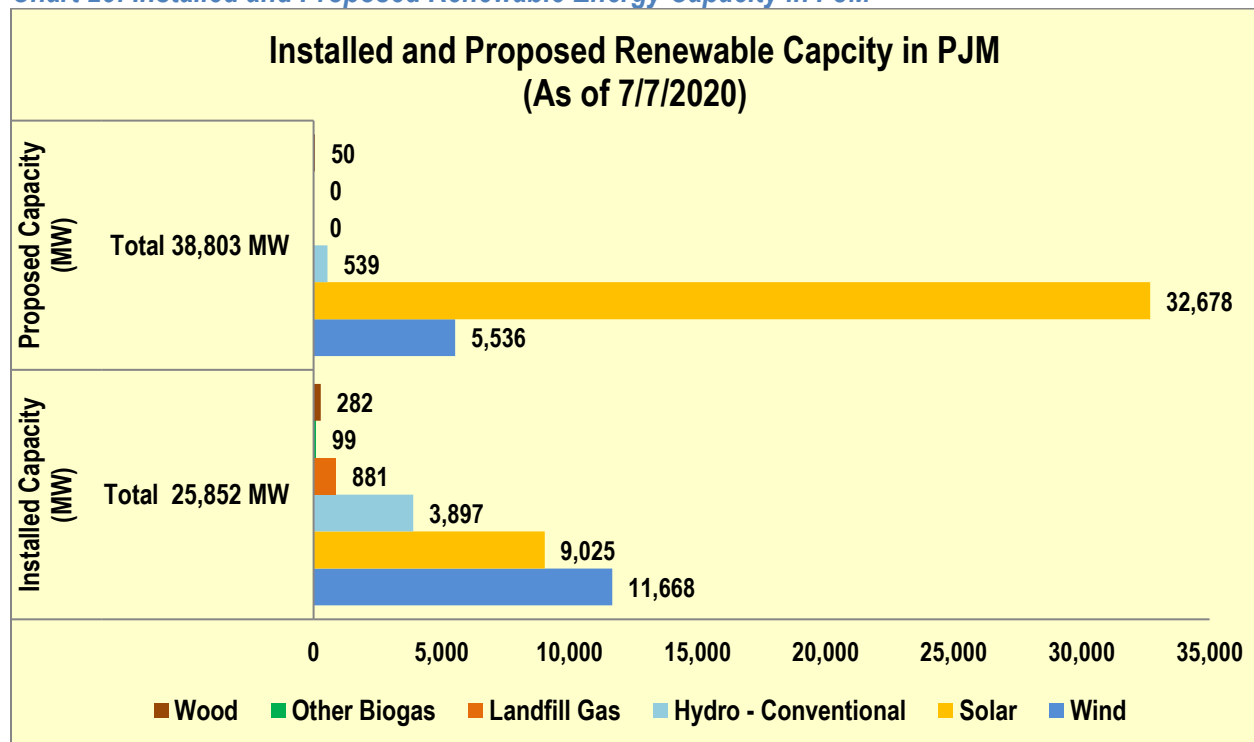
Chart 24: Pennsylvania Renewable Energy Generation in the PJM construction queue



⁴⁵ <http://www.pjm.com/planning/generation-interconnection/generation-queue-active.aspx>

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 in-state facilities, unless the contracts for 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 energy generation capacity, as detailed in Chart 25, that may be eligible for use in complying with the AEPS requirements.⁴⁶

Chart 25: Installed and Proposed Renewable Energy 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, New Jersey and Virginia. Indiana has only an RPS goal while West Virginia, Tennessee and Kentucky do not yet have final RPS programs in place. In states

⁴⁶ PJM-EIS Public Reports, Renewable Generators Registered in GATS and PJM queue. Includes “Active” and projects “Under Construction”

with RPS requirements, the final requirements range from 10% of electricity sales by 2025 in Indiana to 100% of sales by 2050 in Virginia.⁴⁷

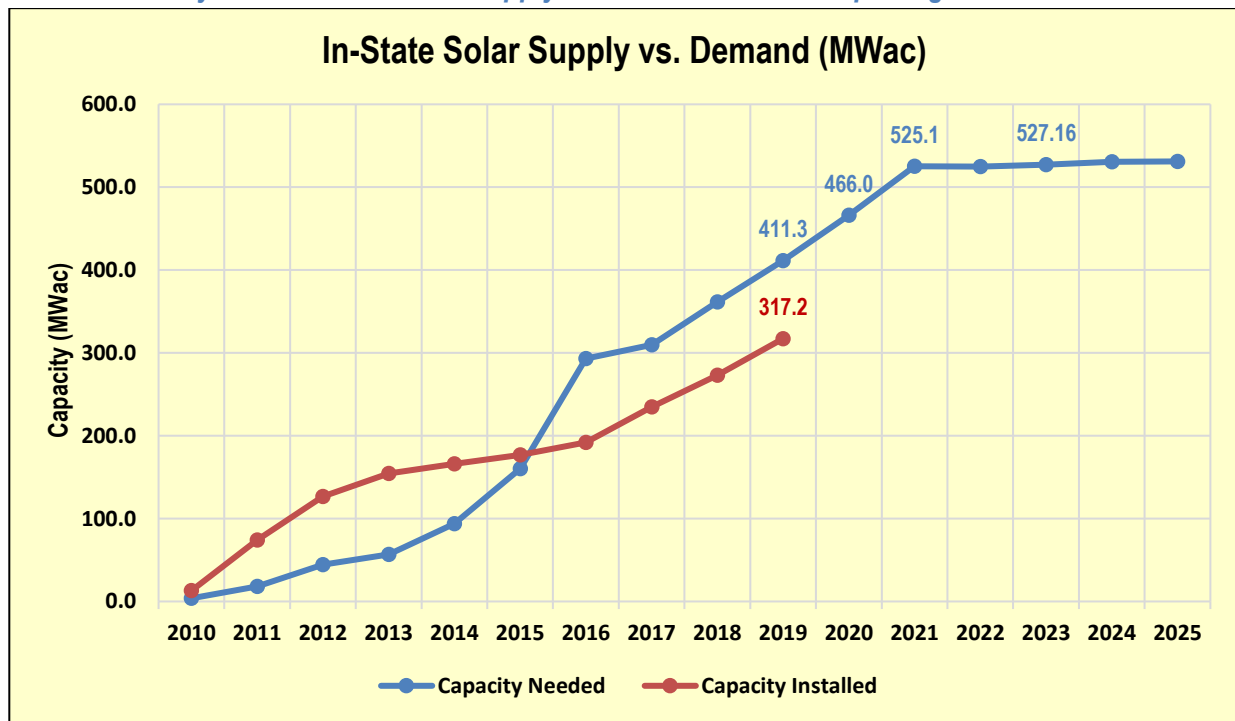
The RPS requirements of the PJM states and the District of Columbia vary considerably regarding the eligibility of generation resources that may be used to meet the requirements. Differences are found in the types of renewable and/or alternative energy generation resources that qualify. Some states allow 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 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 differing requirements under their respective 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 in-state solar AECs, with the exception of NSTI credits from pre-existing contracts that the PUC has subsequently reviewed and approved. To meet their Tier I non-solar and Tier II AEPS obligations, EDCs and EGSs 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, however, analysis performed by the Commission and its AEPS Program Administrator indicates that a significant amount of in-state solar credits are currently banked and may be available for AEPS solar compliance obligations through 2021. This, coupled with NSTI credits that have been approved for use by EDCs and EGSs, is expected to be more than adequate to ensure AEPS compliance through this period, as Pennsylvania builds out its in-state solar generating capacity. While there are several large solar farms planned and under development in Pennsylvania, it is uncertain how much of this generating capacity and the associated solar credits will be available for use in the AEPS marketplace by 2021.

⁴⁷ <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>

Chart 26 provides a comparison of Pennsylvania’s solar requirement to in-state installed capacity. The graph shows that, without consideration of Commission-approved NSTI credits and in-state banked solar credits, Pennsylvania would require a fairly significant increase in the rate of solar development to be able to meet its solar requirement in 2021. Hypothetically, if all the solar projects proposed for Pennsylvania in the PJM planning queue came to fruition, it would add an additional 4,747 MW of installed capacity between 2020 and October 2023, however, only a small percentage of the solar projects that have entered the queue have actually come into service. The PJM queue also has not been a good indicator of solar development in Pennsylvania given that most development-to-date has tended to be small, distributed and behind-the-meter projects that are not tracked by the queue. 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.

Chart 26: Pennsylvania In-State Solar Supply vs. Demand in Each Reporting Year



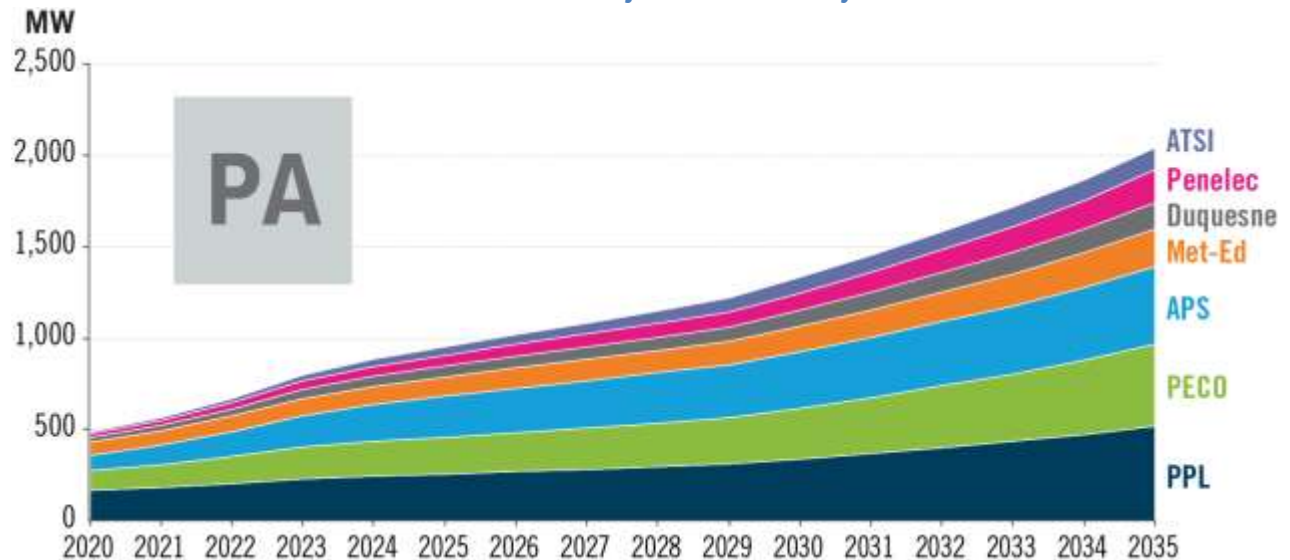
Similar to Pennsylvania, many of the PJM states have “closed their borders”, not allowing the use of NSTI credits for use in complying with their state RPS solar requirements. For this reason, it is likely that most of Pennsylvania’s in-state solar

AECs that are currently available in GATS will remain available for use in Pennsylvania.

Projected solar demand is summarized in Table 7 in Appendix A. Please note that in estimating the required capacity, PUC staff had historically based calculations on a capacity factor of 13%. However, upon further analysis by the AEPS Program Administrator, PUC staff have concluded that use of a capacity factor of 15% or 16% is more appropriate, based on actual data from installed in-state systems.⁴⁸

As previously indicated, the PJM planning queue is used primarily to track the development of generation projects that will enter the wholesale electricity market, rather than the smaller projects being interconnected on distribution circuits managed by the EDCs. Chart 27 shows PJM's estimates for the build-out of these smaller retail solar projects, broken out by EDC service territory, through the year 2035.

Chart 27: PJM's Non-Wholesale Solar Growth Projection for Pennsylvania EDCs



⁴⁸ The relative percentage of time a generator actually produces electricity



7. Recent Activity Since End of Compliance Year

Pennsylvania legislature proposed several bills to address and update the Alternative Energy Portfolio Standards program. Bills were also proposed to establish/enable community solar in Pennsylvania.

Updating AEPS: House Bill 1195 and Senate Bill SB 600:

These bills propose to expand the AEPS Tier I requirements from 8% to 30% by 2030. The new Tier I requirements include 7.5% for in-state grid-scale solar and 2.5% for distributed generation solar. The bills also direct the PUC to study the benefits of a renewable energy storage program. The bills also provide several protections that control costs for electricity customers, including long-term contracting, fixed ACP payments, and a 15-year lifetime limit for generating eligible SRECs for solar projects.

Community Solar Program: House Bill HB 531 and Senate Bill SB 705:

Community solar allows neighbors, businesses, farms, and other community members to directly participate in and receive the benefits from a solar project connected to their local electric distribution company's grid. Participants can subscribe to a portion of an offsite solar project and receive credit on their electricity bill for the power produced, just as if the panels were on their roof. This program extends to all Pennsylvania residents and businesses the ability to acquire solar energy from community solar projects located within their respective EDC service territory.

Under current law, individuals who are renters, live in an apartment building, or lack roof access, are unable to participate in Pennsylvania's growing solar economy. This legislation removes an existing policy barrier that allows individuals to participate in a community solar project if they choose to do so.

Community solar projects can be developed by private owners, municipalities and institutions, stimulating the development of true community partnerships. Community solar has been allowed in 18 other states and the District of Columbia since 2010.



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: 2019 AEPS Compliance Report by Tier

MWhs	Alternative Energy Requirement		Number of Credits Reserved	Weighted Average Credit Price	Cost of Purchased Credits	Credit Deficit Requiring Alternative Compliance Payments
	Tier	Percent of Total Energy Sold				
142,977,174	Solar	0.39	555,396	\$31.58	\$17,540,361.38	2,219
	I	6.61	10,016,752	\$6.41	\$64,207,166.49	65,662
	II	8.2	11,645,974	\$0.31	\$3,601,759.53	78,162
	Total	15.2	22,218,122	N/A	\$85,349,287.40	146,043

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% 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.

Two EGSs, Agera Energy, LLC, and energy.me Midwest LLC reached a settlement with the Commission, via Chapter 11 bankruptcy proceedings.

Table 3: 2019 AEPS Compliance Report by EDC Service Territory^{49,50}

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired ⁵¹	Compliance Status ⁵²
Citizens' Electric and EGS	174,782				
Solar		0.39%	682	681	In Compliance
Tier I (non-solar)		7.05%	12,325	12,326	In Compliance
Tier II		8.20%	14,332	14,332	In Compliance
Duquesne Light and EGSSs	12,966,360				
Solar		0.39%	50,569	50,120	Not in Compliance
Tier I (non-solar)		7.05%	914,358	906,403	Not in Compliance
Tier II		8.20%	1,063,242	1,053,850	Not in Compliance
Met Ed and EGSSs	14,661,003				
Solar		0.39%	57,178	57,179	In Compliance
Tier I (non-solar)		7.05%	1,033,860	1,013,215	Not in Compliance
Tier II		8.20%	1,202,202	1,198,937	Not in Compliance
PECO and EGSSs	38,077,364				
Solar		0.39%	148,502	147,641	Not in Compliance
Tier I (non-solar)		7.05%	2,685,128	2,669,407	Not in Compliance
Tier II		8.20%	3,122,344	3,104,060	Not in Compliance
Penelec and EGSSs	13,861,115				
Solar		0.39%	54,058	54,059	In Compliance
Tier I (non-solar)		7.05%	977,454	975,848	Not in Compliance
Tier II		8.20%	1,136,611	1,135,066	Not in Compliance
Penn Power and EGSSs	4,795,904				
Solar		0.39%	18,704	18,704	In Compliance
Tier I (non-solar)		7.05%	338,196	315,423	Not in Compliance
Tier II		8.20%	393,264	366,787	Not in Compliance
Pike County and EGSSs	71,064				

⁴⁹ The data reported for each Distribution Service Territory is aggregated for the EDC and all EGSs that served customers in that territory.

⁵⁰ The Tier I (non-solar) percentage requirement includes the quarterly adjustment.

⁵¹ 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 Credit Retired column, these EGSs did meet their obligations on a statewide basis.

⁵² Two EGSs, Agera Energy, LLC, and energy.me Midwest LLC failed to fully comply with their obligations. The Commission was able to recover a Letter of Credit posted by Agera Energy and has reached a settlement with these two EGSs, via Chapter 11 bankruptcy proceedings, which will partially cover their 2019 AEPS obligations.

Distribution Service Territory	Total Energy Sold (MWhs)	Alternative Energy Requirement	Credits Required	Credits Retired ⁵¹	Compliance Status ⁵²
Solar		0.39%	277	277	In Compliance
Tier I (non-solar)		7.05%	5,011	5,011	In Compliance
Tier II		8.20%	5,827	5,827	In Compliance
PPL and EGSs	37,050,476				
Solar		0.39%	144,497	143,811	Not in Compliance
Tier I (non-solar)		7.05%	2,612,714	2,600,216	Not in Compliance
Tier II		8.20%	3,038,139	3,023,596	Not in Compliance
UGI Electric and EGSs	1,010,144				
Solar		0.39%	3,940	3,922	Not in Compliance
Tier I (non-solar)		7.05%	71,233	70,950	Not in Compliance
Tier II		8.20%	82,832	82,502	Not in Compliance
Wellsboro Electric and EGSs	105,885				
Solar		0.39%	413	413	In Compliance
Tier I (non-solar)		7.05%	7,467	7,466	In Compliance
Tier II		8.20%	8,683	8,683	In Compliance
West Penn Power and EGSs	20,203,079				
Solar		0.39%	78,792	78,589	Not in Compliance
Tier I (non-solar)		7.05%	1,424,674	1,422,487	Not in Compliance
Tier II		8.20%	1,656,652	1,652,334	Not in Compliance

Table 4: AEC State of Origin – Used for compliance in 2019

Tier	PA	NJ	MD	VA	WV	IL	OH	DE	NC	IN	MI	KY	TN
Solar	195,725	0	17,796	62,471	1,559	4,981	8,052	1,390	263,374	15	15	0	18
Tier I	2,922,235	66,561	71,376	1,732,398	604,868	1,983,935	512,534	36,722	939,692	1,014,867	15	131,522	27
Tier II	7,754,849	271,427	390,264	2,441,023	592,365	0	190,726	0	877	0	0	4,443	0
Total	10,872,809	337,988	479,436	4,235,892	1,198,792	1,988,916	711,312	38,112	1,203,943	1,014,882	30	135,965	45

Table 5: Estimated Statewide AEPS Cost of Compliance in 2021 (2020 Dollars) *

EDC	Solar Credits		Tier I Credits		Tier II Credits		Total Cost
	Credits Needed	Solar Credits @ \$50.00	Credits Needed	Tier I Credits @ \$10.35	Credits Needed	Tier II Credits @ \$4.75	
Duquesne	63,428	\$ 2,822,547	935,223	\$ 8,614,776	1,246,965	\$ 5,271,521	\$ 16,708,844
Met Ed	69,981	\$ 3,114,143	1,105,204	\$10,180,549	1,473,606	\$ 6,229,644	\$ 19,524,336
Penelec	67,890	\$ 3,021,097	1,017,251	\$ 9,370,374	1,356,335	\$ 5,733,884	\$ 18,125,354
Penn Power	23,905	\$ 1,063,775	350,392	\$ 3,227,619	467,189	\$ 1,975,032	\$ 6,266,426
PECO	182,406	\$ 8,117,039	2,838,401	\$26,145,830	3,784,535	\$15,999,059	\$ 50,261,928
PPL	191,173	\$ 8,507,178	2,858,945	\$26,335,070	3,811,927	\$16,114,857	\$ 50,957,105
UGI	101,830	\$ 4,531,396	1,578,444	\$14,539,777	2,104,592	\$ 8,897,126	\$ 27,968,299
West Penn	5,136	\$ 228,549	75,960	\$ 699,703	101,280	\$ 428,159	\$ 1,356,411
Citizens'	895	\$ 39,844	14,215	\$ 130,943	18,954	\$ 80,126	\$ 250,914
Pike County	386	\$ 17,195	6,159	\$ 56,735	8,212	\$ 34,717	\$ 108,647
Wellsboro	537	\$ 23,881	8,220	\$ 75,721	10,960	\$ 46,335	\$ 145,936
Totals	707,568	\$31,486,643	10,788,416	\$99,377,095	14,384,555	\$60,810,461	\$191,674,199

* 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 (MWac)	Nameplate Capacity of Out-of-State Facilities (MWac)	Total Nameplate Capacity (MWac)
I	Biomass Energy			
	Cellulosic (woody) Biomass	339.2	1202.4	1,541.6
	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*	0.8		0.8
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)	14.3	5.3	19.6
	Anaerobic Digester Gas (secondary fuel source)	0.0	0.0	0.0
	Landfill Gas (primary fuel source)	222.0	422.1	644.1
	Landfill Gas (secondary fuel source)	0.0**	0.0	0.0
I	Solar PV	317.2	1631.6	1948.8
I	Wind	1,329.5	6,873.6	8,203.2
I	TOTAL of Tier I	2,569.5	10,225.3	12,794.8
II	Biomass Energy			
	Cellulosic (woody) Biomass	0.0	126.5	126.5
	Black Liquor	0.0	367.9***	367.9
II	Distributed Generation	8.1	0.0	8.1
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	3.7	0.0	3.7
	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	4,180.2	5,451.4	9,631.6
I & II	TOTAL of Tiers I & II	6,749.7	15,676.7	22,426.4

* 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 (MWac)
2015	204,255	179	177
2016	364,442	320	192.1
2017	406,840	310	234.7
2018	471,061	359	273.3
2019	539,701	411	317.2
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
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.⁵³

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.⁵⁴

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;
 - 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;

⁵³ Geothermal Energy Association – Geothermal Basics Q&A, 2012

⁵⁴ Renewable Energy Policy Network (REN21) – Renewables 2016 Global Status Report

vi. Was completed after Feb. 28, 2005.

Solar Photovoltaic (PV)

A solar PV System⁵⁵ 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 plant⁵⁶ 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.

⁵⁵ Solar Photovoltaic Technology Basics at www.energy.gov

⁵⁶ 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 Nov. 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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